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EW ELEVATOR WORLD EUROPE

January - February 2021

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Project of the Year 2021 Winners

The eight winning projects are featured

Focus on Escalator and Moving Walks

Inspections, maintenance and engineering topics are covered


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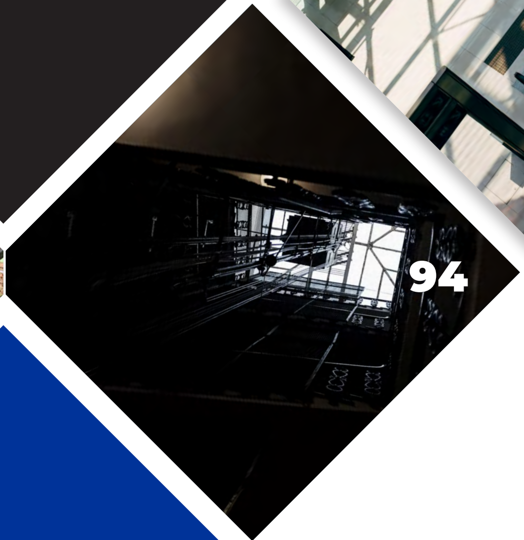

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2021: Finally, It is Here!

by Ricia Sturgeon-Hendrick

Here at the beginning of 2021, we are so hopeful. This is the year we have been waiting for: the year we get well, travel again, eat somewhere besides home and meet with old friends. To celebrate the new year, we present eight winners of the 2021 **Project of the Year** awards. As with many past years, it was the challenge that often decided the winner. Several projects are in Europe — from Spain to Romania — and the rest range from Hong Kong to Australia and the U.S. They are:

• Elevators, New Construction: **Collins House**, Melbourne, Australia. Otis worked within space and time constraints to deliver advanced elevators to a new, landmark tower.

• Elevators, Modernization: **Whiteface Mountain Historic Elevator**, Wilmington, New York. Elevators at a popular tourist attraction were renewed with a nod toward the site's legacy.

• Escalators, New Construction: **Yitzchak Navon Train Station**, Jerusalem. A complex train station design challenged installers to build a monorail to move escalator sections.

• Escalators, Modernization: **Central-Mid-Level Escalator and Walkway System**, Hong Kong. The team brought new technology to the longest outdoor covered escalator system in the world.

• Moving Walks: **Mechanical Ramp of Gran Via Vigo**, Vigo, Spain. A top-of-the-line moving walk was installed in often wet urban conditions.

• Inclined Elevators: **Parque Turistico Observatorio 1873**, Mazatlán, Mexico. Minnesota-based Hill-Hiker thought outside the box to design a custom unit in a harsh environment.

• Private-Residence Elevators: **Stainless-Steel Glass Elevator**, Florida Keys, Florida. Teamwork and creativity overcame myriad challenges, resulting in a beautiful and robust system.

• Special Purpose Lifts: **Pasărea Măiastră Passenger Platform Lift**, Craiova, Romania. The team created a unique hydraulic device that allows a passenger to experience an immersion into a renowned sculptor's world.

In the Codes and Standards area, Undine Stricker-Berghoff wrote **ISO Approves New Standard**. The author interviewed Gero Gschwendtner, ISO/TC 178 chairman, about the "United Nations of standardization" and publication of ISO 8100-32:2020. The European Federation for Elevator Small and Medium-Sized Enterprises follows up with a discussion of the implications of the new standard for SMEs.

The focus of this issue is **Escalators and Moving Walks**, which includes a feature and four technical articles. They are:

• **Urban Mobility in Istanbul** by Kaija Wilkinson. A new metro line with vertical transportation (VT) by thyssenkrupp will add 130,000 passengers an hour to the service. The OEM has provided more than 70% of the VT in the metro.

• **U.K. Evolution** by Colin Craney. This is an in-depth study of UK BS 2655-4:1969, European EN 115-1:2017 and ASME A17.1:2016. Some of the differences are significant.

• **Escalator Fractal Behavior**, **Part Two** by Dr. Ali Albadri. The article answers the question, "Would the behavior (as measured by Smart Step) change when there is passenger loading?"

• **Escalator Runaways** by David Cooper. The author maintains that all escalators and inclined moving walks should have an auxiliary brake to prevent runaways.

• A **Nudge in the Right** Direction by Atif Bhanjee. The author makes the case for bright colors and images on steps and handrails to help passengers adopt safe behavior.

Other articles of great interest include that by Fartash Razmjoo on **Hoist Rope Longevity** that encourages monitoring to ensure proper care, lubrication and tension to avoid failure. We also cast a spotlight on the **Sky Ring Inclined Elevator** in the international duty-free city of Sanya, China. **Consulting for the Future** by Olga Quintanilla is an interview with Eng. Luis Sánchez Lebrero of the Spanish consulting firm Resuelve Transporte Vertical on building a reputation for consulting on difficult projects. Finally, we have an amazing On Camera called **Making it Small** by Matt Irvin. Using 3D printers, a KONE mechanic "makes" working elevators.

This issue is packed, beyond that mentioned, with news and events from around your neighborhood. We hope to see you in person in 2021. Stay safe!

CALENDAR

2021 / 2022

2021

APR 28-29	Euro-Lift Kielce, Poland www.targikielce.pl
MAY 6-8	International Sourcing Exposition for Elevators and Escalators Mumbai, İndia www.@tak-expo.net
28-30	Ascen.tec-Elevator Technologies 2021 Athens, Greece www.ascen-tec.gr
JUN 7-8	Lift & Escalator Symposium Shanghai, China www.liftsymposium.org
7-9	Russian Elevator Week Moscow, Russia www.expo.vdnh.ru
15-17	Elevcon Prague, Czech Republic www.elevcon.com
JUL 7-8	LiftCity Expo Cairo Cairo, Egypt www.liftcityexpo.com
7-10	Asansör Istanbul Istanbul, Turkey www.asansoristanbul.com
27-29	Global Lift & Escalator Africa Johannesburg, South Africa www.gleexpo.com
SEPT 8-11	Eurasia Asansör Fair Istanbul, Turkey www.asansorfuari.com

2021

SEPT 20-23	NAEC 72nd Annual Convention and Exposition	Atlantic City, NJ, U.S.	www.naecconvention.com
OCT 19-22	Interlift 2021	Augsburg, Germany	www.interlift.de
19-23	CTBUH Conference	Kuala Lumpur and Singapore	www.ctbuh.org
NOV 18-21	Global Lift Escalator Dhaka	Dhaka, Bangladesh	www.gleexpo.com
DEC 6-7	International Elevator & Escalator Symposium	Amsterdam, Netherlands	www.elevatorsymposium.org

2022

FEB 16-18	IEE Expo	Mumbai, India	www.ieeexpo.com
24	11th International Seminar on Elevators and Escalator	Tehran, Iran	www.en.kt-uast.ac.ir
JUL 19-21	Expo Elevador 2021	Sao Paulo, Brazil	www.expoelevador.com
SEPT 18-21	NAEC 73rd Annual Convention and Exposition	Louisville, KY, U.S.	www.naecconvention.com
26-28	The Elevator Show	Dubai, U.A.E	www.elevatorshowdubai.com
OCT 19-21	Lift Expo Italia	Milan, Italy	www.liftexpoitalia.com

Europe

Otis in La Défense, Paris

Double-Deck Elevators for Alto Tower

Otis' first SkyRise® double-deck elevators in France are part of a vertical-transportation (VT) system serving the new 150-m-tall Alto Tower, a 38-story office tower developed by Abu Dhabi Investment Authority and La Défense Public Development Agency in the La Défense business district (ELEVATOR WORLD, September 2018). Designed by IF Architects, the structure has a small footprint at ground level that expands outward as it climbs. This, according to Otis France High-Rise Operation Manager Fabienne Blot, "presented a unique opportunity to showcase our SkyRise double-deck technology, effectively meeting the building's needs while maximizing leasable space." Otis observes its double-deck technology reduces elevator core space by up to 40%. Upon entering the building, passengers log their destinations using CompassPlus, which assigns them to the proper cabs. To access an upper-deck elevator cab, passengers ride one of two Otis escalators.

In total, Alto Tower's VT system has 10 SkyRise elevators, including eight double-deck and two heavy-duty units; two Gen2® elevators; and two escalators. Equipped with Otis' EMS PanoramaTM elevator-management system, the SkyRise elevators "are in a unique configuration with the double decks grouped in a single bank, providing point-to-point travel and eliminating the need for a transfer floor," Otis observes. The OEM will also maintain the tower's VT equipment.

Elevator cab hall; photo courtesy of Otis

View from the Alto Tower roof; photo courtesy of Otis

The Link in the La Défense building district in the western Paris suburb of Puteaux; image by PCA

France's Future Tallest Tower The Link to Have Otis Equipment

At 228 m the future tallest building in France, The Link in the La Défense business district just west of Paris will be outfitted with 60 elevators and "several" escalators by Otis, Otis CEO Judy Marks said during a third-quarter 2020 earnings call. The project will also include CompassPlus destination-dispatch, eCall touchless and OptiSenseTM traffic-management technology, she said. Developed by Paris La Défense and designed by Philippe Chiambaretta Architecte (PCA), The Link will consist of 50- and 35-story towers "linked" on 30 levels by green walkways atop a common, three-level base. Aiming for the highest environmental certifications, it will serve as headquarters for energy giant Total and house 130,000 m^2 of office, restaurant, coworking and amenity space. Delivery is anticipated in 2025.

Prysmian Group Completes Acquisition of EHC Global

Prysmian Group, headquartered in Milan, Italy, announced the acquisition of EHC Global, a "complementary add-on to Prysmian's Draka Elevator business," in January. Headquartered in Oshawa, Canada, with manufacturing and distribution facilities in North America, South America, Europe and China, EHC Global supplies escalator handrails, rollers, elevator belts and other components. Founded in 1977, EHC Global also provides a range of technical services for escalators and moving walks, including installation. Prysmian announced its plan to acquire 100% of EHC Global in July 2020 (ELEVATOR WORLD, September 2020). Draka offers more than 7,000 components for the vertical-transportation industry, and Prysmian said the acquisition of EHC Global is "in line with [its] strategy to grow and reinforce its value-added businesses."

Dignitaries look up at the new elevator at the Athens Acropolis; photo courtesy of the Greek government.

New Elevator Eases Access to Athens Acropolis

A new, wheelchair-accessible elevator was put into service at the Athens Acropolis on December 3, 2020, according to the Greek Reporter. With its glass cab, the elevator will allow riders to see nearly unobstructed views of Athens. The bottom landing sits at the ancient promenade on the north slope of the Acropolis, and riders are taken directly to the top of the hill. Prime Minister Kyriakos Mitsotakis said the elevator is "an iconic project to the global community, on the International Day of Persons with Disabilities." He said the new elevator and new pathways make the Acropolis more accessible to those with mobility difficulties. The new inclined elevator replaces a failure-prone platform lift installed on the side of the hill in 2004.

Two-Tower Project Planned on Brisbane's West End

A developer is planning a two-tower, 470-unit residential project and riverside public space on a 1.1-ha tract in Brisbane, Australia's West End, The Urban Developer reported in December 2020. The project, to be undertaken by Manly Properties, would involve dual 26-story buildings. One, with 21,000 m^2 of space, would have 200 apartments, while the other, with 27,500 $m^{2,}$ would have 270 units. Manly, a subsidiary of Sydney-based investment group Henroth, is seeking to change the site's master plan by expanding the public plaza and creating a 4,000-m^2 public park. The original site plan called for fewer apartments spread across five buildings. Under the new plan, residents in each building will have access to a rooftop recreation deck with gardens, pools, barbecue facilities and a gym. The project also calls for a lounge and bar on the third and fourth levels, a "sky dining" room, five basement levels of parking for 741 vehicles, and parking for 730 bicycles. The towers will each target a 6-Star Green Star sustainability rating. A construction timeline was not reported.

Rendering of Manly's proposed two-tower residential project on Brisbane's West End; image by nra-co-lab

EFESME Holds Assemblies

The European Federation for Elevator Small and Medium-Sized Enterprises (EFESME) Board of Directors and General Assembly took place online on December 17, 2020. EFESME reported that, in them, members discussed the several technical and political activities carried out during 2020 in the face of the year's many challenges. It added that members expressed satisfaction in the results of the association and its experts. The many virtual meetings the federation attended and the events it organized were highly regarded.

The importance of the collaboration between the European Commission and EFESME was another focal point. Such strong cooperation is supported by the commission's frequent participation in EFESME events and by the good relationships between its officers and experts, EFESME explained. Likewise, members were pleased with the work and activities performed in conjunction with Small Business Standards and looked forward to more.

Business

Major transition, award and partnership are detailed.

Otis Names Calleja President of EMEA Operations

Bernardo Calleja

Otis has named Bernardo Calleja president, Otis Europe Middle East & Africa (EMEA), the company announced in November 2020. Calleja has been interim Otis EMEA president since October 1, 2020, replacing Mark Eubanks, who left the company in September. An industrial engineer by training, Calleja began his career as an engineer at Otis' San Sebastián factory in 1989 and progressed through several leadership positions before being named president of Otis South Europe & Africa in 2018. He will continue to lead this subregion and maintain his role as the president of the board of directors of Zardoya Otis, a publicly traded subsidiary in Spain. In his new role, Calleja will report directly to Otis President and CEO Judy Marks.

SKF, Imperial College London Continue Joint R&D

Bearing, seal and lubricant manufacturer SKF of Gothenburg, Sweden, and Imperial College London have extended their R&D partnership for a further five years. At the college since 2010, the SKF University Technology Centre (UTC) has researched improved performance and longevity for bearings with a focus on contributing to lower energy consumption for the machines in which they operate. With the new deal, this work will continue until 2025. Several components SKF produces are for elevators and escalators.

SKF R&D Collaboration Manager Dr. Kenred Stadler, said:

"Tight collaboration between leading academia and R&D-driven companies like SKF is key to increasing the speed of innovation in industry. Through our relationship with Imperial College London, which first started in the 1970s, we will drive both short-term, agile projects lasting a few months, as well as longer-term PhD projects."

IGV and Studio Marco Piva team members at the awards ceremony in Milan in May 2020

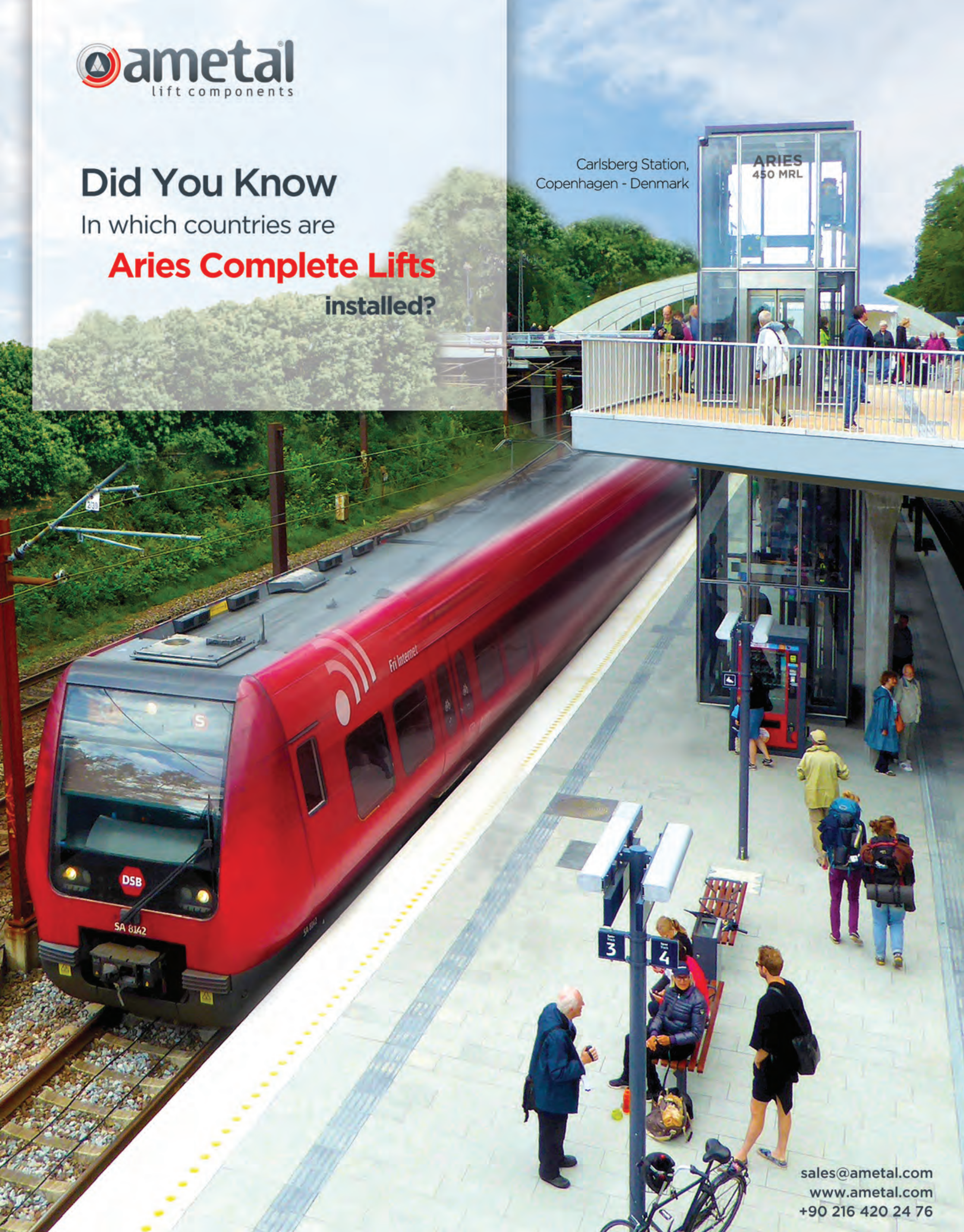
IGV Group's ON AIR Receives International Design Award

ON AIR's Evocative model

A modular, customizable elevator system conceived by Italy's IGV Group and designed by Studio Marco Piva during the first wave of the COVID-19 pandemic, ON AIR received The Plan Award 2020 in the industrial design category, IGV announced in November 2020. Introduced in 2014, the award is an annual international competition that attracted more than 1,000 entries this year.

Combining form and function, ON AIR features antimicrobial materials, rounded corners and smooth edges to prevent germ buildup, a mechanical ventilation system and UV-C germicidal disinfection. To further reduce risk, ON AIR can be equipped with:

- Virus-resistant, touch-free and proximity-activated control panels
- Multilingual voice interface combined with facial recognition to enable exclusive stops
- Remote control of the lift from a mobile device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Business

Acquisition, hire, partnerships and more from around the world

Cibes Lift Group Acquires U.K.'s Titan Elevators

Gävle, Sweden-based Cibes Lift Group has acquired Titan Elevators of Sidcup, U.K., Global Legal Chronicle reported in December 2020. The move is to strengthen Cibes' presence in the London area and mark an expansion of its U.K. business by adding modernization services and high-speed lifts to its offerings. Titan Elevators services include lift installation, repair, modernization and maintenance, but the company also offers bespoke and standardized lifts for various applications. Since its founding in 1997, Titan Elevators has experienced a growing customer base in the London and Home County areas. A specialty is the company's custom solutions in the luxury segment of the high-speed lift market. Cibes Lift Group is one of the world's largest manufacturers of space-efficient lifts for both home and business use.

(l-r) Giulio Cappellini and Michele Suria

IGV Group Names Cappellini Art Director

Italy's IGV Group has named architect Giulio Cappellini art director, the company announced in December. IGV CEO Michele Suria observed the company – which exports 85% of its products to more than 70 countries – distinguishes itself "by assigning the elevator not only a technical and functional role, but also an aesthetic one." Named one of the world's top design trendsetters by Time, Cappellini will reinforce this approach, according to IGV. "Innovating in this sector not only means creating a beautiful coating, but [also] transforming the use of the product – even if short – into a sensory experience," said Cappellini, who will lead discussions with architects on complex projects throughout the world.

Schindler Partners on AI, Digital Engineering

Schindler has entered into a partnership with AI company SenseTime to develop the Escalator Passenger Behavior Safety System, multiple news outlets, including China Daily, reported in December 2020. In announcing the partnership, Schindler said multiple AI technologies, from object detection and behavioral recognition to density analysis, will allow escalators to recognize when passengers engage in dangerous activities, such as attempting to board an escalator with bulky luggage, wheelchairs or strollers. When it detects risky behavior, it will use voice prompts to warn passengers not to board the escalator and use an elevator instead. It will also raise alarms regarding overcrowding to prevent stampedes.

The system will employ cameras mounted above escalators to provide real-time video streams, which are analyzed by the AI algorithm installed on an onsite server. An equipment operator will receive an alert and can stop the escalator and send assistance if needed. In addition, the system will support operational efficiency by controlling activation and deactivation of building vertical-transportation equipment. Schindler said the system is being rolled out in China, but the company has received inquiries from other countries and expects the service to realize global demand.

Schindler also partnered with L&T Technology Services Ltd., a division of India-based global engineering and R&D services provider Larsen & Toubro Ltd., the companies announced in December 2020. L&T will provide engineering services and solutions to help Schindler accelerate its digitization and connectivity initiatives. "Innovations such as digital-twin technology. . . and advancements in wireless connectivity are accelerating Industry 4.0 adoption," L&T Global Head of Digital Manufacturing Services Prabhakar Shetty said. "Through this alliance, we commit to supporting Schindler in matching new-age innovations with traditional engineering."

KONE Taking Part in Finland R&D Partnership Initiative

KONE has launched a program focused on developing innovative, sustainable "people flow and new technologies for smoother and safer urban living," the OEM announced in November 2020. Aiming to contribute to the Finnish government's goal of achieving carbon neutrality by 2035, it is part of Veturi, an initiative funded by government organization Business Finland focused on R&D to create more sustainable, resilient and inclusive cities. Rauno Hatakka, KONE head of Technology Management, says solutions, services and business models developed in the program promise to increase both employment and export opportunities in Finland. "We plan to take a comprehensive approach with program execution, from multidisciplinary R&D activities to building an extensive global ecosystem of partners and customers," Hatakka said.

Biofial Hydraulics Enters New Markets, Invests in Technology

Thessaloniki, Greece-based Biofial Hydraulics recently entered two new markets and invested in new technology, and the company reports it is fully operational as it takes all necessary precautions related to the pandemic. Its hydraulic products are now in Latvia and the Dominican Republic. Describing Latvia as "one of the last pieces to add in our European export puzzle," Biofial has forged partnerships with two customers in the country, which brings its export relationships to 56 countries worldwide.

In the Dominican Republic, Biofial Hydraulics products have been installed in several lift systems. In the past year, the company also invested in two new pieces of production equipment: from Oxnard, California-based Haas, a four-axis cutting and processing center lathe with automatic bar feeder; from Schaumburg, Illinois-based Bodor, a fully automated fiber cutting laser machine. Biofial says the investments have resulted in enhanced production capacity and shorter delivery times.

High-rise towers are central to the plan for Seoul Valley, but the main design focus is on creating a "vibrant green district"; rendering by Henning Larsen.

Towers, "Green District" Central to Seoul Valley Plan

In November 2020, Copenhagen-based architecture firm Henning Larsen released the design for Seoul Valley, a 360,600-m^2 mixed-use development planned for the center of Seoul. With an aim to create a "vibrant green district" in the city center, Seoul Valley will combine office, retail, lodging and residential components within a public podium. The development will have three large towers subdivided "into smaller masses to reduce the sense of scale and create a village-like atmosphere between the spaces at ground level," Henning Larsen said. The lowest level has gardens, terraces and courtyards defining spaces between shops, cafés and restaurants.

The long-empty, 28,600-m^2 Seoul Valley is part of the city's 2030 plan for urban development. "For well over a decade, Seoul has been actively working to revitalize its urban fabric, focusing on the spaces between buildings and the pedestrian links," said Jacob Kurek, a partner at Henning Larsen. "Seoul Valley fits into that vision, promising to bring public life back to the center not just through shops and amenities, but [also] through a design that focuses on public comfort, greenery and local tradition." Plans call for the project to enter the "Schematic Design" phase in spring 2021.

Hitachi Launches Little Elevator Master Training Manual

In partnership with Guangzhou Publishing House, Hitachi Elevator (China) Co., Ltd. launched Little Elevator Master Training Manual, a book aimed at teaching children elevator principles and safety, during an event in Guangzhou, China, in December 2020. The book is part of Hitachi Elevator's continuing efforts to promote safe elevator use among children. In 2018, the OEM published Amazing Journey of Elevator, based on the China Ministry of Education's Guidelines for Public Safety and Education in Primary and Secondary Schools. In May 2018, Hitachi Elevator began the "Shared Reading on Safe Elevator Riding" program and has since worked with public-education entities in locations like Guangzhou, Shanghai and Tianjin to promote the program. With the latest book, Hitachi Elevator aims to help children understand elevators' history and future possibilities.

Class of little elevator masters; photo courtesy of Hitachi Elevator (China)

China

Strong Hitachi and KONE presence manifests in large contracts.

Hitachi VT

Bids to Provide 250 Elevators for Nine Projects Won

Hitachi Elevator (China) has won bids to provide 250 elevators and related services for nine projects with the Shum Yip Group, Hitachi announced in November 2020. Shum Yip, wholly owned by Shenzhen Municipal People's Government, is a large enterprise group that focuses on real estate development, operation services, infrastructure construction and emerging industry investment. It is currently developing, operating and managing 47 industrial parks throughout China. Hitachi, which has collaborated with Shum Yip on previous projects, will provide elevators for the Shenzhen Comprehensive Particle Facility Research Institute; Shenzhen Shum Yip Taifu Kechuang Plaza; Shenzhen Shum Yip Century Valley Garden; Shenzhen Shum Yip Xinhongcheng District Urban Renewal Project; Changsha Shum Yip Group Shum Yip Center; Changsha Shum Yip Group Shahe City; Dongguan Shum Yip Songshan Lake Yuncheng Garden; Nanjing Shum Yip Riverside Project Phase III; and Nanjing Shum Yip G77 Project. These facilities include a variety of commercial structures, including Grade-A office buildings, technology offices, headquarters buildings, premium residential buildings, hotels and urban-renewal projects.

Shum Yip Uptown, an urban-renewal project in Shenzhen, marked an earlier collaboration between the developer and Hitachi; image from PRNewsfoto.

The Kaisa Finance & Technology Center in Shenzhen; image by PRNewsphoto

Tower Tops Out in Shenzhen

The Kaisa Finance & Technology Center, a 258-m-tall office tower in Shenzhen has topped out, vertical-transportation (VT) provider Hitachi Elevator (China) reported in November 2020. The project, which houses 130,000 m^2 of space, will include Grade-A office space, a business center, a shared conference center, a staff canteen, a sky garden and a sky lobby. The tower has obtained pre-qualification for environmental certifications.

With 50 stories above ground and four below-grade levels, the Kaisa Finance & Technology Center will be served by 46 Hitachi escalators and elevators, including 12 high-speed elevators that can travel 5-8 m/s. The elevators are equipped with Hitachi's Destination Floor Reservation System, which incorporates data from system operation, passenger movement, building equipment and layout to provide intelligent elevator dispatching. All building VT will also be equipped with the Hitachi ELECLOUD® system to provide 24-h monitoring and carry out more than 600 AI pre-diagnostic items to monitor faults. The building is expected to be complete in early 2022.

Hitachi has worked with the Kaisa Group for 20 years, during which time it has supplied more than 9,000 VT units. The companies entered into a new strategic agreement in August 2020.

Hitachi and KONE bring hundreds of units to Xiong'an New Area, Beijing and Shenzhen.

Hitachi (China) Delivers First of 361 Elevators for Project

Hitachi Elevator (China) took part in a ceremony in December 2020 to mark delivery of the first of 361 elevators it will provide for Group B2, a large residential development in the Rongdong District of Xiong'an New Area, the company announced. Group B2 is a resettlement housing project consisting of 92 residential buildings, an office building, a kindergarten, a separate primary school and a community activity center. Hitachi is providing all elevators and related services. Work on the site is being overseen by Beijing Construction Engineering Group Co. Construction began in April 2020, but a completion date was not reported. Hitachi noted that, despite the pandemic, it delivered more than 110,000 elevators in 2020, the first time it had achieved that single-year milestone.

Numerous buildings are under construction in the Rongdong District of Xiong'an New Area; photo provided by Hitachi Elevator (China).

KONE Wins Big in Beijing Metro, Shenzhen

KONE has won an order to supply 297 escalators for two segments of the new Metro Line 12 in Beijing, the company announced in December 2020. Line 12, stretching 29.3 km, will run an east-west route through four main districts of the capital city. Its 21 stations will be entirely underground, with 15 of them connecting to other lines. KONE will equip stations from Sijiqing to Jimenqiao with 171 of its TransitMaster™ 140 escalators, and stations from Sanyuanqiao to Guanzhuangluxikou with 126 of the same model. The Beijing Subway, with 23 lines and around 700 km in total length, is the longest and busiest metro system in the world. Line 12 will help relieve traffic pressure in the city center. The project is expected to be completed by the end of 2021. The main architect is China Railway Electrification Survey Design & Research Institute Co., Ltd.

KONE has won an order to deliver 50 elevators to GDH City, a new, two-tower mixed-use development in Shenzhen, the company announced in December 2020. Sometimes referred to as the "Silicon Valley of China", Shenzhen is a global technology hub and home to more 200-m-plus skyscrapers than any other city in the world. The two GDH City towers, standing 180 and 303 m, will offer business apartments and commercial space, including a 100,000 m^2 mall. Within the development will be cultural offerings in a setting highlighting natural surroundings. KONE will deliver 46 MiniSpace™ elevators and four MiniSpace double-deck elevators. The buildings will be equipped with KONE's Destination Control System and E-Link™ monitoring system, which can keep track of the performance of all the equipment in real time from a single location. The contract also includes two years of standard maintenance. The project, under development by Guangdong Land Holdings, is targeted for completion in 2023.

Rendering of GDH City, courtesy of KONE

India

A new association and pandemic-response technology for Chennai metro and Hyderabad airport join metro work.

Indian Metro Projects Promise Improvements

Metro projects in India are being touted as offering easier travel through improvements, including better vertical transportation at stations, multiple sources have reported. The Times of India reported in November 2020 that the Delhi Metro Rail Corp. (DMRC) was in the process of working on its Phase-IV project, which will have better air-conditioning, lighting and security, and, notably, bigger elevators and escalators. A DMRC official said the current elevators typically can carry 8-13 people, but Phase-IV lifts will be able to accommodate 20 passengers, with select stations getting lifts that will carry up to 26 riders. Phase-IV stations will also have escalators installed in sets of two, to allow both upward and downward travel. In total, Phase-IV stations will have 295 elevators and 644 escalators. Current DMRC stations have a total of 935 elevators and 1,030 escalators.

DMRC has also submitted a "reworked" project plan for the cities of Thiruvananthapuram and Kozhikode, which had been delayed 35 months, The Hindu reported in November 2020. The Kerala Rapid Transit Ltd. board had approved DMRC's plan, which involves a public-private partnership (PPP). Under the PPP, the project will implement automatic fare collection and operation of elevators and escalators. The proposal must be approved by the Kerala Cabinet.

Touchless Technology "First" Part of Otis Singapore Project

Otis Singapore integrated its eCallTM mobile app with the existing smart building app at the 66-story, 22-year-old Republic Plaza office building in downtown Singapore, Otis announced in December 2020. Done in collaboration with property owner City Developments Ltd. and implementing an application programming interface – allowing the apps to "talk" to one another – for the first time for Otis, the technology was part of the modernization of an elevator system that includes 15 double-deck lifts. Work also included installation of the CompassPlus® destination-dispatch system. After downloading the tower's CityNexus app, tenants use eCall to summon an elevator as they approach it, helping them avoid touching any public surfaces. "This upgrade demonstrates how we're listening to our customers and working with them to find the best solutions for their buildings, while also helping to promote safety as Republic Plaza tenants return to the workplace," Otis Southeast Asia Managing Director Grant Mooney said.

Republic Plaza, designed by Kisho Kurokawa Architects & Associates; photo by Huaiwei for Wikimedia Commons

Another Tall Tower Rising in Tokyo's Toranomon District

Construction has started on a 38-story, 180-m-tall office tower on a former hospital site in the red-hot Toranomon Redevelopment District of Tokyo, the Council on Tall Buildings and Urban Habitat (CTBUH) reported in November 2020, citing Japan Property Central. Targeting a 2023 completion, the 180,000-m^2 structure is a project of Nippon Steel Kowa Real Estate, Tokyo Gas Real Estate, Kyushu Railway Co. and Taisei Corp. Close to the new Toranomon Hills Station in an area that is "transforming into an international business hub," the tower will join others such as the recently completed, 183-m-tall Toranomon Hills Business Tower, 215-m-tall Toranomon Hills Residential Tower and the 256-m-tall Toranomon Hills Station Tower (ELEVATOR WORLD, February 2020).

New office tower for Toranomon Hills; image via CTBUH

Middle East

Schindler, thyssenkrupp and KONE are among newsmakers from around the region

Schindler to Provide 74 Escalators for Riyadh Airport

Schindler has won a contract to supply 74 escalators for a modernization project at Terminals 1, 2 and the Royal Terminal of King Khalid International Airport (KKIA) in Riyadh, Saudi Arabia, Trade Arabia reported in October 2020. Schindler signed the deal with the Riyadh Airports Co. (RAC) to provide a heavy-usage system that could handle the airport's 28 million-plus passengers per year. The OEM will install 74 of its 9300 models in a project scheduled for completion in 2022. RAC, part of the country's aviation sector privatization program, manages KKIA and is in the process of developing and operating other airports in the region. Within the past 10 years, Schindler has expanded its footprint in the country by acquiring Saudi Elevator and partnering with the Olayan Group, a large, diversified conglomerate heavily involved in the construction sector.

KONE Wins 187-Unit Order for Xi'an Metro Line

KONE has won an order to supply 187 elevators and escalators to Metro Line 9 in Xi'an, the company announced in November 2020. The 30.6-km-long Metro Line 9 will run southwest to northeast between Fangzhicheng and Qinhan Avenue via 15 stations, a route that will serve Lintong University City. The Xi'an Metro currently has five lines in use, and 10 more are to be added in the coming years. Line 9 will serve about 850,000 passengers daily. Through its contract, KONE will deliver 152 TransitMaster™ escalators, along with 31 MonoSpace® and 4 MiniSpace™ elevators. The contract also includes two years of standard maintenance. KONE previously provided vertical transportation for Xi'an Metro Lines 1 and 4 (ELEVATOR WORLD, December 2016). The project is being developed by Xi'an China Railway Rail Transit Co., Ltd. No construction timeline was given.

NBK's new headquarters; photo courtesy of thyssenkrupp Elevator.

thyssenkrupp Elevator's TWIN Used for First Time in Kuwait

thyssenkrupp Elevator has installed 25 vertical-transportation (VT) units in the new headquarters of the National Bank of Kuwait (NBK), including 10 of its TWIN elevator systems, the company announced in October 2020. The 300-m-tall, 63-story NBK building, with a design reminiscent of a pearl and shell, stands in the heart of Kuwait City. It is the second-tallest in the country and the country's first skyscraper to use thyssenkrupp Elevator's TWIN system, which uses two cabins that move independently within a single shaft. TWIN allowed the building's designers to make the most efficient use of available space while using less energy.

NBK is certified to the Leadership in Energy and Environmental Design Gold rating, among the first in Kuwait to achieve that standard. In addition to the TWIN systems, thyssenkrupp supplied 12 conventional elevators – some traveling up to 6 m/s – one panoramic elevator and two escalators. The VT system uses the company's AGILE destination-control system. thyssenkrupp Elevator has a five-year maintenance contract that gives the building owners access to a standby technician.

Dubai

KONE Elevators for Luxury Tower

Rendering of B4 Grande, courtesy of KONE

KONE has won an order to supply 17 elevators to B4 Grande, a new high-end residential tower, the company announced in September 2020. The 287-m, 72-story skyscraper under construction in the Opera Downtown District will offer 882 luxury apartments, many with panoramic views of the Persian Gulf and surrounding areas, plus amenities and retail outlets. The apartment floorplans range from one to four bedrooms, with large penthouses on the highest floors. KONE will deliver 13 MiniSpace™, three MonoSpace® and one KONE Motala™ elevators. The company will also supply its Infotainment screen and E-Link™ system, a facility-management tool. B4 Grande is being developed by Emaar Properties and is scheduled for completion in 2022. The main contractor is China State Construction, and architectural services are being provided by WSP.

Sales in Third Tower of Residential Development Launched

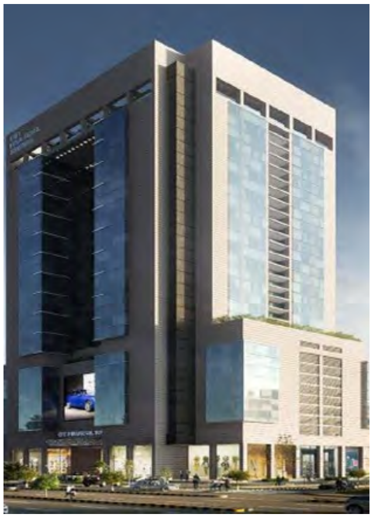
Sales in the 43-story, 255-unit Tower A of Bloom Towers next to Jumeriah Village Circle have been launched by Abu Dhabi-based developer Bloom Properties, Albawaba reported in October 2020. With completion of Tower A anticipated in December, the three-tower, 944-unit Bloom Towers will be fully delivered, with homes being handed over to buyers. The developer said response to units in towers B and C was "extremely positive," and expects a similar outcome for Tower A, which offers one- to three-bedroom apartments complemented by amenities like gyms, private outdoor dining areas, an amphitheater and co-working space. Tower A, according to Bloom Properties, offers opportunities for both investors and homeowners.

Bloom Towers; image courtesy of Bloom Properties

DAMAC Properties Marks Milestone

DAMAC Properties marked a milestone in November when it announced the structural completion of the 53-story, 1,218-unit Tower B of the AYKON City project on Sheikh Zayed Road (ELEVATOR WORLD, May 2018 and May 2016), Albawaba reported. The feat involved 90,000 m3 of concrete and 11,000 mT of steel, equivalent to about half the weight of the Statue of Liberty. The developer observed progress is being made in a real estate industry battered by COVID-19. News of the structural completion came on the heels of DAMAC awarding a contract for the construction of the Zada tower in nearby Business Bay (EW, December 2020). The Dubai Land Department also reported that property sales in August 2020 saw a 13.4% increase over August 2019.

Tower Proposed in Karachi, but Concerns Raised at Meeting



Rendering of proposed Citi Financial Tower in Karachi; image via Saama

A 33-story office building is seeking approval for a site in the Clifton neighborhood of Karachi, Pakistan, but several concerns were raised during a recent public hearing, Samma reported in October 2020. The building, to be named Citi Financial Tower, will have offices on floors 13-31, an executive office on 32 and building services on 33. It will also have showrooms on the first and second floors, parking in the basement level and on floors two-10, and a recreational area on 11. During the hearing in September 2020, residents raised concerns about the building's possible impact on traffic and infrastructure, and noted that other projects that have won approval went on to violate construction and environmental laws. Some residents near the proposed site have raised objections to having a commercial building so close to their homes. If the tower wins approval to proceed, construction would take about five years.

Virtual European Events for SMEs

SBS Lift Seminar, European SMEs Congress and SBS Lift Forum make for a busy year's end.

by Elettra Bilibio

SBS Lift Seminar

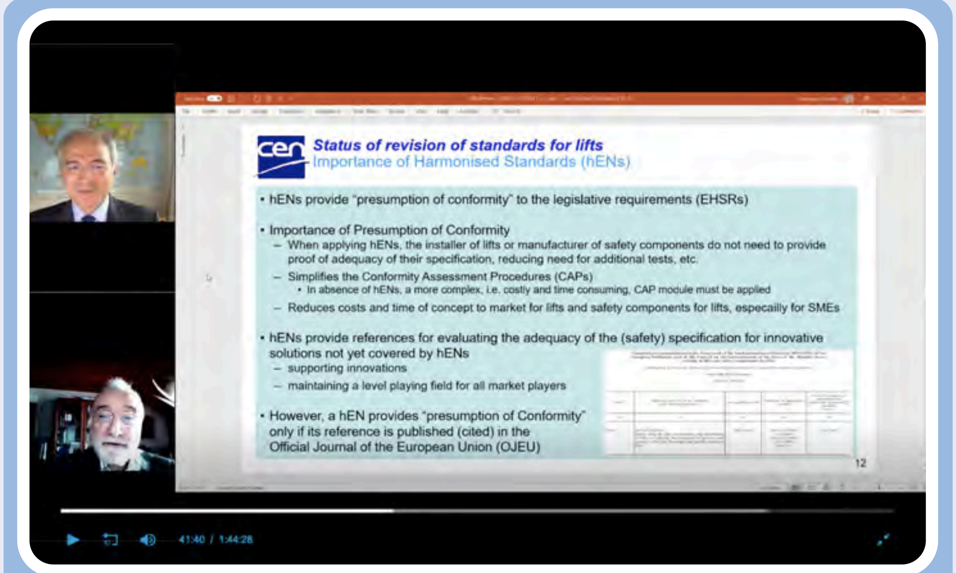
The European Federation for Elevator Small and Medium-Sized Enterprises (EFESME) organized the Small Business Standards (SBS) Lift Seminar in two virtual sessions on November 3 and 10, 2020. Organized every year since 2017 as part of the federation's activities with SBS, this year's seminar focused on the ongoing revision of the EN 81 series of standards and the work carried out within the CEN-CENELEC HaS Task Force.

EFESME separated the seminar into two thematic sessions: one dedicated to CEN-CENELEC, represented by Esfandiar Gharibaan, chairman of CEN TC/10, and the other dedicated to the European Commission (EC) and its expectations on the revision of the standards, presided over by Vesa Katajisto, policy officer and technical desk officer of DG Grow, the EC's department for growth. Both sessions included lively question-and-answer portions.

Session One

The first session opened with the welcoming speeches by EFESME President Massimo Bezzi and SBS President Gunilla Almgren. Both underlined the importance of having more SMEs involved in the standardization processes at the national, European and international level. Supporting SME participation in the activities of the European Standardisation System (ESS) is the cornerstone of SBS activities and many projects carried out by EFESME.

The session then entered its dialogue phase with Gharibaan and EFESME Secretary General Luciano Faletto's presentation that explained how work is progressing on the revision of EN 81 and what to expect for it. They also explained how



(top to bottom) Chairman of CEN TC/10 Esfandiar Gharibaan and EFESME Secretary General Luciano Faletto discussing the importance of harmonized standards

> EFESME will continue to organize online and, as soon as "possible", "face-to-face" events to make SMEs more prominent in European and international standardization and in European policymaking processes to help them create a competitive, opportunity-rich and SME-friendly working environment.

standardization in the lift sector has developed over the years. Legal issues and the importance of having harmonized standards, as well as how to encourage the direct participation of SMEs in standardization processes at all levels, were also discussed. Additionally, technical questions about the standards being revised and more general topics, such as the consequences of the then-forthcoming Brexit on the use of standards, were raised.

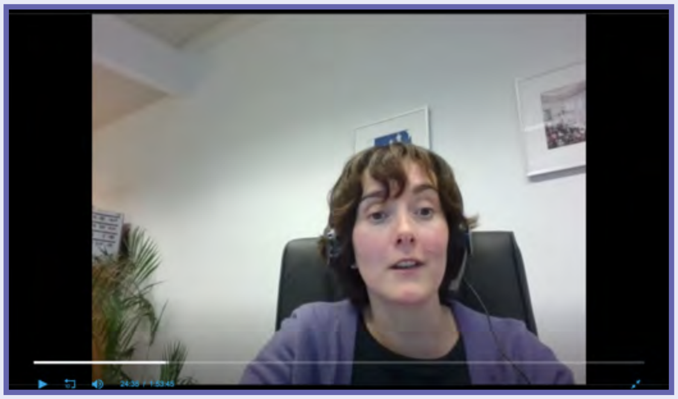
Session Two

The second session, while resuming the discussion on the core review of EN 81 from where it had been left the week before, handed over the baton to DG Grow and focused on its expectations. This time, the seminar was opened by Damyan Petrov, EFESME vice-president, and Maitane Olabarria Uzquiano, SBS director, both of whom stressed the importance of the EFESME and SBS collaboration, and the SMEs' voice.

Immediately afterward, Katajisto presented the EC's views on the current review. He also went into details explaining EC's expectations, the importance of Mandate M/549 and EC's requests when drafting harmonized standards. Faletto and Ivan Ferrarini, technical director at Farma Ascensori and an EFESME/SBS expert, had a lively exchange of opinions with him to clarify many aspects of the mandate and its content, and to again underline harmonized standards' importance for the whole sector. In particular, the experts highlighted how important it is for SMEs to have their positions included in the revision of EN 81, which regulates the lift sector and its daily work. Then, Katajisto explained the various possible ways of SMEs' participation.

EFESME is particularly satisfied with the event, including the quality of the guests' interaction, which led to a lively and stimulating question-and-answer session. Given the importance of informing, training and working with SMEs, the federation will continue to organize online and, as soon as possible, face-to-face events to make SMEs more prominent in European and international standardization and in European policymaking processes to help them create a competitive, opportunity-rich and SME-friendly working environment.

EFESME Vice-President Damyan Petrov opening the second session of the seminar and presenting the main topic of discussion



SBS Director Maitane Olabarria Uzquiano delivers her opening speech on SBS activities and the importance of involving them in standardization processes.

EFESME-SBS expert Ivan Ferrarini intervenes on the importance of harmonized standards.

European Lift SMEs Congress

SBS Lift Seminar, European SMEs Congress and SBS Lift Forum make for a busy year's end.

EFESME President Massimo Bezzi and SBS President Gunilla Almgren open the SBS Lift Forum.

(l-r) Matthias Fritz and William Cockburn answer questions from the public.

EFESME was a sponsor of the first edition of the European Lift SMEs Congress organized by the Spanish Docensas group and with the support of FEPYMA (Spanish lift association), a member of EFESME. The November 18-19, 2020, virtual event, designed to promote communication between European lift SMEs and the exchange of information and ideas, was divided into six thematic panels and attended by speakers and guests from a wide range of backgrounds: from lift SMEs to larger companies; from European institutions to organizations supporting European SMEs; and experts, technicians and architects. All were interested in the latest developments and innovations in the lift sector.

Day One

The first panel addressed the question, "Do Lift SMEs Benefit from the EU?" The participants, all actively involved in activities at the European level, agreed that the European Union (EU) and its institutions and initiatives bring benefits to lift SMEs. However, it is not always easy for them to access these programs, either because of lack of knowledge or because the procedures are extremely complicated. This is where sector associations such as EFESME, SBS and SMEunited are most important. Guests, including Bezzi, Almgren and Luc Hendrickx from SMEunited, talked about the importance of involving SMEs in policymaking at the European level to create an SME-friendly environment. They also talked about the importance of relying on the active participation of SMEs in the ESS to ensure lift standards always consider the demands and positions of lift SMEs. Katajisto agreed on this position and stressed that the active participation of SMEs in the ESS is always welcome and has already led to many important results. The standards themselves can bring countless benefits to lift SMEs, stimulating the economy, ensuring safety and quality, and creating a level playing field in which SMEs can thrive on par with large companies.

The panel ended with Eugenio Barroso, general manager of MP Lifts, taking up the concept of projecting lift SMEs into the future. He highlighted how they must abandon potentially negative features, such as fragmentation of their work, and focus instead on their strengths, like their close relationships with their clients, their agility and their entrepreneurial spirit.

The second panel, moderated by Lars Odlen, a Swedish entrepreneur with years of experience in the remote lift control sector and an EFESME expert, discussed interconnected lifts and investigated the opportunities and risks for SMEs in this regard. Guests came from heterogeneous backgrounds: Ferrarini; Hani Saliba, product & commercial director at MP Lifts; Alfredo Gómez, technological innovation and business development at ITAinnova and member of CEN TC-10; and Ricard Bou, global head of strategic projects of Nayar Systems. They discussed the remote control of systems, preventive maintenance, machine learning and data access. These topics are so important that SMEs with no remote monitoring and predictive maintenance skills will likely be out of the market soon, replaced by other companies that have adapted. But this change should not be interpreted in only a negative way: SMEs are faster, more flexible and more creative than bigger players. Fundamental for their success is to know these topics well, train technicians on the subject and aim for good coordinatation for the promotion of the development of an SME digital environment where they can give their best and continue to be a dominant force in the market.

The third panel addressed the increasingly topical issue of data access and ownership, asking whether lifts in Europe are really accessible to all operators. Conducted by Baptiste Quenardel, representing EFESME member ANPA (French lift association), the panel was attended by Uzquiano, Faletto, Spanish Education Ministry property manager and technology expert Pepe Gutierrez, Docensas Operations and Project Manager Diego Cadierno, and Country Manager of Grupo Netel Francisco Fernández.

The speakers agreed it is very difficult to understand to whom the data belong, especially because there are no open protocols. As a result, the necessary information is not always easily accessible to lift SMEs and their operators for maintenance. In this context, it is becoming increasingly necessary for lift SMEs to coordinate among themselves and with their associations to prevent new technical barriers and train their experts to allow customers to freely choose which services to access so they may fully and fairly compete.

Day Two

The second day of the congress started with a panel dedicated to the market share SMEs will occupy in the future, attempting to explain whether it will increase, or whether lift SMEs will be progressively pushed out of the market. Moderated by Petrov, the panel was attended by architects including Fabian Listerri and Dario Trabucco, and entrepreneurs such as Patrick Cox and Antonio Fernández Moray.

Once again, the speakers stressed that SMEs' agility, spirit of adaptation and promptness give them a competitive edge over multinationals. Their closeness to clients and customization capabilities were identified as formidable strengths. These panelists echoed previous ones in stressing the importance of investing in innovation (in both R&D and customization), training, SME collaboration, SME market presence, and access to information and best practices through local and European lift SME organizations.

The final panel investigated various European lift markets to answer an apparently simple question: "Are lift markets in Europe very different?" Moderated by Giuseppe Iotti, EFESME/SBS expert and an entrepreneur in Italy, the panel illustrated differences, peculiarities, strengths and weaknesses of different markets.

The event ended with the presentation of an interesting new initiative, the European Awards for Lift SMEs, which will take place throughout this year and culminate with an announcement of winners at Interlift 2021, planned for October in Augsburg, Germany. These awards aim to highlight SMEs' work and focus on creativity and spirit of collaboration.

SBS Lift Forum

The December 3, 2020, SBS Lift Forum event was dedicated to safety at work and European and national policies on safety. Organized by EFESME, it was opened by welcome speeches from Bezzi and Almgren, who stressed that workplace safety is crucial and, sometimes, a particularly difficult issue for SMEs. Bezzi detailed work safety for lift SMEs, the risks for them, and how they can continue to be safe and competitive. Almgren highlighted SBS' support of SMEs in their actions and how standards can help to establish requirements to be met.

There were then two panels. One was institutional, with the participation of the EC in the forms of the Directorate-General for Employment, Social Affairs and Inclusion (DG EMPL) and the European Agency for Safety and Health at Work (EU-OSHA). The other was national so the perspective of the member states could be shared.

Matthias Fritz, socioeconomic analyst of the health and safety unit of DG EMPL, talked on the latest developments in EU policy in this area. Starting from a solid base of numbers and data regarding workplace accidents, Fritz explained how the situation has evolved for the better since 1993 and what the short- and long-term benefits of solving the problem of work-related illnesses are.

The institutional panel continued with the presentation by William Cockburn, head of unit at EU-OSHA. Cockburn introduced the topic of health and safety challenges for small businesses.

After giving a general overview of studies conducted by EU-OSHA in recent years, he detailed the most common SME risks and encouraging results from a program put in place to improve workplace safety in SMEs during 2014-2018. Cockburn also stressed the importance of collaboration between the parties.

EFESME members from ANACAM (Italian elevator association), FEPYMA (Spanish lift association) and VmA (German association supporting lift SMEs) approached the topic of how national lift associations can deal with safety in the workplace. Paolo Tattoli, a lift expert collaborating with ANACAM, described the evolution of the legislative situation in Italy regarding safety in the workplace, particularly in the lift sector. His speech also allowed the public to see how the European Directives (in this case, the Lift Directive) and harmonized European standards help lift SMEs. Particular attention was paid to risk assessments, used to introduce risk mitigation to make daily work less dangerous for all operators.

José María Compagni Morales, coordinator for FEPYMA, gave another view on how a country's working culture may prevent the full development of increasingly precise and stringent occupational safety regulations. He stressed that public administrators have a duty to support prevention on the one hand and to create the necessary conditions for safe work on the other.

Finally, Udo Niggemeir, second chairman of VmA, presented an interesting and detailed list of activities that VmA developed to enable its members to develop awareness and skills regarding safety in the workplace. Its checklists help its members be sure they have met the necessary workplace safety requirements. For example, they include specific guidance documents to work during the pandemic. EFESME also used these documents to develop common COVID-19 guidelines (available at bit.ly/3s28EQC) and carry out proper risk assessments.

The event proved interesting for all parties involved. The most important lesson to be learned from the forum is that safety in the workplace is certainly fundamental, but also very complicated: European, national and local initiatives are, therefore, necessary to ensure it, and full support for SMEs is crucial.

Elettra Bilibio is the advisor of EFESME. A political scientist by formation, she oversees relations with the European institutions and the management of the EFESME headquarters in Brussels, Belgium.

David Youhas holds his model elevator he has created using 3D printers, including the ones next to him and behind him.

Making it Small

KONE mechanic David Youhas' 3D-printed model elevator is a project that he hopes will inspire others.

by Matt Irvin

3D printing has empowered "maker culture" for entirely new, technology-enabled generations of inspired tinkerers who see the possibilities these devices offer. One such maker, David Youhas, a KONE mechanic in Champaign, Illinois, hopes his model elevator will inspire others to embrace the opportunities offered by 3D printers.

"Years ago, I made a simple wooden five-stop elevator," Youhas, a 30-year elevator industry veteran, recently told ELEVATOR WORLD. "It was gigantic, heavy, not easily portable, [and the] controller weighed almost as much as the elevator." While this was a noteworthy project, Youhas knew there had to be a better way, and, sure enough, he eventually found it: "When I saw that 3D printers were available to consumers, I had to have one," he said. "This previous project became exciting again when I realized I could make tiny, functional moving parts, like a working door operator and worm gear drive."

The sheave and its drive gear are mounted in A-frames in the hoistway overhead.

A 3D-fabricated door operator

With an array of 3D printers – he has 23 of the devices – Youhas has been fabricating and assembling parts for his three-stop elevator and hoistway. Using a filament made of polylactic acid, his printers churn out plastic pieces designed to precise standards. It's been something of a labor of love for this KONE employee: he has invested about two years into the project. In fact, the work was put on the back burner for a while as the pandemic gripped the country. Seeing a need, he redirected his efforts to help with the fight against the virus. "I had my printers printing [personal protective equipment] for first responders – police, firemen, doctors and various healthcare providers," he explained.

It may seem like overkill having so many printers, but Youhas says there is a need: "The reason for so many is to compensate for the slow printing time of 3D printers. I can mass-print pieces across multiple printers and get the product completed faster."

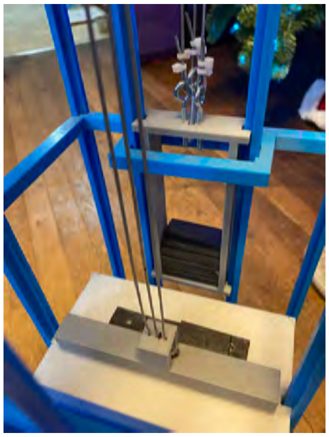
Regarding the technology, Youhas says, "I would love to share the project and inspire others with the unlimited possibilities with 3D printing." To that end, he's considering donating the finished project to a children's museum. But, don't think that will be the end of his miniature vertical-transportation projects: next is a 3D-printed escalator.

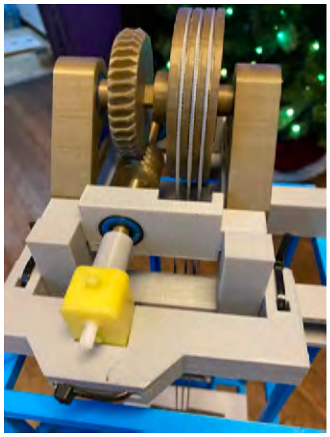
To view videos of the elevator in action, visit bit.ly/3asMWPo.

Elevator Components

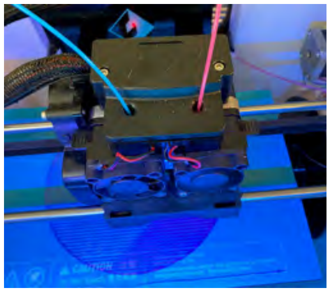
Controller: Arduino microprocessor on a small, open-source board that can be used in a wide range of computerized projects
Machine and door operators: Small, geared, variable-speed DC motors; door operator frame is 3D-printed and holds the motor, belt, drive pulley and idler
Ropes: Aircraft cable
Cab: 3D-printed
Counterweight: 3D-printed plastic frame with weights made from thin bar steel, cut to size
Door components: The doors, tracks, hangers, rollers and gibs are all 3D printed, except for the small nail axle that attaches the rollers to the doors.
Hoistway components: The sheave, worm gear, A-frames, hoistway frame and T-rails were printed, then glued and assembled.
As of late 2020, Youhas had several parts yet to install in the elevator, including the door operator and clutch, door photo eyes, hall buttons, traveling cable and operating software for automatic operation.


The hoisway of the model elevator: the blue panels are the hall doors.


Hoistway cables attached to the car top and counterweight


The worm gear is seen under the sheave's drive gear. Note the aircraft cables used for hoistway ropes.


3D-printed elevator button pushers, a must-have in the age of COVID-19


Closeup of a 3D printer's print head


3D-printed face shields Youhas made for first responders

URBAN MOBILITY IN ISTANBUL

thyssenkrupp Elevator leads the way in providing VT equipment for vast and growing metro system.

by Kaija Wilkinson

During a fall 2020 ceremony marking completion of excavation to make way for the Istanbul Metro's Ataköy- İkitelli line, Istanbul Mayor Ekrem İmamoğlu called a metro the "most valuable asset of a modern city." Scheduled for completion in 2022, the new line will traverse 28 km, have 19 stations and be able to accommodate 105,000 passengers per hour. It will provide connections between the fast-transit line connecting Istanbul's European side from the east to west, as well as between the Marmaray, Başakşehir-Kirazli and Aksaray Airport metro lines.

The line will include 12 stations served by thyssenkrupp Elevator equipment: 45 elevators, 116 escalators and six moving walks. The OEM is also providing 26 elevators and 100 escalators to the Kirazlı-Bakırköy Deniz Otobüsleri line. thyssenkrupp Elevator stated:

> *"Given the number of stops, long coverage, and high transport capacity, the metro line will be among the most important ones in the city, with a high footfall. Therefore, heavy-duty victoria escalators, used in Europe, Asia and the Americas, will be installed. They are designed for 24/7, uninterrupted service and will provide safe mobility in all climatic conditions."*

> Road traffic in Istanbul is often at its maximum capacity, thyssenkrupp Elevator observes, 'making a well-connected, comfortable and efficient metro system essential.'

Road traffic in Istanbul is often at its maximum capacity, thyssenkrupp Elevator observes, "making a well-connected, comfortable and efficient metro system essential." The company has provided escalators and other equipment to metros in Sydney, São Paulo, Brazil; Madrid; London; and Beijing. thyssenkrupp Elevator is no stranger to the Istanbul Metro system, providing approximately 70% of its mobility equipment. "In a metropolis like this, an efficient public-transportation system is crucial, and helps brings Istanbul to the first league of European megacities in terms of urban mobility," thyssenkrupp Elevator CEO Peter Walker says.

thyssenkrupp Elevator spokesman Michael Ridder tells ELEVATOR WORLD the units are built to withstand Istanbul's wind, water and, occasionally, snow. The units have a 145-kg step load and are able to stop in any incident. Increased lower and upper curvature diameters provide a smoother ride, Ridder observes. The victoria model features a strengthened truss and step-roller chains located on the outside to ensure longer life and easy maintenance. Augmented safety features include a missing-step safety device indicator, broken handrail and derailment detection and brake-function monitoring.

These features are also standard tender specifications of all Istanbul Metro projects:

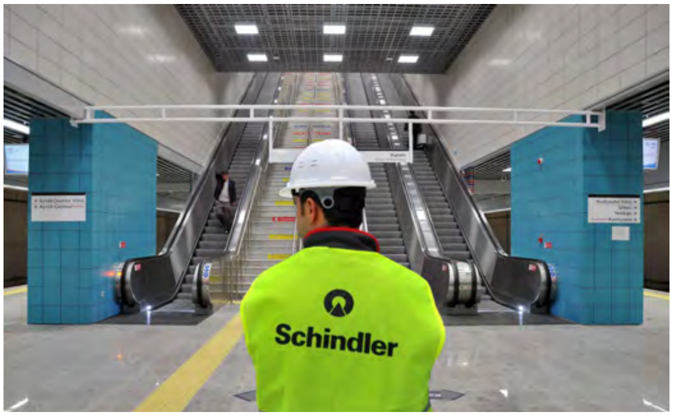
- Drive-chain monitoring by initiator
- Brake-wear indicator
- Cover-plate contact
- Step-thrust device at upper and lower transitions
- Solenoid auxiliary brake on main shaft
- Float switch for water detection in the truss
- Vertical comb-plate switch
- Single-row skirt brush
- Skirt monitoring via four microswitches

A Long History

Construction of and improvements to Istanbul's metro system have generated work for VT OEMs for

Set of heavy-duty thyssenkrupp victoria escalators serving the Ataköy-İkitelli line

Members of thyssenkrupp's Istanbul Metro installation team



For the Marmaray Project, the underwater rail link between Asia and Europe, Schindler provided 10 elevators and 63 elevators; photo courtesy of Schindler.

more than 30 years, since Istanbul Metro was established in 1988. The VT system includes many remarkable units, such as the two funicular cars supplied and installed by Doppelmayr Tramways Ltd. (now known as Doppelmayr Garaventa Group) for the underground Taksim-Kabataş funicular system linking the modern part of the city to suburbs on the opposite bank of the Bosporus[1] that opened in 2006.[2]

Installation

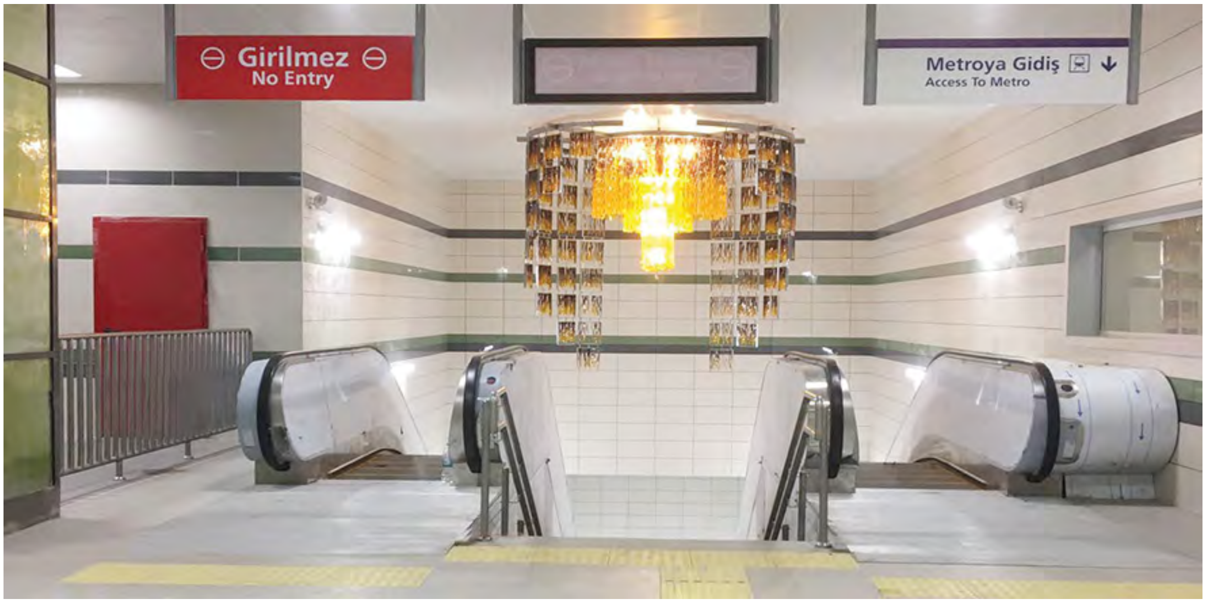
For the Marmaray Project, the underwater rail link between Asia and Europe, which opened in 2013, Schindler provided 10 elevators and 63 escalators. That job included fitting four escalators that are among the tallest in Europe at 65 m.[3]

Hyundai Elevator Turkey provided 196 escalators serving 16 stations of the 18-km-long Üsküdar-Umraniye-Çemeköy line, with the highest unit having a vertical height of 19.4 m and horizontal length of 41.5 m.[4] These are only a few examples.

A Consistent and Integral Role

thyssenkrupp Elevator has played a consistent, integral role. For Marmaray, it provided nearly 350 units: 191 elevators and 155 escalators. That job included numerous panoramic elevators and VT equipment built (like the most recently installed victoria escalators) heavy use and harsh weather. Improvements to the underground line, which included upgraded track and renovations to 36 stations, had been slated for completion in 2015.[5]

For the 18-km-long Mecidiyeköy-Mahmutbey line, boasting the first self-driving vehicles on the European



Hyundai escalators serving an Istanbul Metro station; photo courtesy of Hyundai Elevator Turkey

The underground Taksim-Kabataş funicular system links the modern part of the city to suburbs on the opposite bank of the Bosporus photo from My Travel Diary

side of Istanbul, thyssenkrupp Elevator provided 225 escalators and 108 elevators. Part of the M7 metro line, it runs 18 km between Kabataş and Mahmutbey on the European side of the city, connecting eight districts of Istanbul. It was opened to much fanfare on October 28, 2020, one day before Turkey's Republic Day. Masked passengers flocked to use it, but, this time, Mayor İmamoğlu was unable to attend since he was in the hospital receiving treatment for COVID-19. Joining the festivities via teleconference, İmamoğlu observed Istanbul residents would be allowed to use the line free of charge during its first 10 days of operation, and that it is expected to carry approximately 140,000 passengers per h.[6]

References

[1] "Istanbul — The Tunnels," funimag.com/funimag26/Kabatas01.htm.

[2] wikipedia.org/wiki/F1_Taksim%E2%80%93Kabata%C5%9F_funicular_line

[3]"Schindler's Contribution to Marmaray Project," ELEVATOR WORLD, February 2014.

[4] "Escalators of First Smart Underground are Entrusted to Hyundai Elevator Turkey," EW Turkey, January 2017.

[5] "thyssenkrupp to Supply 346 Units for Tunnel Project," EW, September 2013.

[6] "Istanbul M7 Metro Extension Opens Ahead of Turkey's Republic Day," T-VINE, October 28, 2020.

ELEVATOR WORLD'S 23rd Annual Project of the Year

In this issue, EW is pleased to present the 2021 Project of the Year contest winners. As always, submissions were impressive, and judging was difficult. In a world largely in pandemic lockdown, the entries were surprisingly plentiful and mentally took us to such amazing locations as ancient fortresses on hillsides in Turkey and Italy; mansions in locations like New York state, New Hampshire and the Florida Keys; a museum celebrating a Romanian sculptor; and the bustling streets of Hong Kong and Jerusalem. Here, vertical-transportation companies, from major OEMs to smaller independents, created unique, robust, attractive elevator, escalator, moving-walk and lift systems that provide access and mobility in some of the most interesting and populated places on Earth. The contenders faced many challenges: harsh weather, rugged terrain and shifting specifications, to name a few. More often than not, the depth of these challenges and how they were successfully addressed pushed winners ahead of the rest — by very thin margins. Decisions had to be made, however, and an ultimate winner was selected in each category. Winners have been presented with plaques commemorating their outstanding work.

The EW staff and judges appreciate the many entrants and their participation. We hope readers will enjoy some of our industry's most significant accomplishments from the past year. Start thinking now of any noteworthy projects your company is working on that may be eligible for entry in next year's competition. The project should be composed of a vertical, horizontal or inclined transportation system consisting of an innovative design, special application or approach that solved major problems or overcame unique challenges. Complete contest entry details are available at elevatorworld.com/poy. The submission deadline is September 30, 2021. The transportation-system portion of the project must have been completed within two years of the opening of the contest (April 2019 or later).

PROJECT OF THE YEAR
ELEVATOR WORLD
2021

ELEVATORS, NEW CONSTRUCTION

Collins House

Melbourne, Australia

Otis works within space and time constraints to deliver advanced elevators to new landmark tower.

submitted by Kathleen Padgett, Otis

For more than 150 years, owners and managers of some of the world's most iconic and unique buildings have called on Otis to deliver the solutions and service their buildings need. From the Empire State Building to the Eiffel Tower, Otis moves passengers throughout some of the world's most famous landmarks. So, it should come as no surprise that the company was selected to provide its elevator products for the 61-story Collins House residential tower in Melbourne, Australia. Otis contributed two SkyRise® elevators and one Gen2® Premier elevator to the project, as well as the company's CompassPlus® destination management system, products worthy of a landmark skyscraper noted for its unique design. Otis also successfully met unique installation challenges, not the least of which was delivering equipment to the site across a busy tram route that travels down Collins Street.

Collins House's exterior dimensions measure 11.5 m (37.7 ft) wide at its base, making it Australia's slimmest tower and the fourth-slimmest skyscraper in the world. Architecture firm Bates Smart designed this "skinnyscraper" to match the Collins House footprint, which isn't much bigger than Melbourne's typical house and land block. The building features a slenderness ratio of 16.25:1, coming in significantly less than the ratio of approximately 24:1 for New York's Steinway Tower, the world's slenderest skyscraper.

The sleek, contemporary tower incorporates the grand heritage façade of Melbourne's historic Makers Mark building on downtown Melbourne's Collins Street. NYC has its Wall Street, Paris is known for the Champs-Elysees, and Singapore boasts Orchard Road; in the same way, Melbourne has Collins Street, one of the most prestigious streets in Australia. With nearly 260 luxurious residences — a mix of multistory lofts, expansive single-level apartments and an exclusive penthouse collection — Collins House is a draw for its design, as well as its high-end amenities. The residences were designed with views in mind but are notable, as well, for their oak floorboards, marble splashbacks, glass cabinetry and brass fixtures.

Because of the building's small footprint, Collins House extends up from behind the Makers Mark façade and then

Collins House, built above the 1908 Makers Mark building; image courtesy of Hickory

An elevator car interior with leather wall panels

cantilevers 4.5 m out on one side over an existing 11-story office building next door. (Collins House's developer purchased the air rights above the building to allow the development to proceed as designed.)

Construction contractor Hickory Group used its construction method, Hickory Building Systems (HBS), to develop prefabricated structural modules designed to improve quality and safety and streamline the overall construction process. Collins House is the tallest residential tower in Australia to utilize modular components, and the HBS prefabricated construction method resulted in minimum disruption to traffic and a substantial reduction in the duration of the construction timeline – from 40 to 30 months. The self-supporting structure utilizes conventional formwork up to Level 14, at which stage the prefabricated units were used for the remainder of the project. A cantilever floorplate at Level 15 enables floor space to increase by approximately 35% to the very top.

While the small footprint was a challenge for the builder and the Otis design team, a single point of access at the front of the Makers Mark façade created issues with the amount of room available to maneuver various pieces of construction equipment and building material required. The logistics of delivering, setting up and moving materials and equipment during construction on the site required clear communication and well-organized, just-in-time delivery.

A strong history of customer service and innovation, coupled with experience in meeting challenging building design and installation requirements, allowed Otis to provide an ideal elevator solution for this distinctive, prestigious project.

Transportation System Details

The particularly narrow Collins House site required a rethinking of the structure of tall buildings. It was only through an inventive structural system (combined with cutting-edge construction techniques and advanced systems that met the building requirements in the time required) that a reinvention of the tall skyscraper concept was achieved.

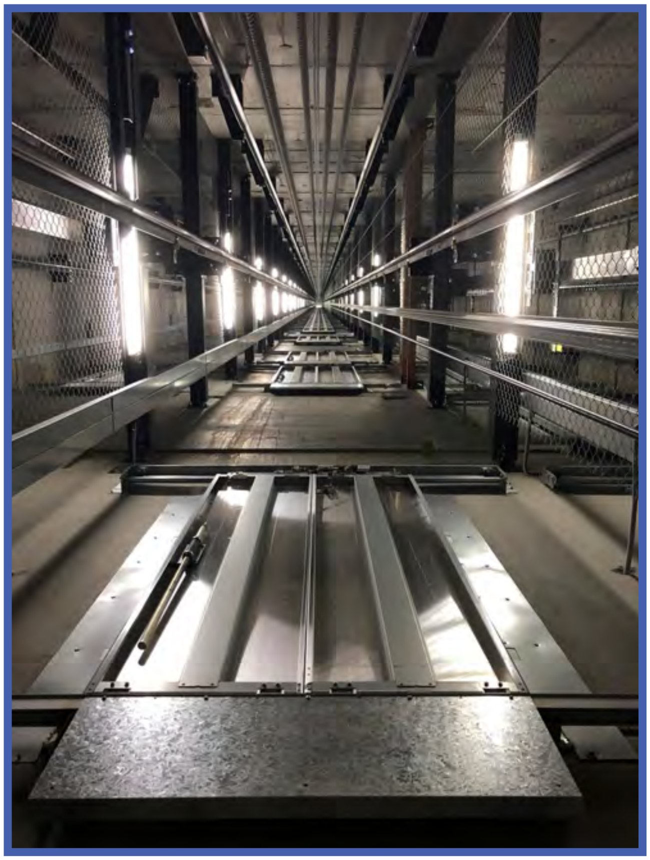
Otis supplied a Gen2 elevator for Collins House that travels from the basement level to Level 19 and SkyRise elevators that travel from the ground floor to the upper floors. The three elevators utilize the same triplex elevator shaft, with the two SkyRise units changing to a duplex shaft after Level 20. "In addition, once we completed the Gen2 installation, Hickory used it to fit out the lower part of the building, while we continued the installation of the two SkyRise units above," said Jeremy Miles, Otis' technical support team leader for new equipment & modernization.

"Otis was chosen to provide the elevators for Collins House based on their industry high-rise experience and value," said Hickory Project Manager Peter Frank. SkyRise, Otis' most advanced high-rise system, integrates technology with space-saving design that gives building designers flexibility in realizing their visions.

SkyRise was perfectly suited for the "skinny" design of the Collins House project. The sustainable design of SkyRise minimizes space requirements, and the elevator's SkyMotion® machines are among the most energy-efficient available. Their lighter weight makes them easier to install, and their smaller footprint saves space. The elevator's controller is built with fly-by-wire technology, similar to that used in aircraft, to provide reliability in a compact design. The controller helps reduce energy consumption, while a patented control algorithm ensures a smooth ride.

The Gen2 system is one of the company's best-selling elevators, with more than 1 million sold since its launch in 2000 (ELEVATOR WORLD, December 2020). Gen2 features flat-belt technology that allows for a compact design, energy-efficient operation and a smooth, quiet ride. The compact system gives architects greater design flexibility and building owners more rentable space. The flat-belt technology, ReGen® drives and gearless machines make the Gen2 Premier among the world's most energy-efficient elevators. The system minimizes noise and vibration and renders the elevator's movement barely perceptible. The belts have a significantly smaller bending radius than wire rope, allowing the Gen2 machine to be 50% smaller than conventional machines. When combined with the ReGen drive system, the system can reduce energy consumption by 75% under normal operation. ReGen captures energy

The elevator car panel lacks floor push buttons because the elevators use the Otis CompassPlus destination-management system.



The elevator system uses a triplex arrangement for the two SkyRise elevators and the Gen2 Premier shaft, seen on the right side.

The Collins House lower ground elevator lobby

that would otherwise be wasted and returns it to the building's power grid for use by other systems. Significantly, the machine-room-less elevator components are so compact, they fit inside the hoistway, eliminating the need for an extra room for elevator components. This was a perfect fit for Collins House, as the system saved construction costs and freed valuable floor space.

The CompassPlus fixtures are easy to use and offer efficient movement throughout the building up to 50% faster than conventional destination-management systems. The intuitive screens guide passengers through their journey with customized service.

A challenge for Collins House construction teams was the delivery of material when and where it was needed. A decision was made to retain the original Art Nouveau detailing from the 1908 Makers Mark building, incorporating it into the façade and grand entrance hall of Collins House as a way to pay respect to the site's heritage as the center of Australia's national trade network in the early 1900s. But, because the site's footprint was so small, it meant early delivery of materials had to come in through the Collins Street entrance. This also meant there was limited space onsite for storage of equipment.

"Effective communication was absolutely critical to delivery of materials," Frank said. "Time slots were allocated to various trades, with due respect to peak traffic periods, and the delivery times were rigidly followed to avoid conflicts."

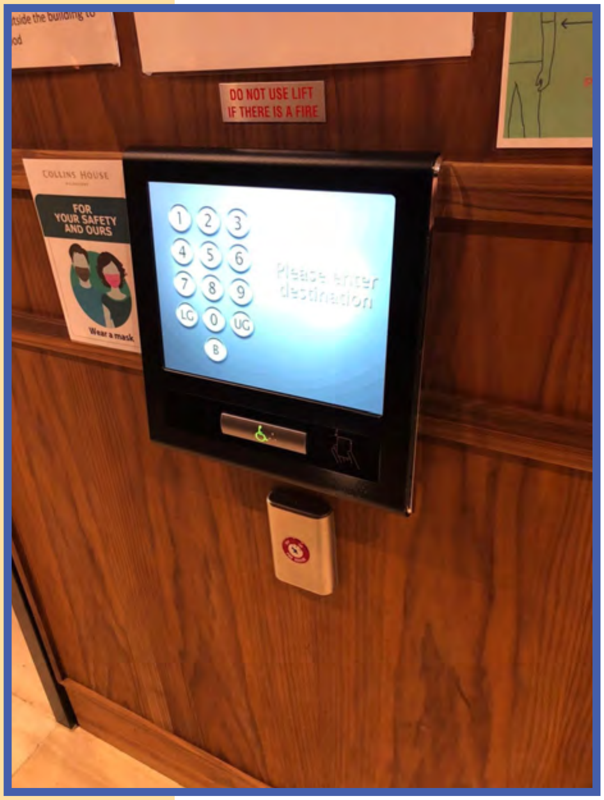
Because Collins Street is a major Melbourne thoroughfare, Otis required a permit from the city to schedule its early deliveries through the front entrance on consecutive Saturdays, on an extremely tight schedule. Complicating matters was Melbourne's tram transportation system. Trams are a major form of public transportation in the city, consisting of a network of some 250 km of double track serving 493 trams, 24 routes and 1,763 stops. Tram service on Collins Street meant Otis had only a 5-min window between trams to deliver equipment.

Once the building's early floors were completed, Otis' remaining material (including shaft rails, motors and elevator cabs) had to be staged progressively throughout the build via a single crane and a single hoist lift, both of which required reserving a specific time to use.

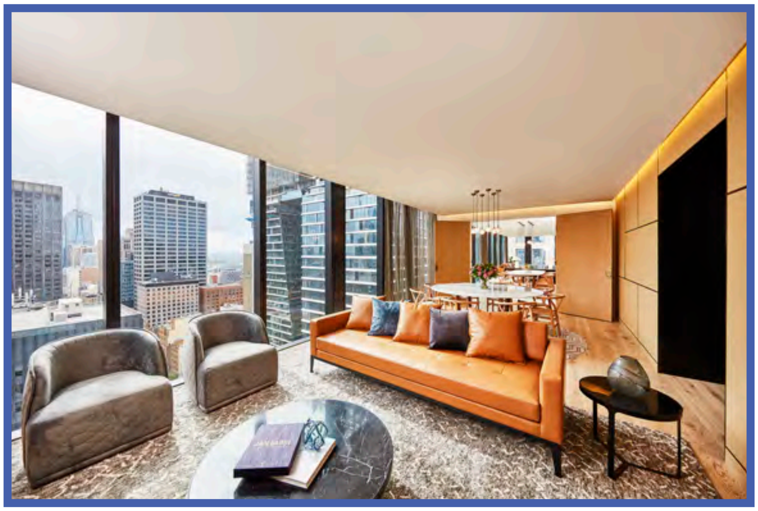
Miles said:

> *"Multiple deliveries of small loads each time made the process extremely time-consuming. Our team mapped out a thorough plan before work started and throughout the project to ensure a timely delivery of our elevator products; one that didn't impede progress by the builder or trade professionals, like electricians or plumbers. We worked closely with Hickory, our customer, to coordinate our schedules and ensure the project flowed smoothly."*

The floors of Collins House have an H-shaped plan, which eliminates the need for perimeter columns. As a result, each precast floor, precast post-tensioned beams and pre-installed



A CompassPlus destination-management system touchscreen


A unit inside Collins House; image courtesy of Hickory

Credits

Owner: Golden Age Group and joint-venture partner Deague Group
Developer: Golden Age Developments
Main building construction contractor: Hickory
Architect: Bates Smart
Elevator services provider, equipment manufacturer and component supplier: Otis

façade (constructed and assembled offsite) was craned into place in 2-3 hr. That meant the elevator shaft rail installation had to keep pace with a four-day structure cycle time as the building grew taller. "The use of a precast elevator shaft and prefabricated floors made progress swift, and we had to keep pace to not fall behind," Miles said.

An example of the speed of the installation was the SkyRise builders' elevators, which were completed less than 30 days after the motor room was completed. That was of particular importance, because wiring for the Compass system between the three elevators needed to be integrated, which was difficult because the Gen2 and SkyRise elevators were nearly 40 floors apart. "It was a challenge to link Compass and other group communications between the units, particularly while construction was ongoing, but the systems [operated] seamlessly," Miles said.

To ensure SkyRise system performance, Otis conducted advanced simulation and analysis to understand site-specific variables, such as building sway and stack effect. Miles noted:

> *"One of the things we had to deal with as it relates to [building] sway was when the crane was in use. When it was loading material and lifting to upper floors, the building would sway. We saw a lot of movement from that, as well as from the effects of wind. As a result, we wound up doing a lot of rail installation during the night, when the crane wasn't in use, to ensure the rails were installed as straight as possible."*

Rail straightness also was affected by the building's unique design. Because Collins House was cantilevered, the structure was progressively stepped back throughout the build to ensure it would not lean more than an expected 300-400 mm. As a result, at project completion, the structure was only about 30-40 mm out. "However, the cantilevering and stepping back of the shaft, as well as crane movement during construction, made the shaft challenging to plumb," Miles said. "Despite this, our team did a great job ensuring excellent ride quality for the customer."

Frank added:

> *"To counteract unequal settlement, the structure was built with offsets at every level, and the building verticality was regularly monitored. The lift rails were installed in symmetry with the building movement so that the finished building and elevators remained vertical. Logistics also were critical, in that there was no space for storage of materials."*

Summarizing, Miles said:

> *"The Collins House project is an excellent example of Otis' ability to provide the right products for a customer's unique needs, as well as successfully work within a demanding construction environment under tight deadlines."*

The project was completed in November 2019.

Whiteface Mountain Historic Elevator

Wilmington, New York

submitted by Douglas M. Scheu,
Architectural Resources, P.C.

Elevator at popular tourist attraction renewed with a nod toward its legacy.

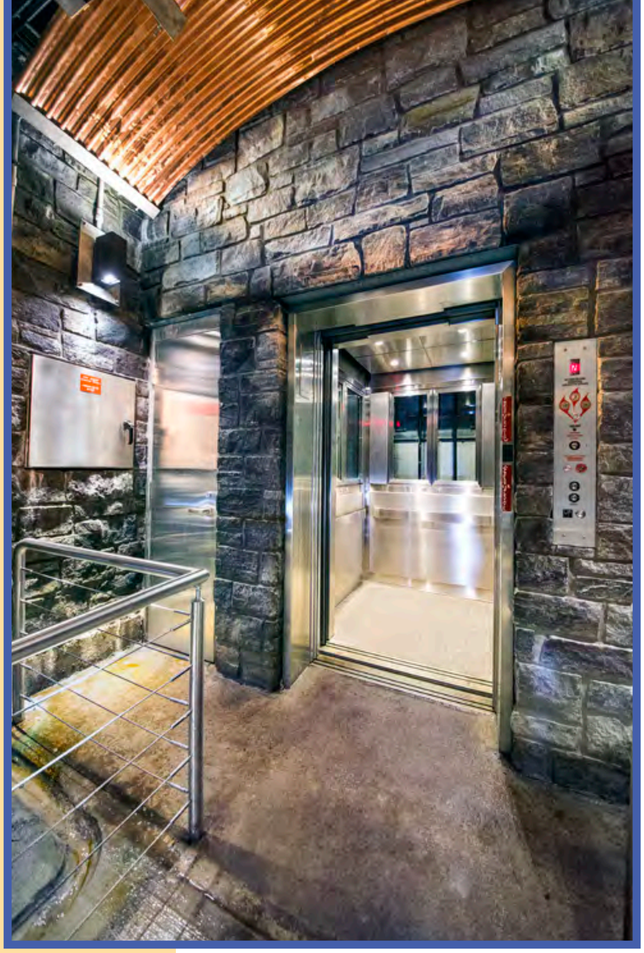
The tunnel

Whiteface Mountain rises 4,867 ft above the lush natural landscape of Lake Placid, New York. As an all-season destination, Whiteface Mountain annually welcomes 75,000 visitors to its summit to view the surrounding 6-million-acre Adirondack park. To reach the summit, visitors first enter the depths of the mountain through a 426-ft-long pedestrian tunnel, then ascend the final 271 ft via an elevator.

The stone-carved tunnel and elevator, both dating to 1938, are the final stretch of the summit experience. As originally designed, once visitors reached the end of the pedestrian tunnel, an attendant would manually operate the vintage elevator to take them up to the Roundhouse. In this open-air elevator, you could smell the mountain and hear the water on the journey through the mountain, separated only by wire mesh car walls.

Modernization Challenge

After nearly 80 years of service, the elevator had become unreliable, with mostly vintage components that had significantly exceeded their designed life expectancy. Constant humidity inside the mountain and melting snow after the winter season had negatively impacted the



Bottom landing, doors open

Inside the car

Hoistway view

Upper landing

condition of the elevator, causing rust and premature failure of the equipment. The Architectural Resources team was retained by the Olympic Regional Development Authority to develop a new elevator that is reliable, accessible and compliant with current code. The ideal design solution would recreate the unique atmosphere and sensory experience of traveling through the mountain.

Unique/Stringent Coordination

The isolated location of the Roundhouse complex atop Whiteface Mountain, compounded by the adverse winter weather conditions, presented logistical and physical difficulties for this project. Access to the site during the winter was extremely limited, in contrast to the peak summer tourism season.

Historic Preservation

The historic nature of the 1938 Roundhouse and elevator required a design solution sensitive to the original character-defining features of the facility. The project was reviewed and approved by the New York State Historic Preservation Office.

New Elevator Experience

The Architectural Resources team removed the existing system from the damp hoistway and installed a new gearless system in the existing overhead, which

New Hollister-Whitney machine

provided a humidity and temperature-controlled location for the new equipment. To replicate the experience of traveling through the mountain, the new elevator features a glass cab and newly illuminated hoistway. Renovations to the tunnel and further excavation at the base of the elevator to remove an existing stairway created a barrier-free, Americans with Disabilities Act-compliant experience that will provide efficient movement of visitors for years to come.

Existing Elevator Conditions

- Type: Offset overhead geared traction
- Controller: Virginia Controls
- Capacity: 2000 lb
- Speed: 200 ft/min
- Door type: Manual two-speed side-sliding
- Landings served: Lower level (tunnel) and upper level (Roundhouse)
- Firefighters' Emergency Operation: No
- Emergency power: No

The original 1938 equipment configuration inside the mountain utilized an offset geared traction machine and overhead deflector-sheave arrangement within a secondary space adjacent to the hoistway. This configuration, in combination with the long travel distance, led to premature failure of the already mechanically inefficient equipment. The constant humidity inside the mountain and melting of snow after the changing of seasons had also negatively contributed to the condition of the elevator equipment.

Elevator Modernization Approach

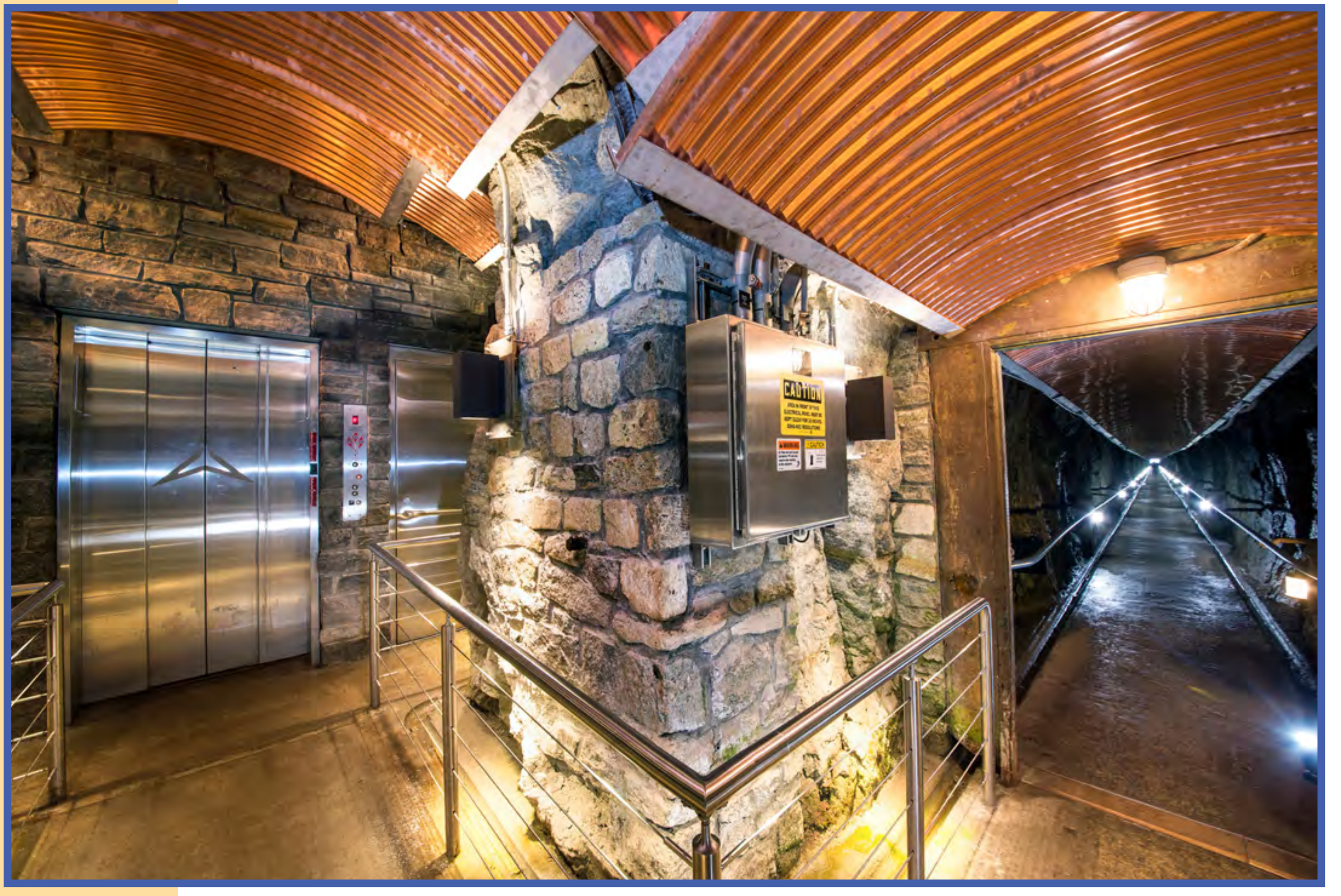
The complex nature of this project dictated the scope of the work:

- Comprehensive upgrade to both primary and standby power distribution systems
- Complete removal of deteriorated structural steel hoistway and emergency stairwell superstructure
- Installation of prefabricated galvanized structural steel system for new hoistway and stair system
- Temporary platforms at precoordinated elevations, matching construction sequencing activities and maximizing construction efficiencies
- Extensive stone demolition at lower-level elevator lobby to remove stairs, create new utility spaces and provide disability-accessible path to new elevator car
- Removal of existing offset overhead geared traction equipment from elevator machine room located adjacent to hoistway and below Roundhouse finish floor
- Conversion of existing overhead sheave space to a new, conditioned elevator machine room to house a new Hollister-Whitney GL171 machine and Elevator Controls Pixel control system
- Installation of custom stainless steel and glass cab with cab design emphasizing the open-air experience and enabling maintenance by staff
- Installation of a new fire-alarm system to provide code-required Firefighters' Emergency Operation (Phase I and Phase II)

Replacement Elevator Specifications

- Type: Overhead gearless
- Capacity: 2000 lb
- Speed: 200 ft/min
- Door type: Two-speed, center-opening
- Landings served: Two, lower level (tunnel) and upper level (Roundhouse)
- Firefighters' Emergency Operation: Yes
- Emergency power: Yes

The elevator system was replaced in its entirety, including, but not limited to, the machine, sheaves, controller, car frame, cab, doors, frames, sills, fixtures, guide rails and counterweight assembly. The new elevator system consists of an overhead gearless traction machine with a permanent-magnet AC motor. With both the machine and control system now directly above the hoistway in a climate-controlled



Bottom landing, at the end of the tunnel

Credits

Owner: Olympic Regional Development Authority Whiteface Mountain
Architect and vertical transportation designer: Architectural Resources, P.C.
Contractors: Bay State Elevator/Murnane Construction
Manufacturer: Hollister-Whitney (cab)/Elevator Controls (controller)
Consultants: Watts Engineering (mechanical, electrical, plumbing/fire protection) and Spring Line Design (structural)

space, the entire system is significantly more reliable and efficient, reducing maintenance requirements and wear on the equipment. The new microprocessor control system will meet current code and have Firefighters' Emergency Operation Phase I, "Recall," and Phase II, "Emergency Operation."

The new cab is constructed of a durable, corrosion-resistant material with glass windows that can be opened from the inside for cleaning. The fixtures are made of a durable stainless steel consistent with the visual enhancements that were being implemented at each landing. To prolong the life of the elevator equipment in the harsh environment, all steel associated with the car frame, platform, guide rail and buffer supports was specified to be galvanized to minimize corrosion and deterioration.

Architectural Specifications

To make the elevator accessible from the tunnel elevation, the existing rough stone entry steps were demolished. This extended the elevator's total travel distance and eliminated an elevation change for pedestrians. The existing metal panel wall that separated the landing from the maintenance stairs and hoistway was removed and replaced with a new granite hoistway separation wall. The wall was constructed in a manner similar to that of the rough, natural walls that make up the existing tunnel. Authorized personnel can enter the elevator maintenance stairwell through a new entrance door on the right side of the elevator entrance door (in the same location as the previous stairwell entrance). The existing transite panel ceiling was removed as part of the demolition and replaced with a copper panel ceiling. The new upper landing elevator doors and frame follow a similar design, all of which maintain the historic character of the Roundhouse. The project was completed in October 2019.

ESCALATORS, NEW CONSTRUCTION

Yitzchak Navon Train Station

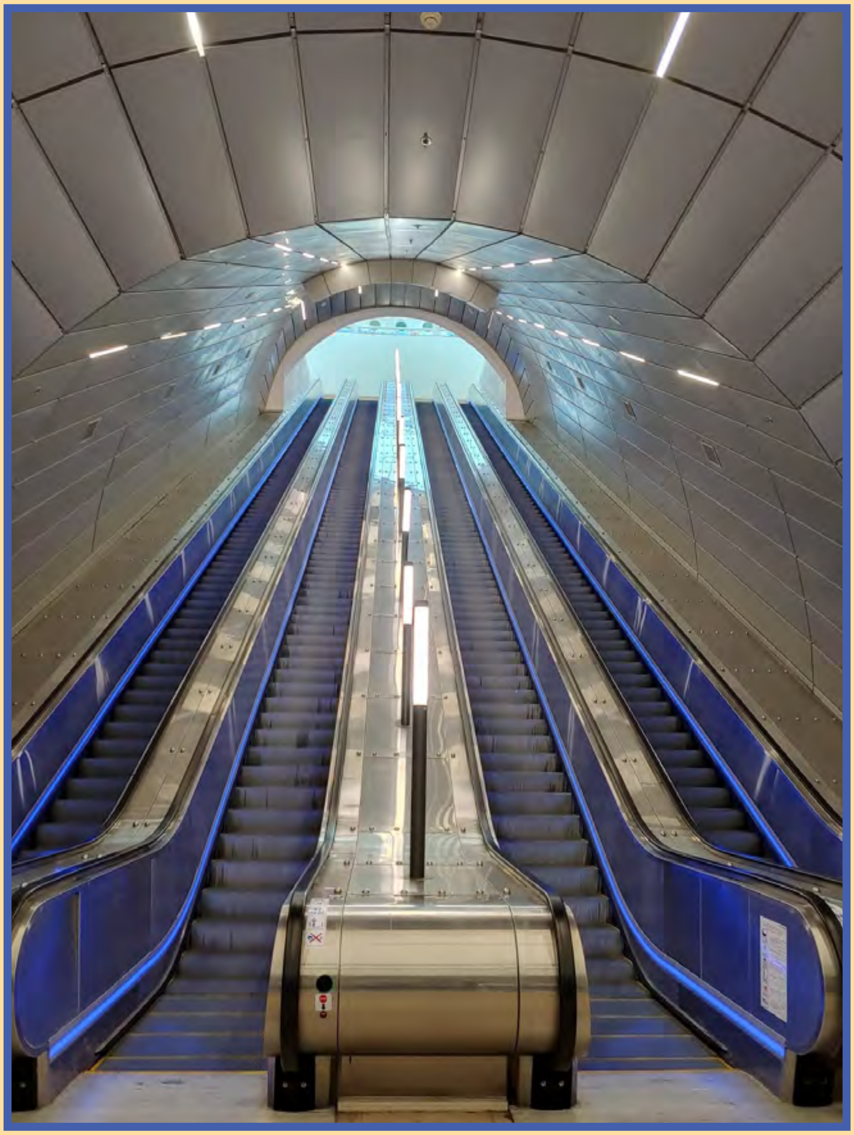
Jerusalem

Complex train station design challenges installers, who devise a custom monorail system to move escalator sections.

submitted by Kathleen Padgett and Olivier Grob, Otis
photos by Sigal Segev Kurz

We care a lot about height in the vertical-transportation industry. Getting passengers to the top of the world's tallest skyscrapers is a feat akin to climbing the tallest mountains. However, in the world of public-infrastructure escalators, it's not height, but depth, that gets the glory. Turn a mountain upside-down, and you get something similar to the Yitzchak Navon Train Station in Jerusalem, where Otis escalators and elevators seamlessly transport passengers from the "top" (street level) to the "bottom" (train platform) some 80 m below.

The facility is the world's deepest heavy-rail passenger station and fourth-deepest underground station, featuring a tunnel approximately 1 mi long. Its entrance is located at an elevation of 815 m, with most of the station's 60,000 m^2 of floorspace underground. The descent to the passenger platforms is accomplished using either a vertical shaft in an oval cut, which includes six elevators, emergency stairs and ventilation shafts, or a 12-unit system consisting of three sets of four escalators, each section of which is 45 m long. The facility's lower level includes the station, platforms with escalators and technical structure, including ventilation blowers, generators, cooling units and electrical rooms. Due to the depth of the station, vast amounts of air must be pumped in from street level, and a system



The escalators meet the facility's intense traffic needs, 24 h a day.

A cross-section of the deep station

for air emission and smoke release in emergencies is required.

Otis provided 25 of its heaviest high-rise escalators (13 515 NPE-model escalators and 12 520 NPE units), 12 elevators (nine Gen2 elevators, including eight Gen2 Premier and one Gen2 Comfort) and three locally designed elevators based on Otis components. This was through Electra Elevators, which has been Otis' exclusive distributor in Israel since 1967.

The primary project challenge came in solving how to move the 12 520 NPE escalators into the site for installation, then lifting and positioning them into place. Each escalator weighs approximately 32 T. and was divided into six segments prior to installation. The creative engineering and logistical solution involved utilizing a custom monorail system anchored to the tunnel ceiling through which installation teams could transport each escalator segment through the hoistway.

While the elevators provided are impressive in and of themselves — some featuring glass doors and panoramic views — it's the story of how the escalators were installed that stands out. Shoham Saporta, vice president of engineering for Electra Elevators, summarized:

> *"Israeli Railways is one of our biggest customers. . . . We used the monorail system, fitted with a large and heavy drum winch, to lift, place and install each escalator and worked around the clock to get it accomplished. As a result, we were able to install the 12 units in just one-and-a-half months."*

The project also includes a 10-year service contract that starts after a warranty period.

The heavy-duty escalators serve as the primary means of moving train passengers to and from the platform far below. They are at an inclination of 30° and in three groups of four escalators each. In total, they travel approximately 1 km. To meet the demands of heavy use,

Yitzchak Navon Train Station

Yitzchak Navon Train Station

Also known as the Ha'Uma Station, the station serves the A1 high-speed train line from Jerusalem to Tel Aviv. Officially named after Jerusalem native Yitzhak Navon, the fifth president of Israel, it's located near the Binyanei Ha'Uma International Convention Center and constitutes part of a major public transportation hub, situated adjacent to the Jerusalem Central Bus Station and a station serving the Jerusalem Light Rail.

they have a rectangular tube truss and sealed welds, which both protect from corrosion and enhance structural rigidity, enabling longer spans without intermediate supports. Rigorous component testing is a key part of the process: escalator steps are dynamically tested under load, not 5 million times (as required by standards), but 20 million times. Steps are also subjected to breakage tests to ensure their quality and durability.

In addition to the 12 escalators that descend to the train platform, the remaining escalators and some of the elevators are utilized in the building above. Several of the Gen2 elevators travel from the ground level to the train platform (for general and handicapped passengers), and others function as service elevators. Since the building is used for public transportation, all units had to be compliant with EN 81-70. Given the site's limited access during construction, some elevators and escalators, once installed, were used to help move workers and materials for installation.

The escalators are part of a sustainable development approach. Their ReGen drives capture energy produced by the units and return it to the building's electrical network. Energy savings can reach 60%, compared to that of escalators not so equipped. Safety components include acrylic protective deflectors; top-height, fall-protection railings; yellow, painted dividing lines; aluminum and stainless-steel steps; rounded stair nosings; protective barriers; low-friction baseboards; black or aluminum brush deflectors; combs with yellow inserts; nonslip, stainless-steel combplates with rubber inserts; and nonslip, stainless-steel landing plate with rubber inserts.

After the escalators were assembled and placed in their final positions, scaffolds were placed directly on top of their steps to provide access to the monorail for dismantling. The project was completed in May 2018.

Credits

Owner: Israel Railways
General contractor: Electra Ltd.
Architect: Barchana Architects & Town Planners
Project consultant engineer: ESL - Eng. S. Lustig Consulting Engineers Ltd.
Services provider, equipment manufacturer and component supplier: Otis (through Electra Elevators, Otis' exclusive representative in Israel)

Central-Mid-Levels Escalator and Walkway Systems

Hong Kong

Bringing new technology to the longest outdoor covered escalator system in the world

submitted by Andy Cheung,
Anlev Elex Elevator Ltd.

The Central-Mid-Levels Escalator and Walkway System in Hong Kong, which was inaugurated in 1993, is a tourist attraction and commuter service and the world's longest outdoor covered escalator and walkway system. It consists of a series of 18 escalators and three inclined moving walks connected by footbridges. Situated in the heart of the city, it spans nine streets from Des Voeux Road to Conduit Road, covering more than 800 m and elevating 135 m through the street hillside.

Some 25 years of relentless service to the community had taken its toll, leading to a need for modernization. Anlev Elex Elevator Ltd., a subsidiary of ATAL Engineering Group, was appointed by the Government of the Hong Kong Special Administrative Region Transport Department and Electrical and Mechanical Services Department (EMSD) to carry out this work in March 2018. Its 12 phases are to be complete in August 2022.

The project involves a unique community of diverse stakeholders: local and expatriate residents, tourists, businesses, young children and elderly. For a transportation system serving more than 78,000 people daily, shutting down escalators for the duration of the project is out of the question. After detailed study and meticulous planning and public consultation, the project commenced to modernize the escalators with the latest energy-efficient features, such as efficient motors, variable-speed drives, LED lights for better illumination and service-on-demand functions. It is expected that the colorful LED lights installed along the units' skirt panels will create interesting photo opportunities for tourists.

Conducting hoisting in busy, narrow streets within a very short time means that meticulous planning is required in advance. Hoisting was only allowed on Mondays to Fridays at 10-11 a.m. and 2-3 p.m. to minimize road traffic disruption.

Community engagement was important to the contractor. Here are some entries to an art competition it held to showcase users' beloved escalator and walkway system.

Engaging the Community

Community engagement is a vital aspect of this extraordinary project. Anlev updates users and the neighboring community every step of the way and alerts them well in advance of the need to make detours. A 24-h customer service hotline handles inquiries.

Tough Conditions

Part of the system straddles busy roads, while an extremely narrow worksite made it difficult to deploy truck-mounted cranes without disrupting traffic and pedestrians. Each task had to be planned with meticulous precision and the utmost consideration for the many stakeholders. Technical challenges included:

1) The very narrow worksite and physical constraints posed by the existing system, such as the escalator canopies: as the client requires the canopies be untouched, the usual method of lowering the escalator by crane into the shaft from above and installing it as one piece would not work. Our solution was to cut each escalator into pieces (none longer than 3.6 m) and insert them from the two ends of the covered space, then reconnect the pieces during installation. This complicated the installation process and necessitated additional logistical arrangements.
2) Likewise, each old escalator must be cut into four to six pieces before it can be moved to the ground. This involved further detailed planning.
3) Part of the system straddles busy roads, while an exceedingly narrow worksite makes it difficult to deploy truck-mounted cranes without disrupting traffic and pedestrians going about their daily business.
4) The lack of data about the system, particularly during the initial design stage, made the team rely on daytime visual observations and physical surveys at midnight to obtain data for this stage.

The project team took just four-and-a-half (instead of the usual six) months to replace the escalators featured here. This included preparation, installation, testing and commission, inspection and trials of each unit.

Use of Technology

TS as a Measuring Tool

As this was a modernization project, the existing infrastructure of the system could not be dismantled or modified. Also, the system has high daytime usage, so data about the system was hard to obtain. Instead of using the traditional measuring methods that require workers to do it manually, our team used total station (TS), a tool commonly used in civil engineering, to measure the escalator's shaft dimensions for the initial design. For the workers, this method was also a safer approach to the required measurement operations. We hope this application sets a precedent for other industry players.

Tailor-Made Escalator Footsteps

In light of the extremely limited working space, special escalator footsteps are designed to act like bridges on the "work-in-progress" escalators. These footsteps are customized to be "one size fits all" so they can be recycled for use in future stages of the project.

After detailed study and meticulous planning and public consultation, the project commenced to modernize the escalators with the latest energy-efficient features, such as efficient motors, variable-speed drives, LEDs for better illumination and service-on-demand functions.

Accurate data about the escalator was obtained through TS, a tool not normally used in our industry.

Footsteps were customized and used for worker safety and will be reused at other sites.

Equipment Specifications

Rated speed: 0.65 m/s
Step/pallet width: 1 m
Inclination: 30° or 17.5° for escalators; 12° and 8° for moving walks

Smart Locks Backed by Mobile Apps

A smart-lock device that comes with a mobile app is used to monitor the temporary distribution board. As the device allows only licensed technicians to access the distribution board, it helps safeguard workers. Its conveniences include Bluetooth operation and cloud data storage.

Quality Control

Anlev designed and manufactured the equipment for this system at our own factory in Nan3jing, China. We received the highest rating in safety and quality performance for seven consecutive years in the Performance Rating Scheme from EMSD (since the scheme began in 2013). In 2018, Anlev won the Hong Kong Management Association Quality Awards' Excellence Award.

Sustainability

In addition to training on environmental friendliness and the installation of green vertical transportation, the following measures were implemented:

- Air: Anlev has assessed the types of air pollution that might be generated from the work and implemented corresponding measures to mitigate the impact to the public.
- Noise: Soundproof insulation was set up along the site to minimize noise pollution, and all noisy work was conducted between 10 a.m. and 5 p.m. on weekdays.
- Waste management: A trip-ticket system was adopted to ensure proper disposal of construction waste from the worksite.

Safe So Far

As of the time of this submission (when 12 of the 21 units over seven phases had been completed), there was no reportable accident relating to this project since our work commenced in 2018.

Credits

Building owner: Hong Kong Special Administrative Region (HKSAR) government
Designer: Anlev Elex Elevator Ltd.
Planners: Anlev, HKSAR Transport Department and Electrical and Mechanical Services Department
Transportation-systems contractor: Anlev Elex Elevator Ltd.
Component supplier: Nanjing Anlev Elevator Ltd.
Equipment manufacturer: Nanjing Anlev Elevator Ltd.

MOVING WALKS

Mechanical Ramp of Gran Via Vigo

Vigo, Spain

*submitted by Helena Calado,
thyssenkrupp Elevadores S.L.U.*

Top-of-the-line moving walks installed in often-wet urban conditions.

The project "Accessibility Vigo — Rampas Mecanicas Gran Via de Vigo" is a cog within a machine that is "Vertical Vigo," an ambitious project that aims to improve pedestrian mobility between the lower part of the city and the O Castro Mountain, turning Vigo into a reference in accessibility, and economic and environmental growth. The installation of six moving walks in Gran Via de Vigo, a street emblematic of the city, brought us a little closer to this achievement. With a capacity to transport 6,000-7,300 people/h, it moves passengers under a colorful roof that evokes the area's characteristic rainbow tones.

Rainfall is prevalent in the city. For the moving walks, stainless-steel exterior coating, drainage solutions and weather-resistant paint were some of the applications to help ensure high quality and durability. To satisfy the demand of the city's inhabitants, they have an inclination angle of 4.98-5.16º, a length of 9.6-48 m and a pallet width of 1.2 m. In addition, to improve their availability, these units incorporate an INSIGHT remote control and monitoring system with which both the client and company may monitor the moving walks' condition and provide a quick and efficient response to any equipment incident.

Safety

The units are compliant with EN 115-1, which includes protection:

- Against elongation or breakage of step chains
- Against the reversal of the direction of travel
- Between steps and combs
- Against breakage or deformation of steps and their rollers
- Entrapment at the handrail entrance
- Against an open pit

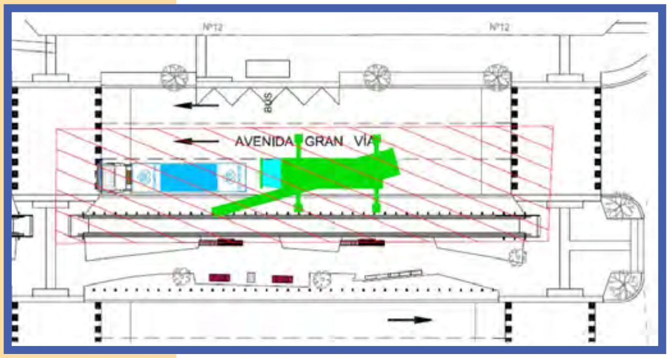
There are also rollers to eliminate static electricity, handrail synchronization and monitoring, sensors for lack of a step(s)/pallet(s), floor cover locking and brake system monitoring via safety blocking/unblocking.

Technology

The units are equipped with frequency converters, which allows a unit to operate at a speed of 0.2 m/s when it does not have passengers. This saves energy, as do the white LEDs used

Passenger safety and comfort were prioritized to provide the streets of Vigo with light and accessibility in equal parts.

The moving walks zip pedestrians under vivid-colored porticos.



The units were transported in sections of up to 16.5 m on trailers that delivered the equipment parallel to the pits.

Equipment Specifications

Model: ORINOCO XTRA 6EK HOR 4,98
Quantity: Six units
Arrangement/supply: Simple arrangement in one/two/three pieces, according to length
Length: 39.28/21.88/48/13.98/29.750/9.6 m
Angle of inclination: 4.98º/4.98º/5.07º/5.16º/5.1º/5.06º, which adapt to the inclination of the street
Pallet width: 1.2 m
Speed: 0.2 and 0.65 m/s
Capacity: 6,000-7,300 persons/h
Balustrade/handrail type: Glass and lacquered aluminum/thermoplastic in black with 316 stainless-steel base
Exterior covering: Two sides in 316 stainless steel
Power: 12 kW, three-phase, 380 V at 50 Hz (motor); single-phase, 220 V (lighting)
Pit dimensions: 1.8 m wide, 5 m (upper) and 3.5 m (lower) long 1.7 m (upper) and 1.35 m (lower) deep
Applicable standard: EN 115-1:2008+A1:2010
Reversible capability: At will
Climate class: Class III, exterior

as under-balustrade illumination. thyssenkrupp Elevator's predictive-maintenance system, MAX, will also be implemented, and diagnostic display indicates the reason for a stop. A series of pairs of transmitter-receiver photocells on each side of the tread/pallet band form a photoelectric barrier that detects the presence of people along the staircase. This system is mainly used for remote operation, allowing stopping and starting without the need to verify the presence of people *in situ*.

Extra features to cope with the outdoor conditions include:

- A drain placed in the lower head
- An oil separator in both heads
- An epoxy-type paint for the structure
- IP65 motor protection
- Stainless-steel exterior screws and handrail guide
- Pallets with waterproof bearings
- Electrical conductions and microswitches with IP54 protection
- Automatic lubrication
- Chain protection

Two-color traffic lights on both heads of the skirting board are used to indicate the direction of the unit's movement, and microswitches stop the escalator as soon as an object enters the space between the steps and socket. Other technology includes:

- Covers for access to the intermediate support (where applicable)
- Anti-static rollers
- Thermostat control during operation
- One stop key and one local/remote key
- 2RS rollers
- Tramex moisture meters in upper pit
- Plastic protection for the stop
- Reinforced handrail drives with openwork rollers (instead of Poly V® belt drives)
- Automatic restart after voltage drop

Installation

An elaborate installation plan was made involving meticulous coordination with our client. The client's objective was to confront the challenges of work in the middle of the city center, where road traffic, passersby and structure accesses were disturbed as little as possible. Once it was determined that the work would be performed during the daytime, the sections of the truss were lowered using a 60-80-mT crane. This crane was also used to assemble and connect the sections in the pit. The whole of this operation was carried out on the same day for each corridor. It was necessary to move the crane, depending on the sections to be assembled.

Despite the challenges of working amid the pandemic, we completed the installation quicker than planned, in September 2020.

INCLINED ELEVATORS

Parque Turistico Observatorio 1873

Mazatlán, Mexico

Minnesota-based Hill Hiker leads a team that thinks outside the box to design a robust, custom unit for a challenging environment.

submitted by Bill MacLachlan, Hill Hiker, Inc.

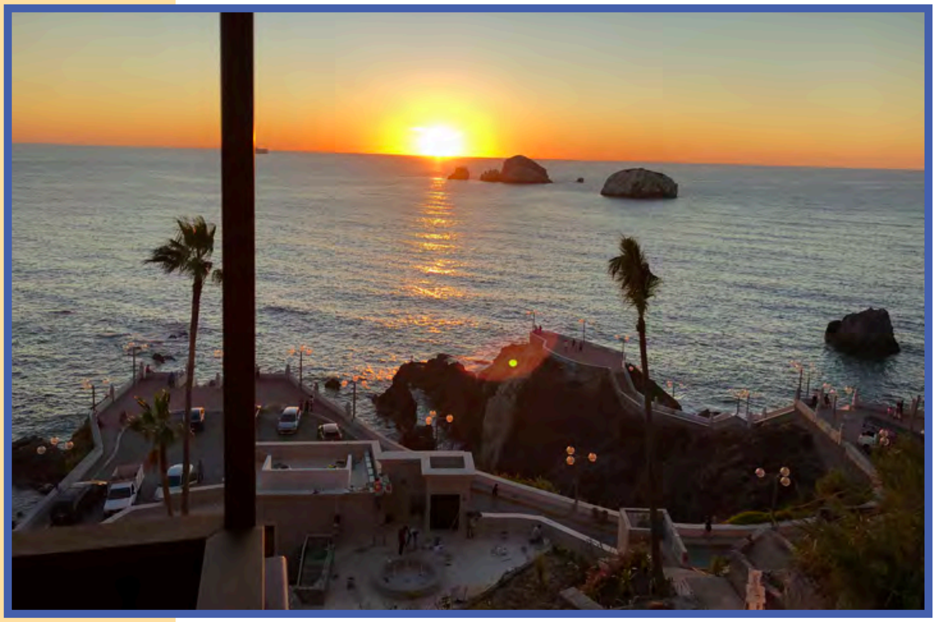
Amado Guzman, an entrepreneur and businessman in Mazatlán, Mexico, had a vision to restore the city's historic and once-beautiful observatory. The people of Mazatlán originally built it as a military outpost atop Cerro del Vigia to protect people from invasions of enemy ships and pirates. In 1873, the need and strategic advantage of the outpost waned, so the local government agreed to transition the building from military to scientific use. The outpost became the second meteorological and seismological observatory in the country.

Guzman believes everyone should experience the history of the building and the unique views it offers. Perched on the highest bluff in the city, 289 ft above sea level, the observatory was difficult to access, although the nearly perfect vista was worth any difficulty. When Guzman contacted Hill Hiker, Inc. to take on the task, the Minnesota-based company was ready, as it had been installing inclined elevators in challenging locations throughout the U.S. and world since it was founded in 1997.

Before any work could start, Hill Hiker owner and President Bill MacLachlan flew from Minneapolis to Mazatlán to explore the feasibility of an inclined elevator. Machete in hand, MacLachlan and the local team trudged through decades of overgrowth to chart a path for the elevator. Hill Hiker then connected the local team with its engineers at VAA, LLC. Through six

The car was outfitted and painted to resemble a miniature San Francisco cable car.

The views from the top of Cerro del Vigia are breathtaking.



Sunset over the water

months of engineering, manufacturing, hill preparation and even some trepidation, Hill Hiker was ready to install the inclined elevator.

Mazatlán's Cerro del Vigia site proved to be quite challenging because of the uneven surfaces that did not allow for a straight line of travel up and down the hill. Hill Hiker and the engineers agreed on the use of I-beams to create a consistent grade. Normally, I-beam installation would be done by crane; however, Mazatlán had no crane that could reach the length of the hill, which posed many challenges. The first was its steep and inconsistent grade. The total length was 260 ft. The angle of the track was 30˚, but, in the middle section, it was more than 20 ft off the ground.

A crane was used for sections near the top and bottom of the hill, but installers had to get creative with the middle sections. Using only tools such as ropes, chain falls and pullies, the I-beam installers were able to place the metal beams by hand.

With a consistent grade of 30˚set, Hill Hiker, the local team and the group of engineers created a unique, commercial, inclined elevator to overcome the complexities of providing safe and reliable public transportation on a hill exposed to harsh salt air and humidity akin to the Amazon rainforest river basin. Hill Hiker had to deal with added concerns about erosion of electrical equipment, track wear and safeties.

Hill Hiker worked with its electronics supplier, ISC, to develop and install the most powerful and robust wireless system it had ever placed on an elevator to provide reliable and consistent communication over the full travel length of 260 ft. The elevator's wireless car station is protected in a NEMA 4X (IP66) enclosure. The rationale for wireless was to avoid the need for a traveling cable that would be prone to malfunction in an exposed environment. This made it

Additional System Features

Gearbox ratio and type: 150:1, worm/worm double reduction
Brake: AC Electro Magnetic
No. of ropes: Two
Rated breaking strength: 14,400 lb per rope
Rope material and diameter: Galvanized aircraft cable, 7 X 19-3/8-in.
Machinery workspace type: Fully enclosed room; disconnect in sight of motor and within reach of panel
Outside width of car: 70-7/8 in.
Outside length of car: 99-1/8 in.
Platform material: Marine-grade, Americans With Disabilities Act-compliant, nonslip fiber-grate flooring
Motor: UL-certified variable-frequency drive AC motor with soft start and soft slowdown
Call stations: Onboard and at each landing station with security
Emergency-stop buttons: Top, bottom and onboard
Track system: Captured rail design
Overspeed governor and spring buffer location: On car
Security: Keyed or keyless code
Limit switches: Deceleration, directional and terminal switches at top and bottom of hill
Electrical safety features: Disconnect with lockout/tagout, low-voltage switches and controls

The elevator traverses the steep hill.

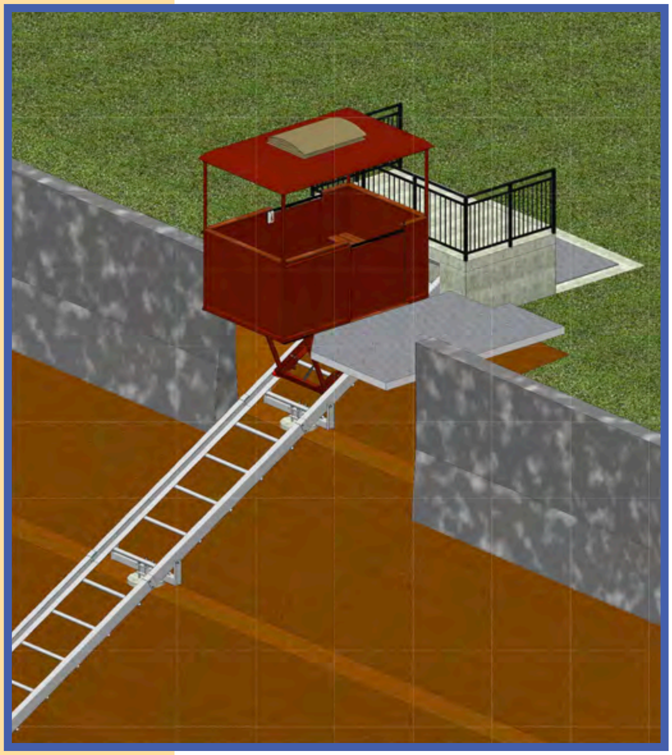
What can only be described as a concrete bunker was built to house the machine room.

the most durable inclined elevator Hill Hiker has installed. All other electronics are hardwired with SOOW cord and housings rated to IP67.

Concerned about the height of the track, the harsh environment and the safety of the public, Hill Hiker decided not to pursue a counterbalance or continuous-loop system. Instead, all involved opted for the proven reliability of a double-cable winding-drum machine to avoid unnecessary in-running nip-points and lessen part failure rate. The driving machine needed to be properly protected from the environment, as well as from the public. The local team chiseled a motor room out of the hill's bedrock at the top of the hill and poured what can only be described as a concrete bunker. The motor room provides solid support for the driving machine, while also protecting the 15-hp motor and control panel from the environment and vandalism.

With the ever-present salt air assailing the elevator, Hill Hiker chose to manufacture the elevator using durable 316 stainless steel. The material put all concerns of rust to rest. Hill Hiker's welders were able to shear and bend flat sheets of stainless steel to form the company's signature C-channel railing. Using the C-channel, they created a jig to fabricate 4-ft-X-10-ft track sections able to properly support the elevator car and secure its chassis within the track.

A team member observes the unit in operation.



Architectural drawing of the inclined elevator

The security of the chassis is tantamount to the security of the elevator's passengers, as well as the elevator itself, since Mazatlán is located in a seismic zone that frequently produces earthquakes. The nature of the tremulous movements is commonly mild, but some border on the extreme. Considering the supports for the I-beam and strength of the track's design, Hill Hiker, the local team and the engineers are confident the elevator can handle most natural phenomenons.

The Hill Hiker elevator car offers 40 ft^2 of interior usable floor space and an additional fixed bench seat. The car alone weighs 1,200 lb. and has a capacity of 3,000 lb. Hill Hiker, Inc. had to design a chassis and safety system that would be able to safely halt the load, while ensuring that the safeties would continue to function in the sea spray. The manufacturing team installed oversized style-A safeties with corrosion-resistant bearings connected by stainless-steel, machined 2-in. shafts. When set, the safeties make contact on the guiding members of the elevator: the more downward force, the stronger the hold. The safety system is so robust that it well exceeds the required factors of safety.

The local team did not want the elevator to simply be a functional people mover; they wanted it to be an attractive and inviting centerpiece of the hill's unique landscape. Hill Hiker's manufacturing team produced an elevator that resembles a miniature San Francisco cable car. The elevator's roof provides shade for the passengers, as well as in-car communication in the form of a bell passengers enjoy ringing when approaching a landing. The 42-ft-high car walls were hand-painted locally to fit the cultural atmosphere.

Guzman has truly created a centerpiece of cultural significance to the city. The observatory is visited by many of the thousands of cruise ship tourists who frequent Mazatlán every year and is a favorite among the locals. From a dilapidated military outpost to a thriving event center, museum, boutique hotel and eatery, the site is a testament to Guzman's complete realization of his vision. "The community was so amazed about this new facility and access to the observatory," Project Consultant Daniel Diaz observed. "A lot of people have now gone up there, and the sensational way to get to the top is spectacular!"

Credits

Project owner: Amado Guzman
Manufacturer, contractor and designer: Hill Hiker, Inc.
Design/engineering: VAA Engineering, Planning and Design Services
Electronics supplier: ISC Cos.
Project consultant/manager: Daniel Diaz Gamez & Construction

PRIVATE-RESIDENCE ELEVATORS

Stainless-Steel Glass Elevator

Florida Keys, Florida

Teamwork and creativity overcome myriad challenges to deliver an aesthetically pleasing, robust system.

submitted by John Virk, UT Elevator

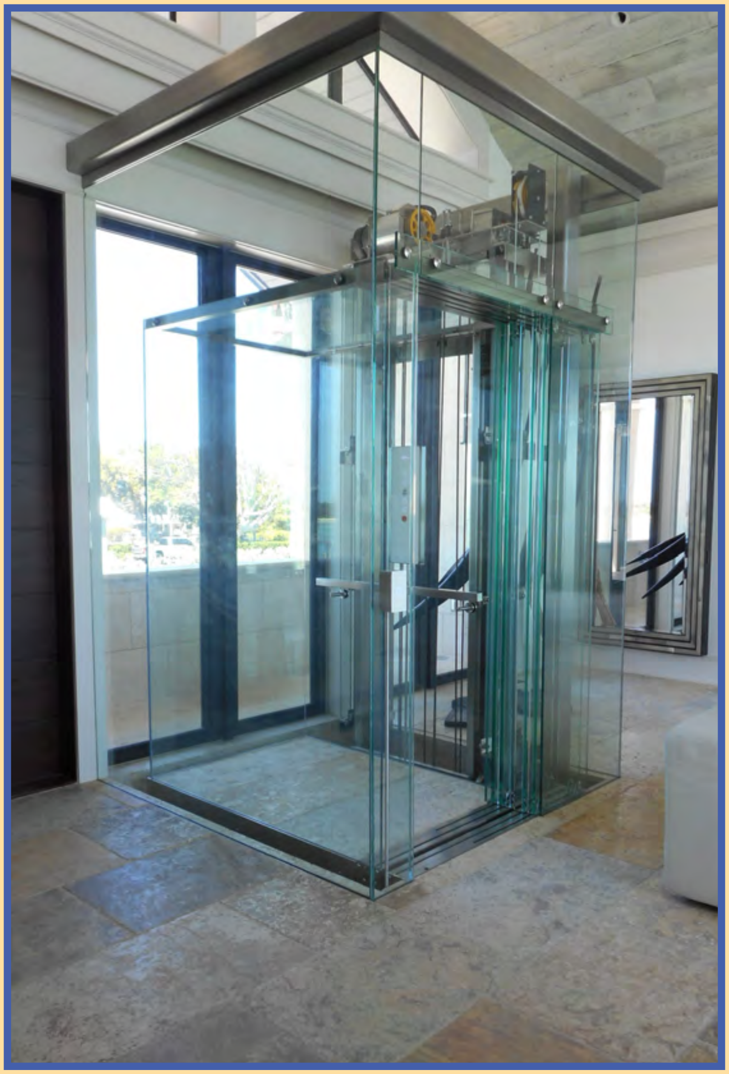
When contacted by an Arkansas-based architect designing a Florida Keys home, UT Elevator (UTE) felt the main challenge would be logistical, since the project was more than 1,600 mi.from company headquarters in Toronto. It rapidly morphed into a project much more complex – one that would test the full capabilities of UTE. As it turned out, the architect had come across an earlier Project of the Year article in ELEVATOR WORLD about UTE ("Mitered Glass Elevator," EW, January 2016). "This is exactly what they're looking for" is the phrase we remember. At the time, we did not know all the challenges the project had in store.

Upon initial building inspection and dialogue with the architect, it became clear that not just a custom glass elevator would suffice. It needed to be one that would withstand the extremely harsh, humid salt air and hurricanes of the region. Shortly after the project commenced in 2017, Hurricane Irma made landfall, with direct impact on the project site.

The house was built like a fortress, with more than 50 2-ft-tall piles driven into the bedrock below and concrete beams spanning the entire main floor. It quickly became evident that the elevator portion of the project would require our firm's dedication to design a glass elevator and hoistway enclosure to meet not only aesthetics and ride quality, but also a new level of strength and durability.

To accomplish this, the project needed to be executed via five subprojects defined by our engineering and design teams:

1) Cabin glass and glass fixtures: Cabin panels were safety rated with mitered corners for optimal views and assembled with custom hardware and a variety of glazing and adhesives. The car station was flush-mounted glass with capacitive touch buttons and an integrated hands-free phone.
2) Structural assembly in 316 marine grade stainless steel and custom coated guide rails: Brushed, Blend "S" stainless-steel finish for the car and counterweight frames, rail brackets, machine bed plate and pit plate,



The glass-and-steel elevator serves as a centerpiece to the home's "great room."

and guide rails dipped and galvanized, then zinc- and powder-coated to match the stainless steel.
3) Hoistway glass and stainless-steel structure: A two-level, all-glass hoistway integrated with the stainless-steel elevator support structure, along with an intricate array of embedded glass channels
4) Underdriven glass doors: All metal components in 316 stainless steel, track assembly secured to hoistway glass with landing mechanisms mounted to custom-designed structural brackets attached to the building steel
5) Variable-voltage, variable-frequency (VVVF) drive system and electrical routing, custom-built permanent-magnet drive machine with internal components coated in Armology TDC® and electrical power and signals routed via conduits embedded within the cabin and hoistway to keep them clear from view and protected from exposure

General weather protection involved modular, lower-level hoistway glass and a door designed to break away in the event of severe flooding. It also included an electrical subsystem in liquid-tight conduits with routing above base flood elevation; all electrical components are National Electrical Manufacturers Association rated 4.

Execution of each subproject relied heavily on cooperation between the developer and architect, and included a foray into video communication, computer-automated-design (CAD) and file exchanges over the cloud.


Care was taken to ensure waterfront views were unobstructed.

Cabin Glass

UTE specified the cabin to include four vertical panels and a single-pane glass ceiling. The vertical panels are approximately 7 ft tall with 45˚ mitered corner edges with cutouts to suit a flush-mounted, capacitive-touch glass car station, along with holes at the top of each panel to secure them to a welded frame above. Each panel is 13.5 mm, composed of two tempered 6-mm lights laminated together with a cured resin interlayer. Significant care was taken by our Concord, Canada-based supplier, Accura Glass Bending Inc., to ensure the panels remained flat during the tempering process and that the holes and cutouts were accurately aligned during laminating. This was to ensure minimal light distortion so that, when the panels were assembled, the 45˚ miters would be perfectly aligned. To achieve the miters, the panel edges were precision ground and polished to the final overall dimension.

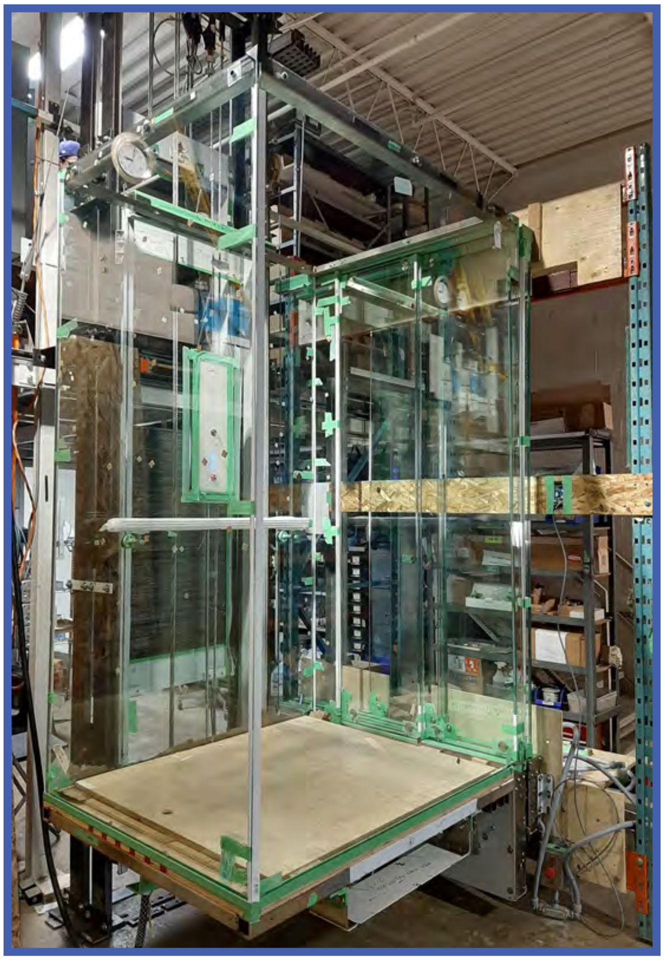
Water-clear silicone was used to bond the panels to allow for vibration dampening and structural adhesion, while the panel assemblies were secured into embedded glass channels built into the cabin floor below and bolted onto the welded frame assembly at the top using a set of bespoke 8-mm glass standoffs with low profiles.

Glass Fixtures

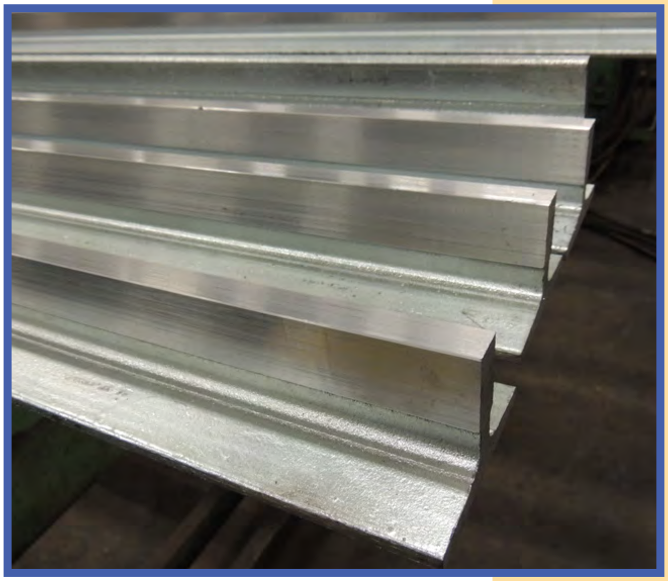
Capacitive-touch glass fixtures were embedded into the control side glass panel for a uniform, flush appearance. The design posed numerous challenges and involved detailed communication and coordination with Italy-based fixture supplier Vega srl to fit all components into the allocated space. Custom latches were developed to secure the faceplate to the back box so the plate could be removed with a suction tool. All button contacts and our LED backlit logo needed to be compact in design. This process even involved visits to UTE in Toronto from Vega ownership and management.

Another key design challenge involved concealing the assembly and routing signals. Since the hoistway surrounding the system was full glass, the fixture assembly would be fully visible from all angles, and we were required to keep


The team lays PVC pipe for elevator power cables during a site visit.



System preassembly



Weather-resistant, galvanized rail

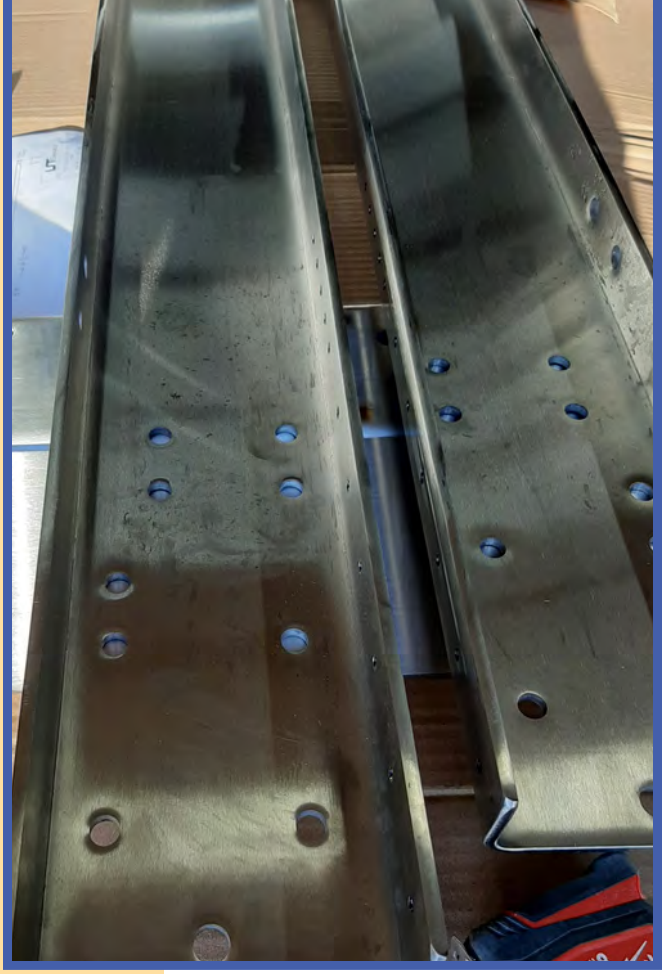
Capacitive-touch glass fixtures were embedded into the control side glass panel for a uniform, flush appearance.

uniform material and lines intact. The solution included a set of finished stainless-steel plates bonded to the rear of the control panel glass to which the fixture control box was mounted. A custom-welded and polished stainless-steel rear cover with welded studs then cladded the control box and fit precisely to the dimensions of the front bond plates. The signal cable was then routed below the platform via a finely polished stainless tube.

UTE's Greatest Production Challenge to Date

Moving from typical carbon to 316 marine-grade stainless-steel manufacturing presented a significant challenge to our team, resulting in a multistep process involving a variety of suppliers and a significant level of coordination and quality control. This included three separate fabricators (UTE included), two local polishers and onsite manual finishing in coordination with the general contractor.

The inherent challenge of fabricating stainless steel to a high-level finish additionally required the production team to move to a fully formed and fabricated methodology for the structural members in place of our standard structural c-channel and angle iron fabrication. This allowed for all parts to begin with flat plate steel laser cut according to CAD-modeled patterns and categorized by material thicknesses, which would, in turn, allow for the crucial and integral first bulk-polishing step. Each flat component was acid passivated



Formed frame stiles

prior to punching and fabrication, then followed a logistical and complex manufacturing process whereby parts were grouped via final geometries and their required production routing.

The only subassembly not glass or stainless steel were the guide rails, although the production process was equally challenging. To meet the project's environmental-protection requirements, each guide rail underwent a multistep coating process starting with hot-dipped galvanizing, then zinc primer coating, and application of two layers of finish powder coating.

Hoistway Glass and Stainless-Steel Support Structure

The team envisioned a glass centerpiece on the main floor's "great room," which, when the elevator was present, would still provide a full and clear view of the ocean through the south curtain wall. Included in the centerpiece would be an artistically designed stainless-steel support structure that would both provide structural stability and complement the overall project. UTE developed the hoistway glass and steel support structure concept, then worked closely with the architect and general contractor to realize it.

The hoistway glass was manufactured with the upper level panels approximately 10 ft high X 6 ft wide for two of the hoistway walls and modular 10-ft-tall sections on the landing side to which the landing door system would connect. On the lower level is also a segmented glass façade entry system integrated with the lower-level glass landing door. There was a distinct challenge in handling and transporting the hoistway glass, as crates were custom made for both sets of glass, with the hoistway crate weighing approximately 1,500 lb. A particular challenge was having the glass manufactured in Toronto to very tight tolerances while providing enough flexibility to adapt to field conditions.

Detailed layout drawings and 3D models were created in-house to simulate site conditions. This allowed for nearly the full assembly to be digitally created and installed. The mock digital installation was imperative to the project's success.

The intricate, stainless-steel, welded support structure began with a 1.5-in. solid pit plate pre-drilled and tapped to accept the elevator chassis structure. It then traveled up via 5-in. structural tubes 25 ft tall with angle brackets pre-welded to accept the rail brackets and chassis assembly. The crown of the structure was fondly referred to as "the halo." It was designed to be multifunctional to secure the support structure to the building's reinforced roof beam, and contain the glass channels to accept and position the large, upper-level hoistway glass.

Additionally, the lower level consisted of a steel-and-glass "break-away" vestibule, designed and built by UTE, extending past the glass hoistway façade. The break-away concept was specified by local building code in the event of severe flooding for a structure to "break away" so as not to transfer high loads to the building structure if items are not integral to it. The lower level landing door system was designed into the hoistway glass façade in a modular fashion as it, too, needed to be part of the breakaway system, should flood loading eliminate the door panels.

UDD Operator

Among the first companies in North America to implement the under-driven-door (UDD) operator for a glass elevator, we were confident in our adaptation of Fermator's UDD solution for this project. We were required to be hands-on with the development of this system so the door components could be finished with 316 stainless steel and ensure proper modifications were in place to integrate with the glass hoistway. Constant coordination with the Spanish door supplier was challenging – yet rewarding – as its staff members were accommodating and thorough.

The car door features two laminated, safety-rated glass panels that are 17-mm thick, governed by the underdriven permanent magnet and VVVF integrated drive. The car door interacts with two glass landing door assemblies, each of which is attached to the building structure via custom-designed landing mechanism brackets built to support and adjust the full load and traffic load from below.

The complexity of the UDD door system required complete assembly and testing at our Toronto facility with electrical connections, parameter adjustments and door-panel adjustments made locally to allow for minimum onsite calibration. Assembly, disassembly, shipping and reassembly onsite created myriad challenges to ensure all adjustments remained intact upon arrival.

Integration of the car door operator with the cabin platform involved a significant degree of design modeling and local setup and testing. The overall chassis was offset toward the landing to balance the loading resulting from the heavy car door operator. Our design team developed an integrated welded stainless steel channel system to allow for modular assembly and positioning onsite.

Drive System and Electrical Subsystem

At the center of the drive system is a custom-built permanent magnet AC synchronous motor supplied by HIWIN Corp. Torque and speed settings were predetermined and internal components were coated with Armoloy® to guard against oxidation. A 2:1 roping system was used for loading efficiency to allow for the machine size to remain in line with the project's view requirements. A variable frequency drive from KEB America supplies controlled voltage to the motor, as well as receives closed-loop feedback encoder signals. This system enables ride quality that matches the aesthetics.

One of the first tasks undertaken upon starting the project was determining the path for all signal cables to reach the required elevator components and lead back to the remote elevator controller. An intricate 3D conduit network was created digitally, then communicated to the general and electrical contractors via layout drawings. The general and electrical contractors then implemented the network during the initial construction phase. Multiple routes, which involved embedding PVC conduits into the main floor concrete and having them reach the landing door mechanisms and hoist machine via the structural support column, were required. This allowed for virtually no cables (other than the traveling cable) to be visible from the all-glass hoistway, a feat that required significant creativity. An added layer to the overall routing challenge was achieving the same level of cable and component concealment for the car's electrical subsystem.

A True Team Effort

The project's success relied heavily on close coordination among all members of the team, including the elevator manufacturer/installer, the general contractor and its subcontractors and the project architect. Production and engineering commenced with installation of the finished project at the forefront of the design. The UTE design team ensured all hardware was preassembled onto components (where possible) to ease installation.

As construction progressed, there would be repeated video call check-ins with field staff to relay adjustments or minor alterations that could potentially affect the elevator system. There were also three pre-planned field visits by UTE staff at predesignated project checkpoints. These visits allowed local production "go-aheads,' also imperative to overall execution. The key solution to the challenge of supplying such a complex, integrated system was preassembly of nearly the complete system at UTE's Toronto facility.

Logistics, Suppliers and Shipping

Arguably, the unspoken heroes of such complex projects are members of the logistics and shipping team who ensure all parts are ready, stored, protected and delivered to the site in a safe and efficient manner. With such a complicated array of participants, the logistics challenge not only stressed the company's current methods, but allowed for a complete and effective overhaul to create a digital project-monitoring system.

As anticipated, the largest challenge we faced was having the glass cabin and hoistway panels produced in Toronto, the glass door system in Spain and having them reach the site and relative floor locations of the project in a timely and safe manner. To help achieve this, the UTE logistics team ensured that all glass materials were grouped into custom crates that would allow for proper handling and tracking.

A designated 52-ft tractor-trailer hauled all components to the site, where the general contractor and UTE's field team received and unloaded the goods. Once again, the teamwork between UTE staff and the customer team ensured safe handling, removal and storage of all system components and set the tone for what would become the flagship project of our company. It was completed in March 2020.

Specifications

System type: Gearless traction machine-room-less stainless-steel/glass elevator
Drive: 2-hp permanent-magnet AC synchronous motor with closed-loop variable-voltage, variable-frequency drive control
Door operator: Undercar-mounted, under-driven-door glass
Travel, speed and capacity: 12 ft, 40 ft/min, 750 lb
Composition: 316 stainless-steel, safety-rated tempered laminate glass
Hoistway: Full glass panoramic, integrated stainless-steel support structure

Credits

Developer: Lee Jackson Construction Inc.
Architect: Terry Parker & Associates Architects
Manufacturer and installer: UT Elevator Inc.
Suppliers: Accura Glass Bending Inc.; ACLA USA Inc.; D&R custom Steel Fabrication; Draka-Prysmian; Fermator S.A.; HIWIN Corp.; KEB America, Inc.; Stella H; Vega SRL; and Vaughan Metal Polishing Ltd.

SPECIAL-PURPOSE LIFTS

Pasărea Măiastră Passenger Platform Lift

Craiova, Romania

Unique hydraulic device allows a passenger to experience an immersion into renowned sculptor's world.

submitted by Marius Paraipan, ELMAS SRL

The architectural spirit of the Constantin Brâncuși International Art Center is built on the work of its namesake, the great Romanian sculptor Constantin Brâncuși. Brâncuși (1876-1957) made major contributions to the renewal of the Romanian language and artistic vision through his work. More than a central figure in the modern artistic movement, Brâncuși is considered one of the greatest sculptors of the 20th century. It is with this spirit and vision that the Art Center commissioned the "Pasărea Măiastră" (Bird in the Air) passenger platform lift. Within the boundaries of the Art Center in Craiova, an underground wing was built and dedicated to Brâncuși, who, though born in the village of Hobița, received his professional training in Craiova as a teenager. The underground wing is topped by a gazebo of glass, a work part architecture, part "optical-art" sculpture that aims to create an optical illusion between several forms often found in Brâncuși's work: square cube-prisms, ovoid form and fusiform volume. At the same time, there is a reference to a project Brâncuși did not carry out: the Temple of Indore. The "Glass Gazebo" inside the Art Center arose from the legend of his uncompleted project, being

A 3D model of the Brâncuși International Art Center

The hydraulic platform (outside view)

The panoramic cabin

Drive system onsite (assembling location)

Communication system (intercom type)

Drive system pre-assembling phase

Fully glass cabin (view from above)

The landing operating panel is activated by card.

Cabin control panel/handrail

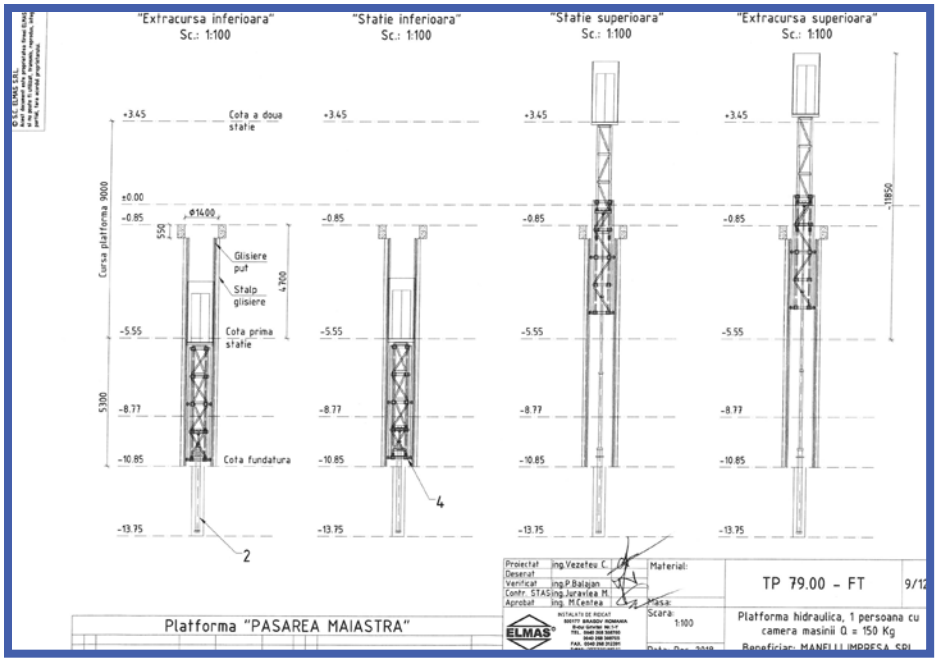
realized of integral glass walls 12 m high and 3 m wide, constituting a prismatic square volume on the outside, while, on the inside, horizontal glass lamellae and an ovoid "being" suggested inside: a silhouette of the "Bird in the Air."

From the underground hall, a platform with a full glass cabin lifts a single person in the middle of the "Măiastră" flooded by outside light. The passenger has the opportunity to experience, in the few tens of seconds the "ascent" lasts, an immersion into Brâncuși's world and what the artist would have wanted to transmit through his work: elevation, peace and light of spirit.

For this unique project, ELMAS SRL delivered and installed a product that fits the proposed architecture and offers a visual, meditative and physical experience through the journey inside the glass prism. After analyzing the project's architecture, ELMAS specialists designed Pasărea Măiastră to be a unique product that complies with all technical, safety and aesthetic rules. The hydraulic platform is intended for vertical

Credits

Elevator designer/manufacturer/installer: ELMAS SRL
Developer: Manelli Impresa SRL, Bucharest Branch
Architect: DS Birou de Arhitectura SRL (Dorin Stefan)
Platform component suppliers: Bucher Hydraulics GmbH; Nyír-lift Kft.; Marazzi; ETN Elastomer-Technik Nürnberg GmbH



Overall drawing

transportation, so it was made in accordance with the Machinery Directive 2006/42/EC with a lifespan of 25 years.

Drive System

The passenger platform runs a 9-m travel height at a nominal speed of 0.15 m/s with a capacity of 150 kg (one person). For the drive system, the ELMAS team designed a technical solution consisting of a centrally positioned hydraulic piston and telescopic metal structure consisting of two segments. All these elements are mounted inside the platform shaft. The platform shaft consists of two sectors: one made of reinforced concrete, and the other formed from the inside of the glass ovoid. At the moment of activation, the hydraulic piston actuates the inner segment of the rectangular metal structure. After the expansion of the inner segment, the platform travel continues by taking over the outer metal segment until the final station is reached. The outer metal segment is guided on four fixed guide rails mounted in the shaft, and the inner segment is guided on another four rails mounted inside the outer metal segment. Upon reaching the maximum stroke point, the platform cabin is completely inside the glass ovoid, creating a unique sensory and architectural effect. The hydraulic unit, supplied by Bucher Hydraulics GmbH, is equipped with protection against overpressure, low pressure and overload, and has an integrated leveling system.

Cabin

The hydraulic platform for the passenger consists of a semiround cabin with the dimensions 960 X 1,125 X 3,100 mm. It is made entirely of glass, offering a 360° panoramic view and an attractive architectural appearance. The manual, center-opening doors are made of glass and offer a sensation of greater space with high visibility. Also, the cabin module has a semicircular handrail of stainless steel, a control panel equipped with an alarm button for communication with the service call center, an emergency stop button that brings the cabin to the main station and a wireless video camera.

Control

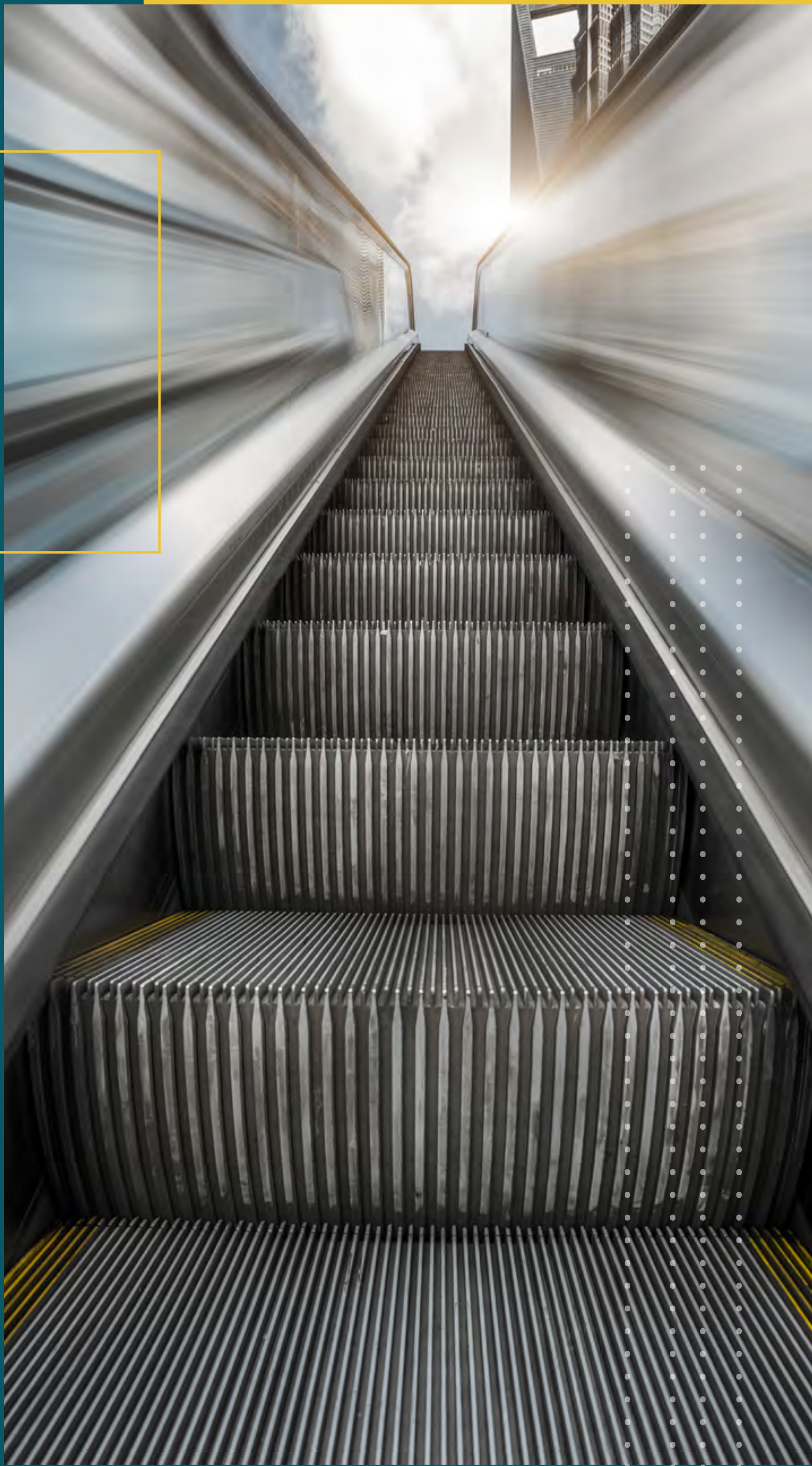
The control of the passenger platform lift is performed exclusively by an operator trained by the supplier. It constantly monitors the passengers' access, movement and exit. The landing operating panel has buttons with bright confirmation (for displaying the direction of travel), a screen for viewing the passenger in the cabin, a communication system (intercom type) and a control activation module. To ensure a high level of safety in operation, the platform landing operating panel is activated by means of a card used exclusively by the trained operator.

Before allowing the passenger to enter the cabin, the operator explains the working of the lift. In standard mode, the platform cabin is set from the main control panel to stop at the highest point of travel for 30 s. This time can be set to another value if desired. If the passenger wishes to get to the base station quicker, two options are available:

1) The rider actuates the alarm button, which opens communication with the operator, who then brings the platform to the main station.
2) The rider actuates the emergency stop button, which resets the preset stopping time (30 s) and automatically lowers the platform to the main station.

Main Control Panel

The hydraulic platform is equipped with a main control panel and programmable controller that allows automatic diagnosis of operating parameters and interfaces with the service technician's laptop. The main control panel of the platform is connected to an uninterruptable power supply that activates when the main power source is interrupted. This system ensures that, in the event of a power outage, the cabin moves to the base station. Power is supplied to the cabin by means of a cable system.



U.K. EVOLUTION

In this Readers' Platform, your author discusses codes and events that have influenced escalator design.

by Colin Craney

This issue's focus topic presents an opportunity to consider the evolution of the U.K. escalator sector, with reference to some key developments and a comparison between jurisdictions.

Table 1 compares some requirements of U.K. BS 2655-4: 1969 with those of the European EN115-1: 2017 and ASME A17.1-2016. While some of the differences reflect changes arising from metrification and cultural/historical factors drawing upon local building codes, others are worthy of wider consideration.

BS 2655-4: 1969 was the first British Standard (BS) specific to escalators and included several engineering provisions that exceed those of today's European (EU) standard. Specifically:

- A 4-mm maximum clearance between adjacent steps, as opposed to the current 6 mm, which is perhaps a reflection of the emergence of cleated step risers and meshing steps
- A step-to-skirt clearance, the sum of which should not exceed 6.5 mm (maximum 5 mm on one side), as opposed to the current 7 mm (maximum 4 mm on one side)

Regarding determination of structural loadings, a different approach is taken but does not differ significantly. Compare BS 2655's step contract load of 290 kg/m^2 against

	BS 2655-4		EN 115-1		ASME A17	
Maximum speed	0.75 m/s		0.75 m/s		0.5 m/s	
Step static load	580 kg/m^2		6,000 N/m^2 and prescribed static and dynamic tests		Based on 135 kg on an area 150 mm X 250 mm and a safety factor not less than 5 it is a prescribed form of fatigue testing.	
Step dimensions	Width: 0.6 m to 1.05 m; depth: not less than 0.4 m; height: not exceeding 0.24 m.		Width: 0.58 m to 1.1 m; depth: not less than 0.38 m; height: not exceeding 0.24 m.		Width: 0.56 m-1.20 m; depth: not less than 0.4 m; height: not exceeding 0.22 m	
Number of flat steps/ distance	Up to 0.45 m/s: 400 mm		Up to 0.5 m/s: 800 mm		Minimum of two steps; maximum of four steps.	
	0.65-0.75 m/s: 1,220 mm		0.45-0.65 m/s: 535 mm			
	0.65-0.75 m/s: 1,600 mm		0.65-0.75 m/s: 1,220 mm			
Contract load	290 kg/m^2 on area of exposed step treads		Related to step width: 60/90/120 kg per step		Based on loading factors of 210 kg/m^2 static and 360 kg/m^2 running.	
Structural static load	440 kg/m^2 on area of exposed step treads		5,000 N/m^2 distributed over width of step band and between supports		In accordance with applicable design code and calculated maximum static load	
Permitted angle of incline	35° permitted up to 6-m vertical rise and 0.5 m/sec		35° permitted up to 6-m vertical rise and 0.5 m/sec		30° maximum (+ 1° tolerance)	
Auxiliary brake requirement	Additional brake required on all escalators		Auxiliary brake required on escalators in excess of 6-m vertical rise		Required on all chain-driven escalators, with alternative of multiple and separate chains with monitoring devices	
Overall structural loading	440 kg/m^2 on area of exposed step treads		5,000 N/m^2 to ensure maximum deflection 1/750 of the distance between supports		270 kg/m^2 over horizontal projection of entire truss	
Truss safety factor	Safety factor of 3 (based on 440 kg/m^2)		Prescribed design loadings and deflections		In accordance with applicable design code and calculated maximum static load	
Track factor of safety/ loading	Safety factor of 3 for tracks and step frames (based on 290 and 580 kg/m^2)		6,000 N/m^2 and to withstand all possible loading and distortion effects imposed during normal operation		In accordance with applicable design code and calculated maximum static load	
Drive and step chain safety factor	8 (based on 290 kg/m^2)		5 (based on 5,000 N/m^2 distributed over width of step band and between supports)		Based on a loading factor of 210 kg/m^2 on the exposed footprint and not less than 10	
Maximum step-to-step clearance (mm)	4 mm		6 mm		6 mm	
Maximum Side Skirt clearance (mm)	Single side	Total	Single side	Total	Single side	Total
	5 mm	6.5 mm	4 mm	7 mm	To applicable code, defaulting to 4 mm max and 5 mm max under prescribed loading	To applicable code, defaulting to 7 mm max
Side skirt protection	Skirting to be firm and unyielding with low coefficient of friction at surface.		Skirt deflectors for all U.K. installations after January 1, 1984, and under EN 115 in Europe after January 31, 2005		Prescribed force/deflection limit and smooth surface; Step/skirt performance index; Skirt deflectors permitted; skirt obstruction device required.	
Step riser protection	Smooth surface with low coefficient of friction or vertical grooves.		Meshing vertical cleats with smooth surface; prescribed load test		Meshing vertical cleats; Step demarcation	
Height of handrail	840-1,040 mm		900-1,100 mm		900-1,000 mm	
Fire protection and flammability	Step frames and treads to be nonflammable and landing plates of fire-resistant materials		Recognition of fire hazard risk and prescribed fire ratings/testing of materials, together with fire management systems.		In accordance with applicable building code	

Table 1: A comparison of BS5655-4: 1969; BS EN115-1: 2017; and ASME A17.1-2016

A realistic risk-based approach should have retained the prescriptive requirement for an auxiliary brake. And, while A17.1 does not prescribe an auxiliary brake, its provisions relating to alternative drive-chain safety exceed those of EN115-1 and are perhaps a better measure and mitigation of risk.

today's 60 kg, 90 kg and 120 kg per step; an overall structural load based upon 440 kg/m^2 on the exposed step tread against today's 510 kg/m^2; and step static load of 580 kg/m^2 against today's 610 kg/m^2. Factors of safety, though, are reduced, from the BS 2655 safety factor of 8 for the drive chain and step chain to 5 under EN115. This is, perhaps, reflective of experience and improved manufacturing and quality-assurance provisions.

Under BS 2655, safety factors applied are 3 to tracks, based on a step loading of 440 kg/m^2; step frames, based on a loading of 580 kg/m^2; and to the truss itself, based on a step loading of 440 kg/m^2. The current EN115 standard opts for a prescribed loading.

BS 2655 required an additional brake on all escalators incorporating a chain or belt link between the drive machine and step band. The introduction of the opt-out to this requirement, based on the use of multiplex or multiple chains, which was introduced in EN115: 1983, was, in my view (and in light of recent failures) a retrograde step. The change from a prescribed mitigating safety measure to one based on factors of safety may have, in light of improvements in technology and quality control, appeared attractive. The approach, though, is heavily reliant on the quality of materials and manufacture, and satisfactory planned maintenance. A realistic risk-based approach should have retained the prescriptive requirement for an auxiliary brake. And, while A17.1 does not prescribe an auxiliary brake, its provisions relating to alternative drive-chain safety exceed those of EN115-1 and are perhaps a better measure and mitigation of risk.

The question of unintended reversals or runaways is perhaps the most pressing issue currently facing the industry and something I have previously written about in more detail. There is no plausible rationale that supports the EN115 application of auxiliary braking only to installations exceeding 6 m in vertical rise, which is, in fact, a diminution from the old BS 2655 provision and an area in which the A.17 code surpasses EN115-1.

In the 1970s, die-cast aluminum unisteps began to replace the traditional fabricated step. The result was greater accuracy of step construction; reduced overall load upon the truss; and an easier life for those of us undertaking step removal/replacement, in terms of the loads we were required to manually handle.

In 1979, a side-of-step entrapment injury to a child on a Birmingham, U.K., department store escalator provided the initial impetus for the application of skirt deflectors, which was set out in U.K. HSE PM34, November 1983, and repeated in the U.K. version of EN115: 1983. Their use became mandatory for new escalators in the U.K. ordered after January 1, 1984, and, though initially resisted, was eventually incorporated into EU EN115: 1995 by Amendment 2, 2004, as a requirement for new escalators in Europe. PM34 also required that skirt deflectors be fitted to existing escalators wherever reasonably practicable.

The events surrounding the development of the U.K. and EU application of skirt deflectors are of interest, as this was implemented in the U.K. by way of guidance, rather than law. Enforcement was achieved by way of Health and Safety Executive (HSE) liaison with the U.K. industry and the PM34 onus upon purchasers of escalators to ensure compliance. Provision for enforcement already existed in sections 3 and 4 (protection of persons other than employees and duties of persons concerned with premises to persons other than employees) of the U.K. Health & Safety at Work Act (HSWA). While enforcement relating to existing escalators was somewhat less rigorous, the reasonable practicability measure of risk, coupled with the requirements section 4 of the HSWA and with consistent industry advice, encouraged the great majority of escalator operators to retrofit their installations.

A number of alternative solutions existed, mainly in the rail transportation sector, but the deflector brush emerged as the established solution, mainly because of its relatively straightforward application as a retrofit to existing escalators.

An important, if less obvious, improvement is the provision of maintenance controls. When I started in the industry, these were rare, with only the start key switches used to control movement during maintenance and repair work. A tragic fatal accident during a step chain replacement in 1980 provided the impetus for the retrofit of maintenance controls. This was successful to the extent that it is now rare to find an escalator not equipped with what today's standards consider a basic safety provision.

The question of the most appropriate angle of inclination presents an interesting exercise in risk assessment. A maximum 30° incline applies in the U.S., while Europe permits a 35° incline for escalators with vertical rise less than 6 m. A straightforward intuitive approach indicates that a reduced angle of incline results in a lower risk of fall. So, in applying a 35° incline, we accept an increased risk of passenger fall in exchange for an economic benefit in the form of a reduction in escalator footprint. The theory underlying this tradeoff, if, indeed, there is one, presents an interesting question in risk management.

Glass balustrades were developed in the 1950s and became predominant during the late 1960s and through the 1970s. The mullions included in the early designs began disappearing in a quest for a wholly transparent balustrade and sightline, such that, by the 1980s, the design was standard in the retail sector. However, in the early 1980s, the so-called "slimline" escalator made its debut. While the change from opaque to glass balustrades had complicated the design of handrail systems, the problems were exacerbated because of the further reductions in space necessitated in the slimline design. Though early issues relating to the stiffness of these balustrades have been more or less resolved, the reduced cross-section of the slimline handrail, and problems relating to these handrail drives, still arise. Couple these aesthetically driven design changes with cost-reduced (or value-engineered) tracking and component mounting/bracket systems, and the result is a limited equipment life with lower levels of resilience and reliability. We have moved forward in terms of safety devices but have taken some backward steps in terms of product engineering.

In 1987, a tragic fire at the London Kings Cross underground station turned the U.K. industry's focus to the maintenance and cleaning of escalators, and associated fire risks. I recall attending an incident in which a supermarket escalator had caught fire in the early hours of the morning. The fire brigade

The glass balustrade with conventional handrail drive system was a design that did not find favor in the U.K.

> The events surrounding the development of the U.K. and EU application of skirt deflectors are of interest, as this was implemented in the U.K. by way of guidance, rather than law.

extinguished the fire, which was caused by a drive motor burnout. The firefighters used crowbars to remove the upper tank-trap, prompting both the insurers and I to question whether it really had been necessary to use a hydraulic breaker to separate the step chain and an ax to chop out 20 steps and the side skirts, and to cut the handrails. The fire officer explained (while attempting to suppress a grin) that he couldn't be certain that the fire had not spread into the truss, so he thought it best to take no chances. Perhaps having been called out at 2 a.m. on a cold and dark morning presented a good opportunity for the guys to test out their training. Our investigation revealed that a wheel on a motor-driven floor-scrubber being transported on the escalator became wedged between a step and the underside of the skirt decking, fracturing the step. The escalator continued for a time, but the step eventually became dislodged and collided with the upper combs, locking the step band and causing the motor to burn out. (There were no comb switches on the escalator.)

I recall that, around the same time, issues were being raised relating to the flammability and performance of materials under fire conditions. Contracts were let for balustrade panel replacement and for replacement of steps that incorporated a plastic step tread, which, when ignited, produced toxic fumes. These steps were replaced with modern unisteps.

My more recent fire-related investigations have involved lighting ballasts that ignited after having been allowed to exceed their shelf life and deteriorate to an unacceptable condition. In one case, a contractor manager advised that, at the time of the fire, the circuit had been isolated. If this were to have been believed (and it wasn't), the incident could only have been attributed to spontaneous combustion, rather than to a handrail lighting system's deteriorated electrical wiring and ballast units, which was, in fact, the case.

In regulatory terms, we are, in general, well served by the EU Product Directives and the standards, in terms of new equipment. We are less well served, I think, in specific domestic regulation, which is limited to Section 19 of the U.K. Workplace (Health, Safety & Welfare) Regulations 1992. While the requirements of Section 19 are wide and far-reaching, these provide little by way of specific guidance, and in that sense, we rely upon references to the standards and the U.K. SAFed Escalator Guidance, which can prove problematic when considered in court.

In terms of technological development, we have seen no successful radical innovation in escalator design, although we have witnessed a few crash-and-burn product releases. We continue to employ chain technologies, coupled with the basic geometric form of the step design, metal track systems and rubber/polymer handrails.

Technological development has been incremental, with the development of existing system elements, rather than radical innovative leaps. The development of handrail drives has been a particular focus for attempts at innovation and improvement, and some of these have worked well, though others have not. Microprocessors have replaced the traditional relay panels (though, outside of monitoring, I doubt the need for these on an escalator) and energy-saving drives, both of which are technologies drawn from other sectors. My experience with so-called "green" or "lubrication-free" chains has been negative, with these products failing to live up to expectations in terms of performance and longevity.

Overall, the diminution of engineering standards that arose due to reduced factors of safety introduced in EN115: 1983, compared to BS 2655-4, has contributed to the emergence of a less-robust, less-safe product. I am strongly of the view that we shall soon revert to the universal application of auxiliary brakes. I doubt that the drafters of EN115: 1983 foresaw the unintended consequence of their work in the "value-engineered" designs now prevalent and enabled by way of a proliferation of computerized engineering, design and manufacturing systems.

> In 1987, a tragic fire at the London Kings Cross underground station turned the U.K. industry's focus to the maintenance and cleaning of escalators, and associated fire risks.

More recently, the key factor driving competition has been price coupled with aesthetics, although the aesthetics factor appears, for the moment, at least, pretty well exhausted. The effects of globalization have been such that the competitive forces driving unit price have shifted production from Europe to China (and China has the largest domestic demand, which is a significant proportion of global demand, and, therefore, an inherent competitive advantage). I do, however, detect a welcome shift in emphasis from price to quality. The nature of escalators is such that unplanned downtime is often so disruptive to business operations and so significant in terms of commercial loss, that the additional capital cost of a superior product is preferable to the risk of disruption and loss resulting from price-driven considerations.

Turning to current matters, I note an increased promotion of step riser advertising, of which I remain skeptical. Questions arise in relation to the coefficient of friction of the material adhered to the step riser, in relation to the consequence of the detachment of this and possible failure or step pile-up. Some years ago the U.K. HSE, among others, undertook research into the visual perceptions experienced by escalator users in relation to the risk of falling due to disorientation. As far as I am aware, no similar research has been conducted into the effects of step advertising in relation to risks of passenger falls.

I note also the widespread marketing of handrail sanitization equipment, more often based upon UV effects, in relation to COVID-19. I also note commentaries in social media questioning the efficacy of these products. Once again, supporting research appears sparse. While I am no scientist, I would have expected to see scientific evidence in support of the functionality and effectiveness of these devices in terms of destroying the coronavirus. There are also concerns relating to the mechanical application of these devices and the possibility of the introduction of other hazards. I have no inherent objections to these products or to those promoting them; I do, however, take the view that more research is required in terms of the safety of step advertising. The current vogue in handrail sanitization is of interest, if only in terms of how quickly firms have been able to design and produce UV devices, many of which come with extravagant claims as to their effectiveness. The need may be pressing and the window of opportunity short (or, we hope it will be), but I harbor an underlying suspicion that a simple regime of manual periodic cleaning, applying a suitable disinfecting agent, may prove at least equally, if not more, effective.

In conclusion, I see many more safety devices, all of which are welcome, with a wholly unwelcome deterioration in mechanical design, driven by aesthetics in terms of spatial reduction and what is often ill-considered cost reduction. I envisage that there is further scope for the application of new technologies in terms of sensor-based safety devices and in a review of the EN115-1 design provisions, including a wider application of auxiliary brakes.

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ESCALATOR FRACTAL BEHAVIOR, PART TWO

Further studies on the deployment of the concept of the fractal in correlation to the mechanical performance and availability of escalators for passenger service

by Dr. Ali Albadri

Part one of this series[3] showed and proved the fractal nature and behavior of data collected from the smart step, which is run in an escalator without the effect of passenger loading.[1 & 2] The systematic, consistency and repeatability features of the data have proven that they have fractal patterns and characteristics.[2] The fractal values can be used as a tool to recognize the escalator fingerprints during normal and up-normal operation conditions. Up-normal operation conditions could manifest themselves during usage. Examples are the mechanical degradation of components in the mechanical system or a mechanical failure.

This article will show the impact of passenger loading on the fractal nature of the data from the smart step. It will show the escalator behavior during passenger loading, compared to the free loading condition. The core element this article is trying to answer is, "Would the pattern of the fractal behavior, established in Part 1, change when there is a passenger loading effect?" This study answers, "Yes; the patterns and signals profiles change by 3-10%, compared to those of the unloaded conditions. As expected, the main change in the profile of the signal is on the main passenger side of the escalator.

The analysis of a series of traces of data over time from machines has deep history. Studying the historical trends of various parameters in a machine against time shows the complex nature and behavior of the machine. More to the point, this history can guide designers and maintainers to deal with the mechanisms of the machine in a dynamic way, as the machine behavior changes with time due to wear and tear or mechanical failures.

A Scientific, Systematic Look at Behaviors and Patterns

Despite the complexity and accurate setup required for an escalator to run safely, escalator behaviors and patterns have never been looked at in a scientific and systematic way. For the last 10 years or so, we have been trying to change this culture with the help of our smart step. In previous publications,[1-3] we established that data from the smart step have the pattern of being consistent, systematic and repeatable. The data can act as a fingerprint indicator for the quality of design and pattern of operation for escalator A, compared to escalator B, for example. In another study,[3] we determined the fractal dimension (Df) values for different traces. The values of Df can be used to determine how smooth and stressed a specific escalator design is, or how good or bad a maintenance regime is. Indicative linear relationships were derived between the Df values and stress levels generated from the smart step. These stresses could be correlated to potential mechanical issues or failures in the escalator. Similar principles can be used on any other mechanical machines or electronic assemblies.

The basics of studying traces from electronic products and assemblies are not new. Many publications[4-7] have tried to discover the fractal nature of the signals from electronic assemblies and products. The aim of those studies was to develop efficient and effective digital output signals to quantify the behaviors of those systems in fractal models. Fractal models have made a major impact in the area of communication, particularly regarding a computer data network. Several studies have demonstrated that the network traffic loads exhibit fractal properties.[7-9] Next, we will continue to understand the fractal nature of the data from smart step when passenger loading is considered.

Methodology Used to Determine Df

Per our previous study,[3] the scaling step technique has been used here to determine Df. A computer program was written in Microsoft Excel to determine Df and plot the data. Our methodology is very similar to the Multiresolution Length Method, which has been used by many researchers.[10-12]

The steps in the time series (s) = {s(0), s(1), s(2), s (3), . . .s(n)} of length n of the trance. Each point in the plot is represented in (xi, yi) when i = 1, 2, 3, . . .n. xi values are abscissa, and yi values are ordinate values. The Euclidean distance between two points (x1, y1) and (x2, y2) is:

dist(s1, s2) = ((x1 - x2)2 + (y1 - y2)2)0.5 (1)

The total length of the curve of the first-time resolution is calculated as:

L = I = 1∑n - 1 dist(si, si + 1) (2)

It is noted that, as the resolution becomes coarser, the estimated length of the time series becomes less accurate. Repeat the above for different resolutions (r) = r1, r2, r3, r4, . . .rp, where rp is the maximum coarsest resolution at which the length of the curve is calculated. By drawing a log-log graph (1/rk) versus (Lr) and computing the slope, Df is calculated from:

(Df - 1) = -[log(Lr)/log(1/rk)] = -[slope] (3)

A smart step was built to run in a newly, fully refurbished escalator. The escalator was run with passenger loading. The passenger density was not high. Eight strain gauges were mounted at different locations in the step (Figure 1). The gauges were located at critical locations in the step after conducting finite element analysis simulation on a 3D model for the step. The step was loaded via axial, torsion and chain differential tests per the recommendations in the BS EN 115 standard.

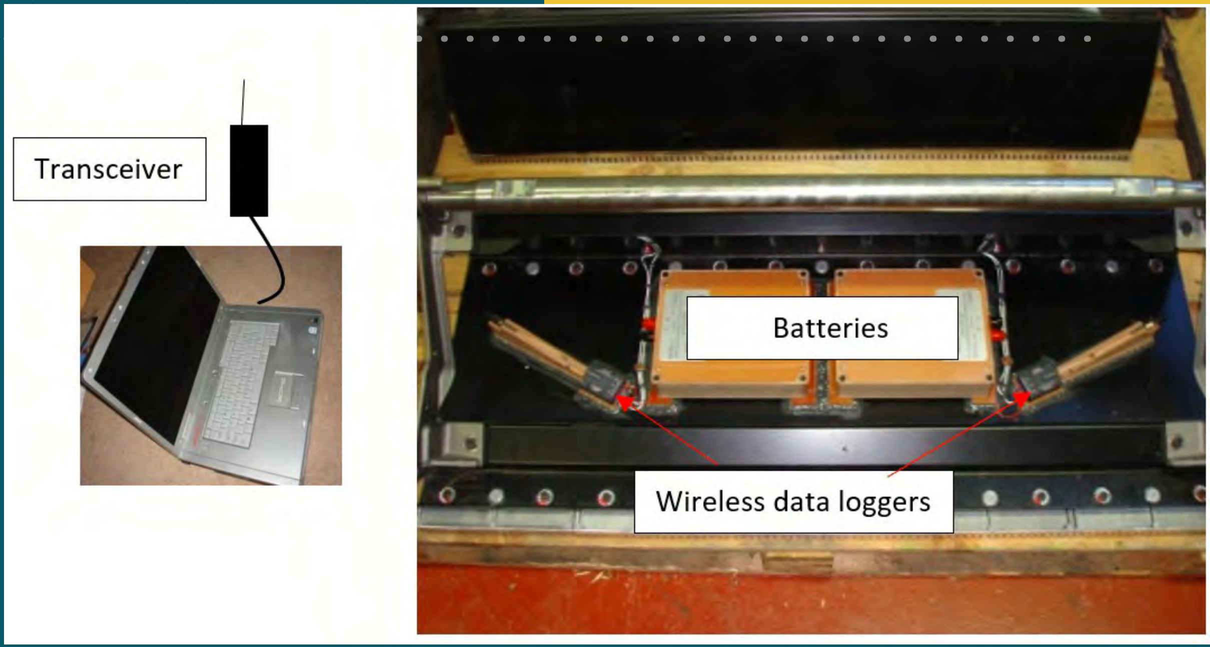


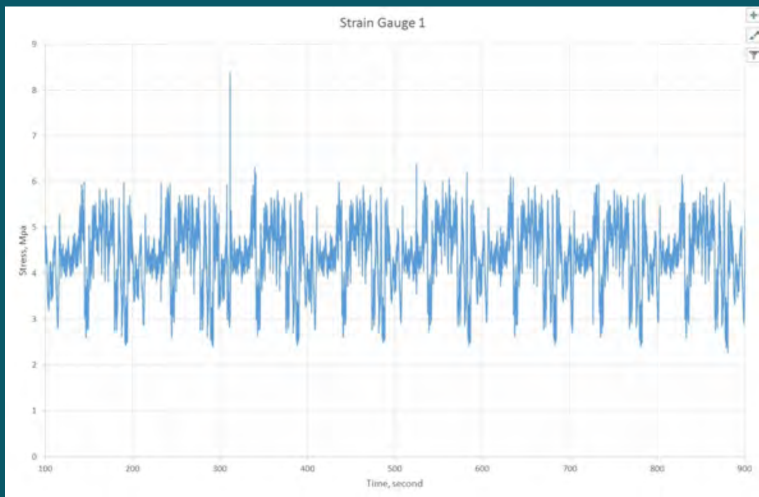
Figure 1: The smart step and communication system

Results and Discussion

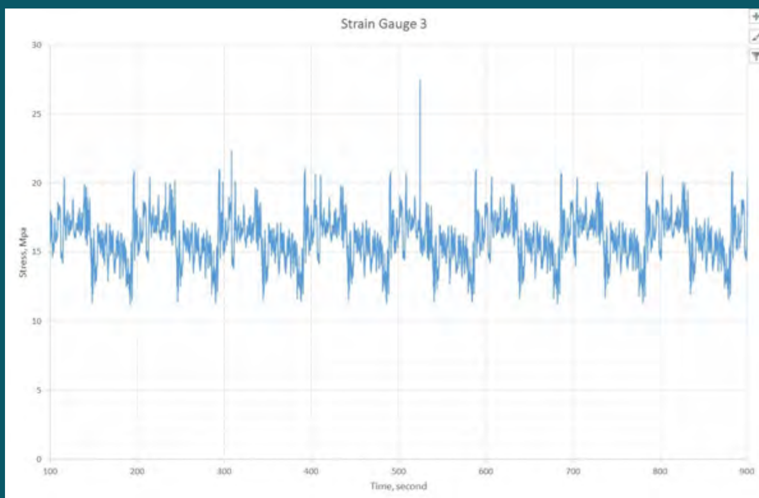
Figure 2 shows data of the traces for the nine strain gauges, which were downloaded from the smart step after running the escalator for more than 15 min. Unfortunately, strain gauge 2 developed a malfunction; therefore, the data from this gauge is ignored. Due to passenger loading, in most (if not all) of the traces, some peaks developed on the main side of the escalator. These peak stresses were generated from passengers walking or standing on the step.

Passenger density was low during the trial. An escalator with low passenger density was chosen because we did not want clatter creating signals that could become difficult to interpret. Even with low density, the effect of passenger loading made the generated signals/traces from the step rougher in patterns and appearance, especially on the main side of the escalator. Therefore, the values of Df are higher during passenger loading, compared to those of a free-loading escalator (Table 1).

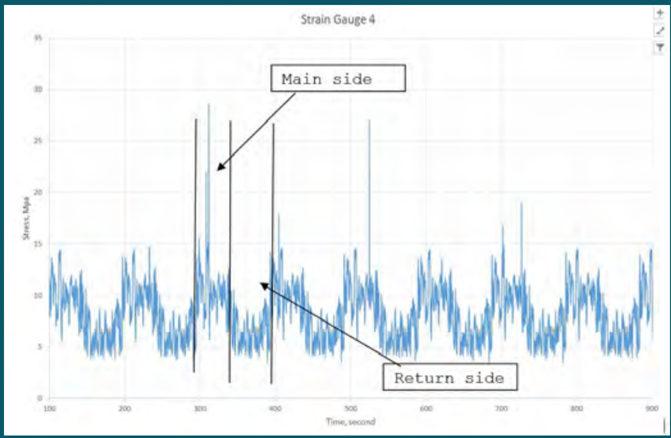
It is not a surprise not to see a manifestation of a relationship between the Df and stress levels during passenger loading (Figure 4). This is due to the variability in passenger behavior (fast or slow, walking or standing), weights, distribution (location of applied load), etc. For a plot like this, it is only fair to depend on when the escalator is free of passenger loading. However, more studies will be conducted to verify many other variables, such as high passenger density.



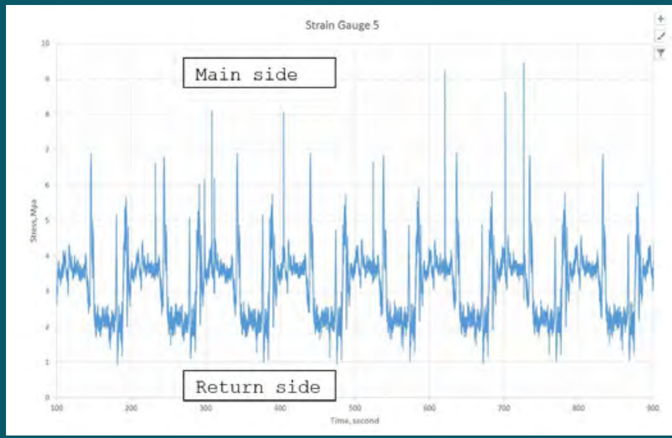
Strain gauge 1



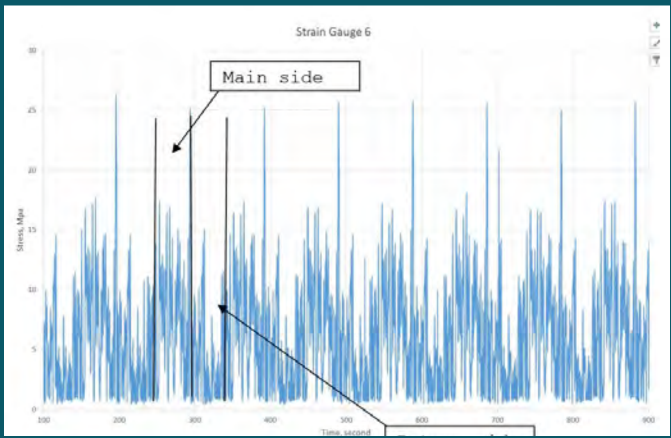
Strain gauge 3



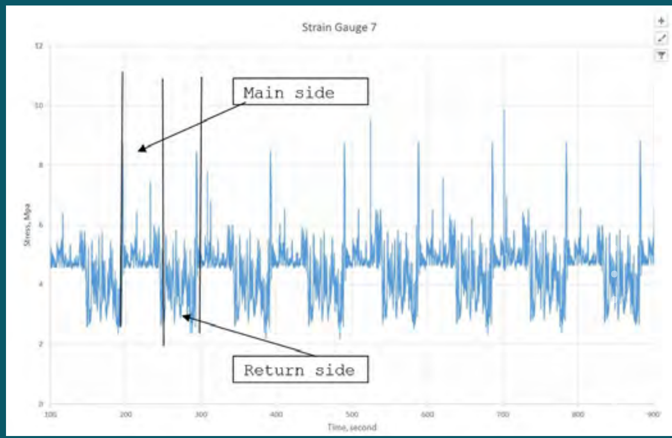
Strain gauge 4



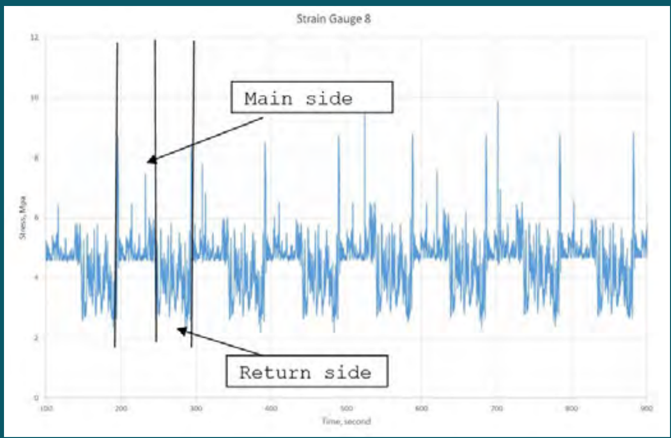
Strain gauge 5



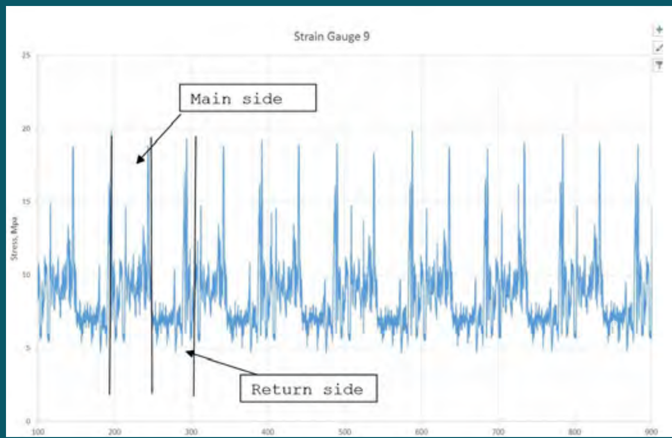
Strain gauge 6



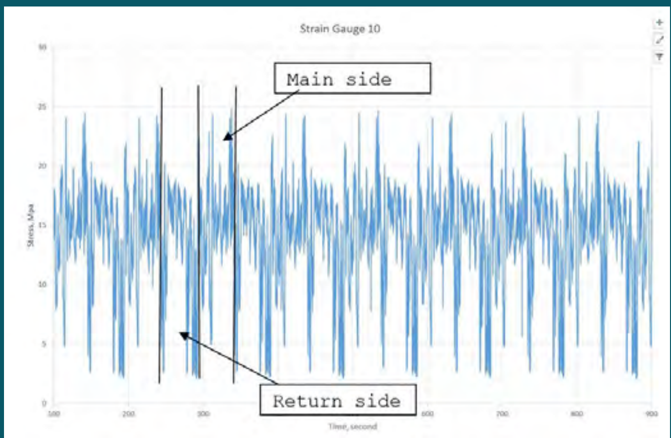
Strain gauge 7



Strain gauge 8

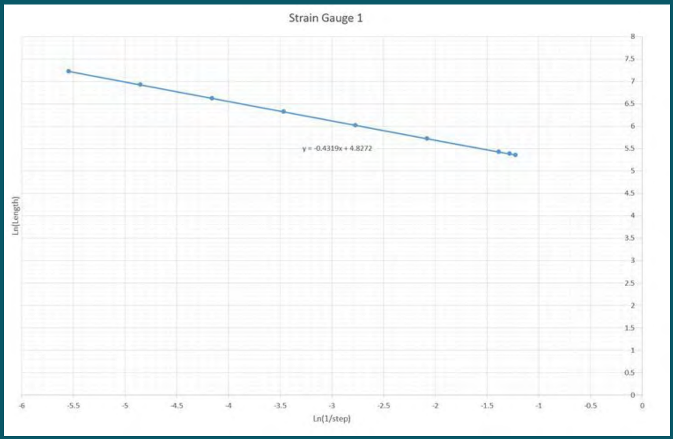


Strain gauge 9

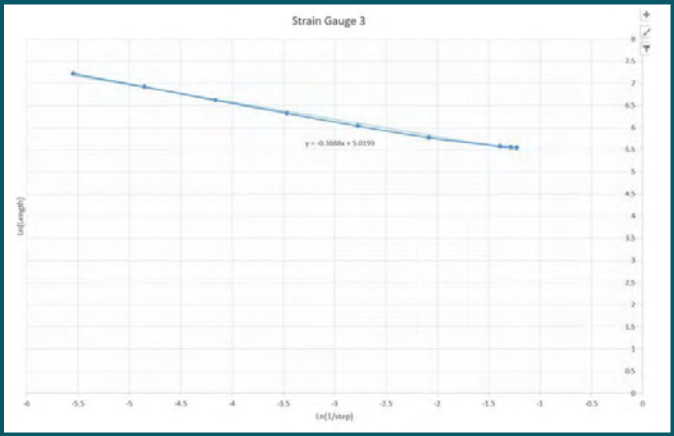


Strain gauge 10

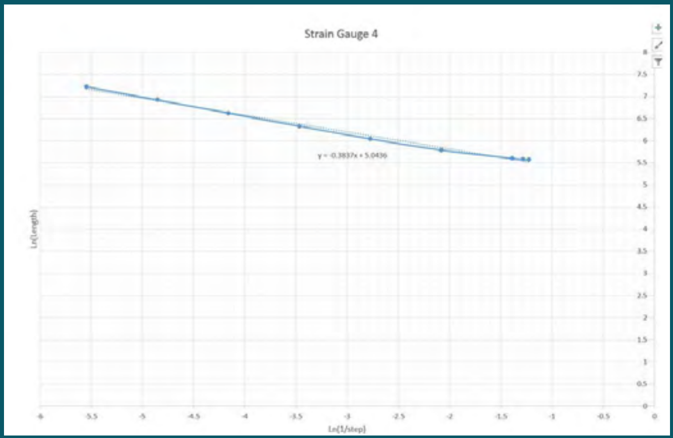
Figure 2: The full spectrum of measurements recorded by the strain gauges from the smart step



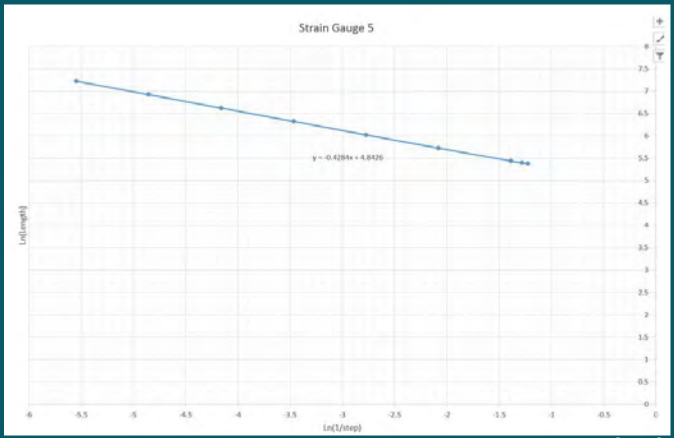
Strain gauge 1



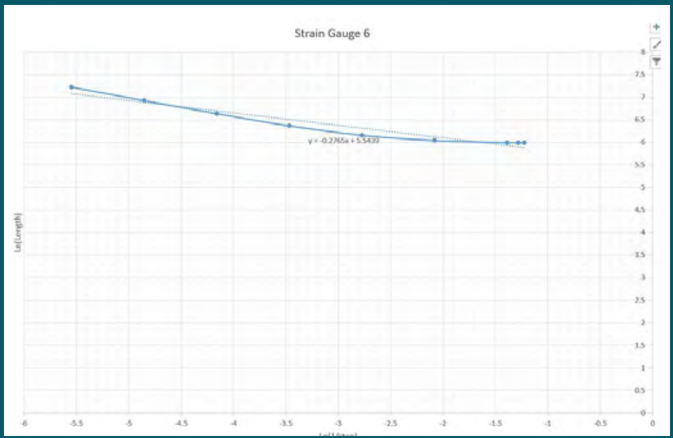
Strain gauge 3



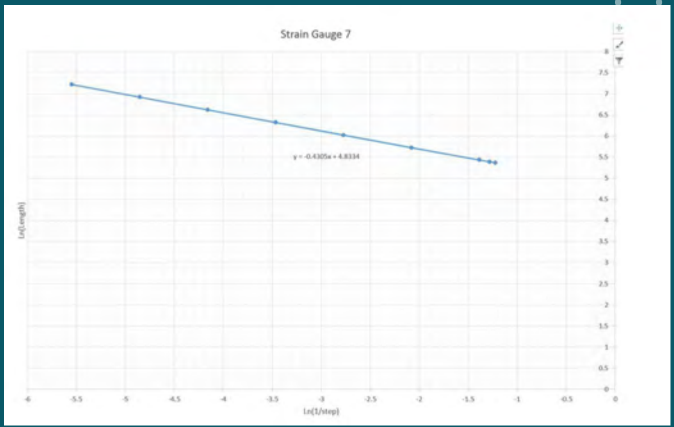
Strain gauge 4



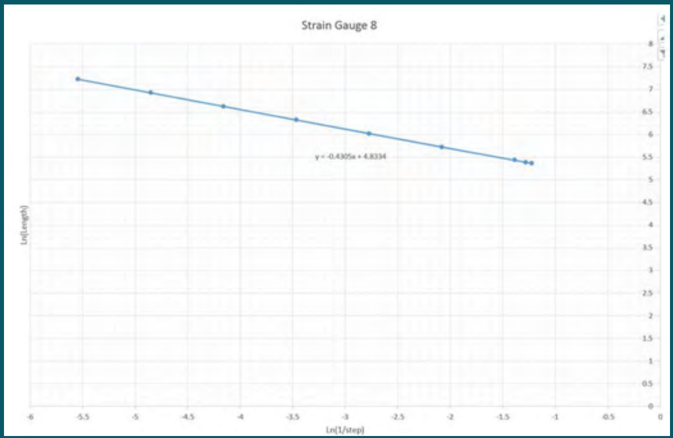
Strain gauge 5



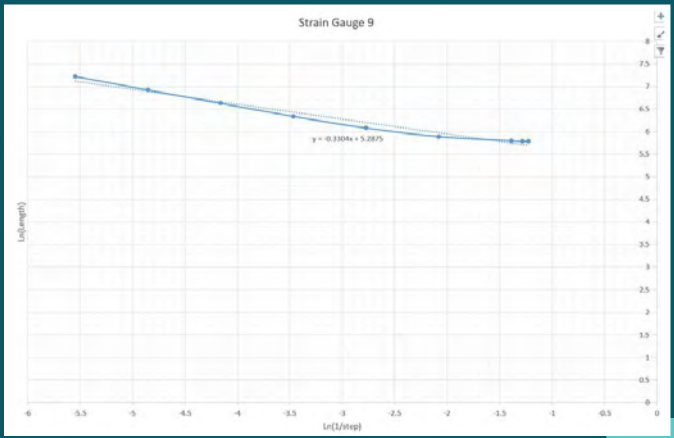
Strain gauge 6



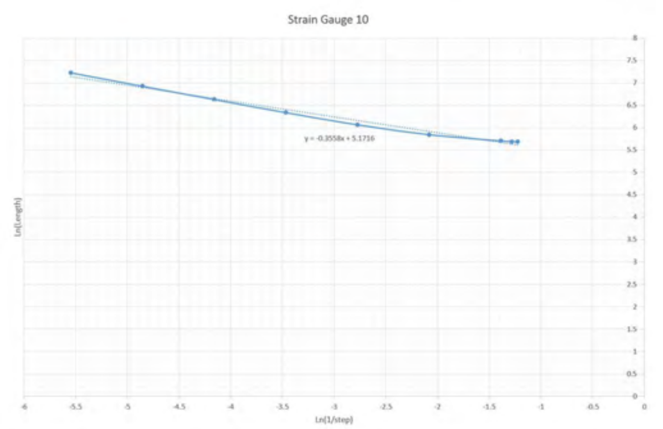
Strain gauge 7



Strain gauge 8



Strain gauge 9



Strain gauge 10

Figure 3: The plots for all strain gauges in the smart step to estimate Df

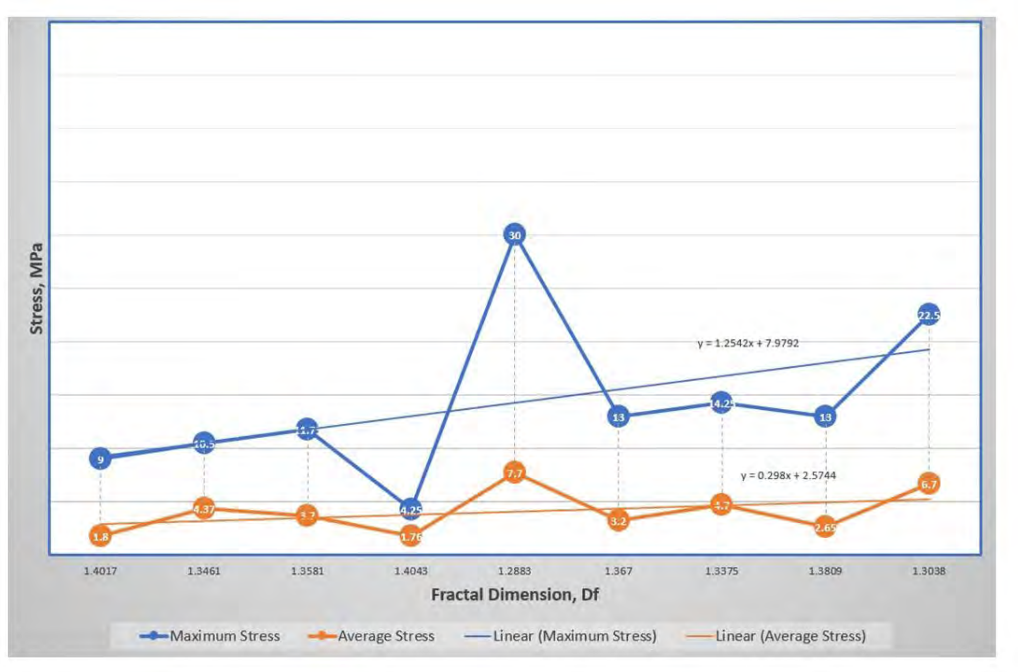


Figure 4a: The relationship between the maximum and average recorded stresses measured by the smart step against Df without passenger loading[3]

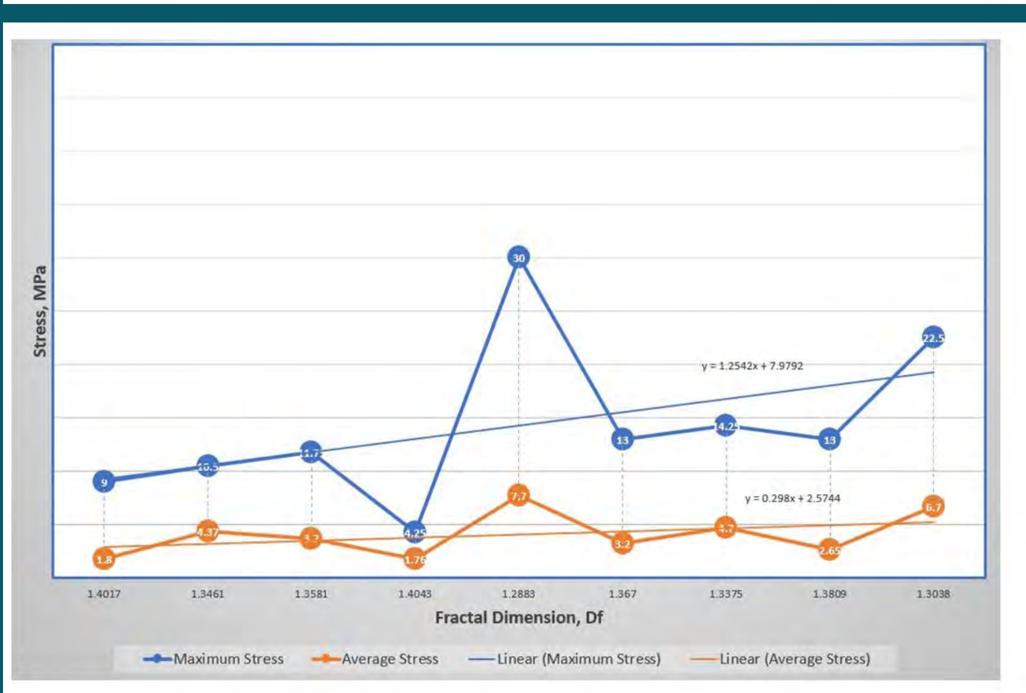


Figure 4b: The relationship between the maximum and average recorded stresses measured by the smart step against Df with passenger loading[3]

Strain Gauge	Df Without Passenger Loading	Average Stress (MPa) Without Passenger Loading	Maximum Stress (MPa) Without Passenger Loading	Df With Passenger Loading	Average Stress (MPa) With Passenger Loading	Maximum Stress (MPa) With Passenger Loading
1	1.401	1.8	9.0	1.432	5.0	8.5
3	1.346	4.3	10.5	1.389	10.0	27.0
4	1.358	3.7	11.75	1.384	10.0	27.0
5	1.404	1.76	4.25	1.430	4.0	9.5
6	1.288	7.7	30.0	1.280	6.0	25.0
7	1.367	3.2	13.0	1.430	5.0	9.7
8	1.337	4.7	14.25	1.430	5.0	9.7
9	1.38	2.65	13.0	1.330	10.0	20.0
10	1.303	6.7	22.5	0.356	15.0	24.0

Table 1: Assessed Df and maximum and average stresses measured from smart step data: data without passenger loading were taken from our part one of this series.[3]

Multifractal Dimension Values in Overall Traces/Signals

Now that we have proved the fractal nature and characteristics of signal data, we can use the principles and methodology of our studies to explore and understand the actual design behavior of machines and forecast the required maintenance regimes for them. Our attempt here is to use the data we have collected so far to explore whether each Df values of a particular trace consists of multiple partial Df values. First, we will determine whether these partial Df values are controlled by simple mathematical processes, such addition and averaging, to produce the overall value of a particular Df value of an overall trace. This in-depth look will help investigators focus on a particular region or location in a mechanical system of a machine like an escalator.

This study will try to discover whether there are multifractal dimension values in overall traces/signals collected from the smart step after it has been run in an escalator. One case will be without passenger loading, and one will be with passenger loading. Similar ideas have been tried for the study of nonlinear behaviors of machines like milling and skimming workshop machines.[6] Additionally, music signals at multiple time scales have been studied. Their result was proposing the multiscale Df concept. Their method and proposal appeared to be promising for music signal analysis.[6]

As far as we are aware, no other references clarify and adopt the concept of multiple partial Df values in a way similar to that adopted in this research. We believe that our approach here will focus the minds of designers and researchers to improve machines' performance and reliability. Local regions in overall traces of data can be scrutinized in depth using the Df concept. It may then work as a diagnostic tool to help designers and maintainers by qualifying their machines.

Methodology Used to Determine Df

The scaling step technique has been used to determine Df. A computer program was written in Microsoft Excel to determine Df and plot the data. Our methodology is very similar to the Multiresolution Length Method, which has been used by many researchers.[4 & 7-10]

The techniques used to determine Df values and obtain the raw data/measurements from the smart step have been explained in depth.[2-3] Each trace for each strain gauge was divided into four regions: upper D region, return incline region, lower D region and main incline (Figure 5). ("D" is used to indicate the transition stages in the step band from the main to the return sides and from the return to the main side.) Figure 6 shows how the trace from strain gauge 7, for example, was divided into the four regions. Df was calculated for each region. The measurements, again, were obtained when the escalator was free of passenger loading and with passenger loading.

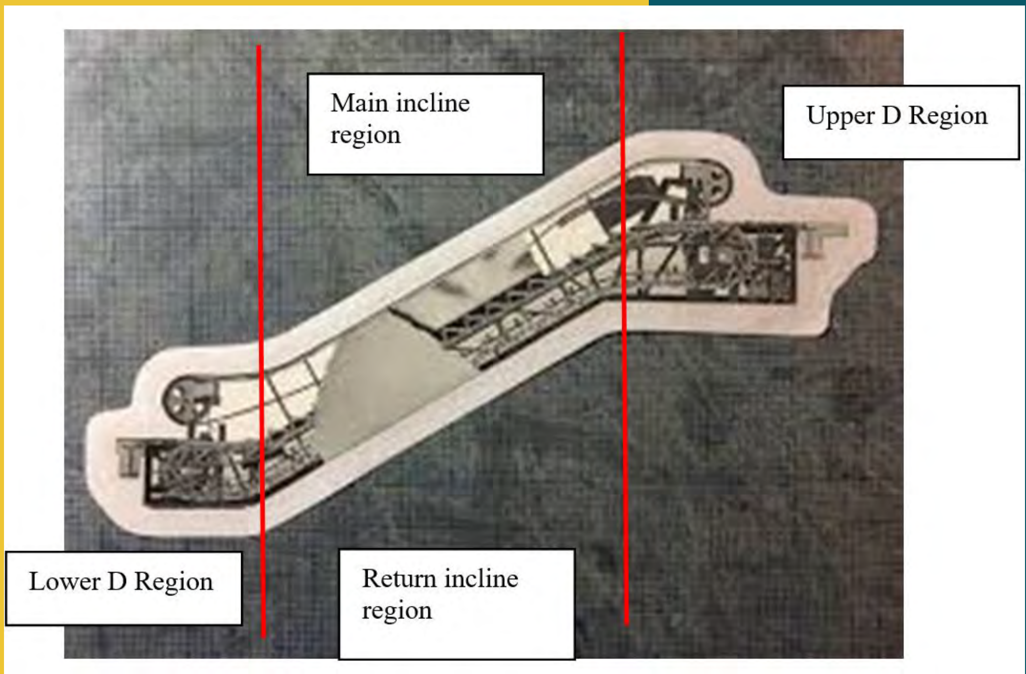


Figure 5: The four escalator regions

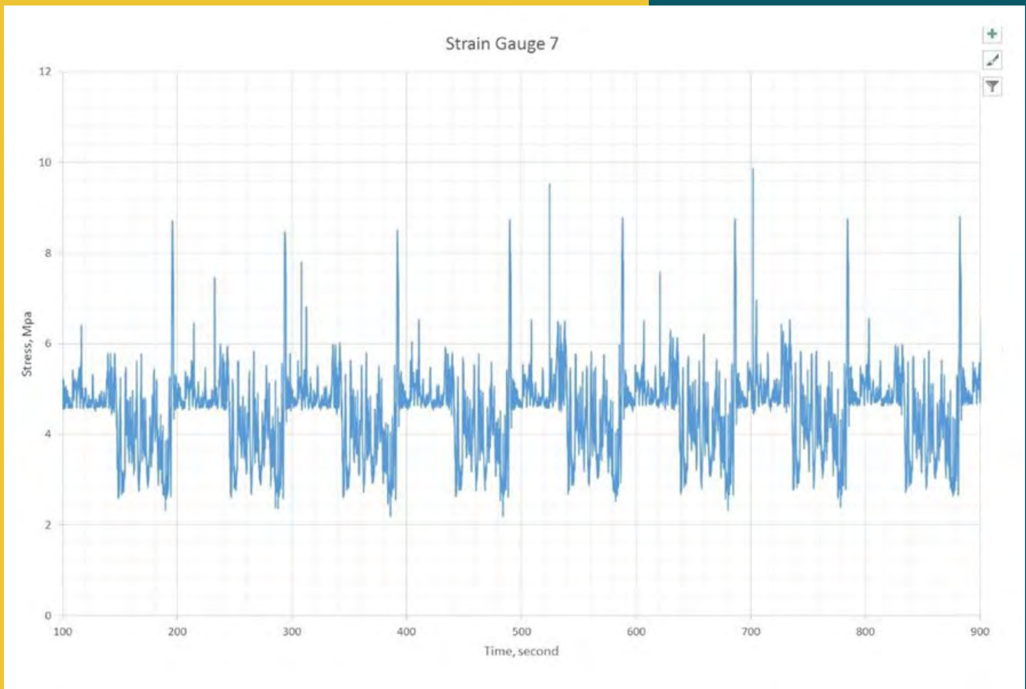


Figure 6a: The overall trace for strain gauge 7

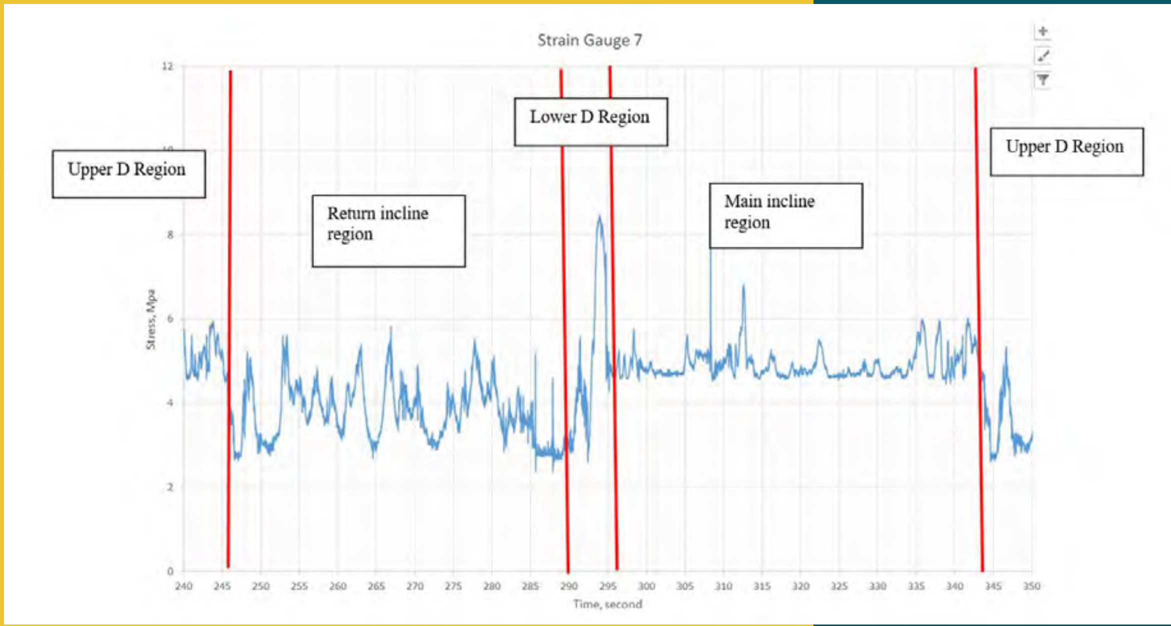


Figure 6b: An example for strain gauge 7's trace: this shows a complete cycle of the step in the escalator with passenger loading.

Strain Gauge	Df1 Calculated From the Trace of the Upper D Region	Df2 Calculated From the Trace of the Return Incline	Df3 Calculated From the Trace of the Lower D Region	Df4 Calculated From the Trace of the Main Incline	Average (Df1 + Df2 + Df3 + Df4)/4	Df for the Overall Trace From Reference
1	1.389	1.4295	1.4089	1.4004	1.406	1.401
3	1.3631	1.3848	1.3618	1.3406	1.3625	1.3461
4	1.3703	1.3559	1.3719	1.3626	1.3651	1.3581
5	1.407	1.3919	1.4103	1.411	1.4050	1.4043
6	1.2741	1.25	1.2796	1.3363	1.285	1.2883
7	1.3521	1.3613	1.3586	1.3786	1.3626	1.367
8	1.3294	1.3549	1.3384	1.3185	1.3353	1.3375
9	1.3503	1.3865	1.364	1.3947	1.3738	1.3809
10	1.3112	1.3024	1.3168	1.3004	1.3078	1.3038

Table 2: Estimated Df values during free passenger loading

Strain Gauge	Df1 Calculated From the Trace of the Upper D Region	Df2 Calculated from the Trace of the Return Incline	Df3 Calculated From the Trace of the Lower D Region	Df4 Calculated From the Trace of the Main Incline	Average (Df1 + Df2 + Df3 + Df4)/4	Df for the Overall Trace From Reference
1	1.4327	1.4308	1.4308	1.4327	1.4325	1.4319
3	1.3657	1.375	1.396	1.4006	1.3843	1.3888
4	1.4071	1.4136	1.3937	1.3581	1.3931	1.337
5	1.4303	1.4229	1.431	1.4327	1.4292	1.4284
6	1.2784	1.287	1.3134	1.2646	1.2858	1.2765
7	1.4267	1.4271	1.4223	1.4338	1.4274	1.4305
8	1.4267	1.4271	1.4223	1.4338	1.4274	1.4305
9	1.3322	1.3174	1.3566	1.3374	1.3359	1.3304
10	1.3212	1.3498	1.3706	1.3685	1.3525	1.3558

Table 3: Estimated Df values with passenger loading

Results and Discussion

Tables 2 and 3 show the estimated Df for the measured data, which were obtained from previous studies during free passenger loading and passenger loading.[3] The tables show that each region in the escalator has its own Df value. The value for each region reflects the nature, simplicity or complexity of that region, considering other components and subassemblies in and around that region. The value can be used as an indicator or a reference to determine the health of the machine, particularly in the region under study.

The most interesting finding in Tables 2 and 3 is that the summing and averaging technique works well with the partial Df values in assessing the overall Df value. This technique has great benefits in determining the health of the escalator (or any machine). It will allow investigators like designers and maintainers to quantify the sub-behaviors of individual components and subassemblies in a machine and compare them to the overall Df value and the shape of the overall trace.

Conclusions

Running the smart step during passenger loading has produced systematic, repeatable and consistent patterns of traces but with some variations in the shapes of signals in the form of more and higher peaks on the main side of the escalator during passenger loading (compared to no passenger loading). The overall patterns of the traces are rougher in appearance. The Df values during passenger loading have shown 3-10% increases compared to the Df values of a passenger-free escalator.

Due to the variabilities in passenger loading and behavior, there is not a relationship between the Df values and stress levels generated in the step. It is only fair to use such a plot for an escalator free of passenger loading. Only then will the plot show a true reflection of what is going on mechanically inside the escalator.

Measuring partial Df values for individual locations in a particular machine, like an escalator, offers many advantages to designers and maintainers in quantifying, then qualifying their machines. This study has proven the individual partial Df values can give a real reflection of the local behavior of the machine. Adding, then averaging, the values of the partial Df of individual locations in the machine provides the overall Df value for the entire machine.

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Dr. Ali Albadri is chief engineer for Tube Lines Specialist Services. He has worked for the University of Manchester Institute of Science and Technology (UMIST), Brunel University, Oxford University and the industry. He was a materials scientist for Cookson Group, design engineer for ABB and senior design engineer for Olympus the Hydronix. He holds a PhD from UMIST and has published papers for various industries, including vertical transportation.

ESCALATOR RUNAWAYS

In this Readers' Platform, your author contends that all escalators and inclined moving walks should have an auxiliary brake.

by David Cooper, ELEVATOR WORLD Correspondent

A number of high-profile escalator runaways have happened in recent years, resulting in passenger injuries and deaths. By "runaway," I mean the uncontrolled rotation of the escalator step band in the down direction. This usually involves excess speed being attained and passengers being unable to egress quickly enough to avoid injury.

Recent escalator runaways include:

- March 26, 2017; Mong Kok Shopping Mall, Hong Kong (17 injuries)
- October 23, 2018; Piazza Della Repubblica, Rome (20 injuries)

The U.K. has not been immune to escalator runaways, with incidents occurring at the Cutty Sark and Reading railway stations. In reality, runaways have been occurring ever since escalators were invented, with some attracting more media attention than others. One of the worst cases occurred at a baseball stadium in the U.S. in 1994. Becoming known as the Camden Yards incident, it resulted in 43 people being injured.

A runaway situation can occur in both upward and downward modes, but the ultimate event results in the escalator rolling backwards (downward) in an uncontrolled manner. Where the escalator was initially traveling in the "up" direction and a runaway occurs, it may be referred to as a "runback" or "unintended reversal." Where the escalator was running in the downward mode, the unit will simply be in an uncontrolled descent. In either case, the situation may or may not include acceleration of the step band.

In such situations — and especially when an acceleration component is involved — passengers are often deposited in a pile at the bottom end of the escalator due to their inability to egress the escalator because of its high speed. When these events occur, passengers are often seen clambering over the handrail to avoid colliding with others at the bottom of the escalator. In the photograph below, an accumulation of passengers can be seen building up, with passengers behind them unable to avoid those at the bottom as there is no way to escape due to the escalator being installed with a void to the side.

Investigation into such incidents reveals a number of ways a runaway can occur, including a drive chain failure, brake failure or gearbox failure, as indicated in Figure 1.

There have been incidents in which a second component failure also contributed to a runaway situation, primarily when an auxiliary brake is installed but failed to bring the step band to rest. There are other reasons an escalator can runaway, but those illustrated above are the primary ones found in researching the subject. Another reason is a drive unit fixing failure that renders the drive chain, brake and gearbox ineffective, but this appears to have been a one-off event.

Dr. Lufti Al-Sharif previously derived a Venn diagram (Figure 2) showing seven possible ways accidents occur with escalators, with escalator runaways falling into categories including design, maintenance and passenger behavior. Passenger behavior has not been found to be among the primary causes of a runaway. However, it can play a minor role, such as when a passenger presses an

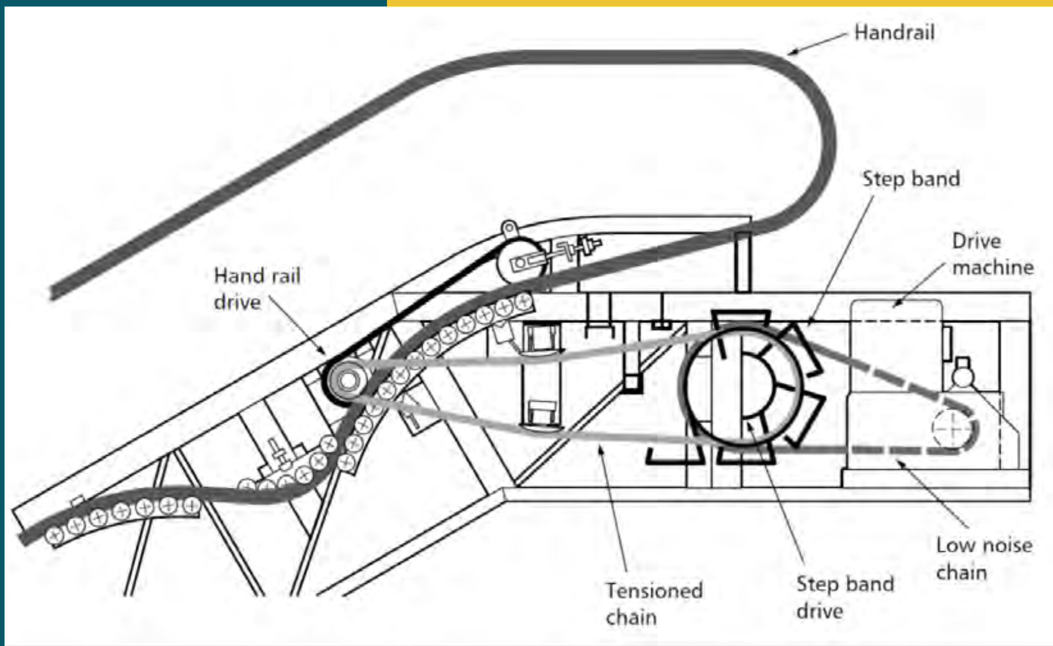


Figure 1: Principal Components of an escalator drive system; source: CIBSE Guide D

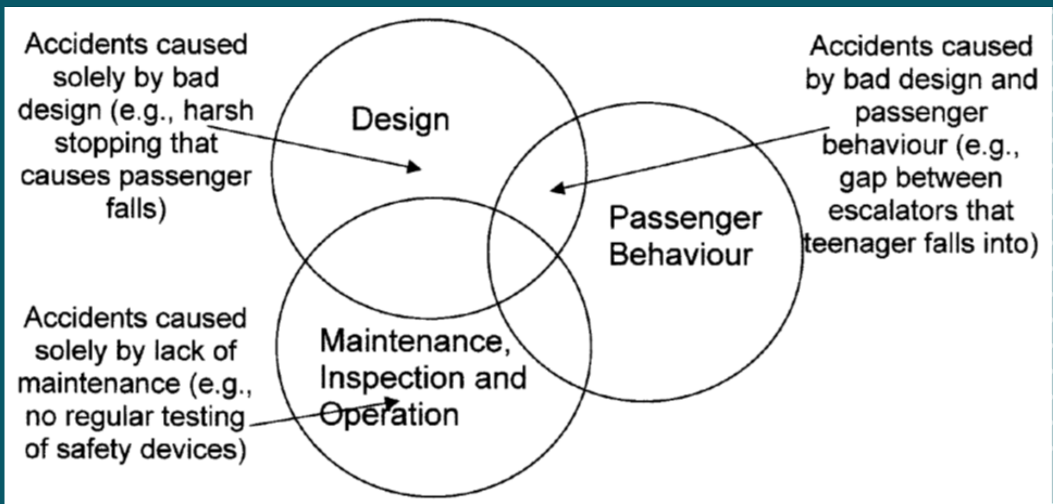


Figure 2: Al-Sharif's Venn Diagram of escalator accident causation

emergency stop button that leads to the discovery that the operational brake fails to hold. In addition, it has been found that, in the initial stages of an accelerating runaway, passengers continue to board the escalator if it is a downward-running machine, unaware that it is in trouble.

This leads to the other two components: namely, design and maintenance. When it comes to design, the inclusion of an auxiliary brake is a consideration. Not all escalators require an auxiliary brake which, in my opinion, needs thinking through.

Consideration should also be given to the location of the operational brake since, if it is onboard the gearbox, it will provide no protection in the event of a gearbox internal failure. This is the same for geared-machine lifts where the brake is typically between the hoist motor and gearbox.

Maintenance is normally a key contender in escalator runaway situations, especially with respect to brake failures in which issues such as lubrication getting onto braking surfaces, poor adjustment or worn pads can be contributory factors. One should also remember that the brake is often used as a means to stop an escalator at the end of a working day. Therefore, even if a variable-frequency drive is fitted, the pads are subject to wear on a regular basis.

In the incident in Rome, it appears that someone activated an emergency stop button, expecting the operational brake to bring the escalator to a safe stop and hold the step band in position. The operational brake, however, failed to do so. It appears the step band started to accelerate in the down direction, causing passenger overcrowding. In the environment where the escalator was installed, it would be expected that an auxiliary brake would have been installed, and on that assumption it clearly failed to arrest reversal of the step band.

In the photograph below, passengers are shown during the initial phase of a runaway. One passenger can be seen holding onto the passenger in front of them.

The 2017 EN115 standard (5.4.2.2) more-or-less mirrors the previous 2008 and 1995 standards with respect to requiring an auxiliary brake and states:

Escalators and inclined moving walkways shall be equipped with auxiliary brake(s) if:

a) the connection between the operational brake and the driving sprockets of the steps/pallets or the drum of the belt is not accomplished by shafts, gear wheels, multiplex chains, or more than one single chain, or

b) the operational brake lacks an electrical-mechanical brake according to 5.4.2.1.2, or

c) the rise exceeds 6 m.

The problem with this situation is that an escalator or inclined moving walk with a rise of less than 6 m with a conformant drive chain can still fail and runaway due to brake failure, gearbox failure or drive chain failure.

The 2017 EN115 standard (Clause 5.12.2.7.3) also calls for detection of unintentional reversal of direction of travel and states, "A device shall be provided for escalators and inclined ($\alpha = \geq 6°$) moving walks to detect the unintentional reversal of direction of travel." The problem with this is that it could use the operational or auxiliary brake (if fitted) to prevent the reversal, and these components have been known to fail. 5.12.2.7.2 also calls for the detection of excessive speed before the speed exceeds a value of 1.2 times the nominal speed.

It can be argued that the standards provide sufficient protection. However, it is your author's contention that an auxiliary brake should be provided on all escalators and inclined moving walks in situations where the failure of the operational brake, gearbox and/or drive chain can occur. In reality, this would mean that all escalators and inclined moving walks would require an auxiliary brake.

All too familiar escalator static safety signage on the inside of an escalator – visible, but perhaps a little too late; © Peopletrans.com.au.

A NUDGE IN THE RIGHT DIRECTION

In this Readers' Platform, your author describes how heuristics can bring escalator safety into the 21st century.

by Atif Bhanjee

Escalator safety signage in its current format is based on the ancient concept of semiotics, or studies based on sign processes. Indeed, the current crop, developed alongside traffic signs since the late 1960s, are a fixed requirement for every escalator. The black-and-yellow colors, the stick figures, well-intentioned and carefully designed to meet regulation, are ubiquitous, but when was the last time you saw a passenger give it their full attention? Like a traffic sign on the street, it exists to be obeyed for the safety of self and others. However, unlike a traffic sign, escalator safety signs are not enforced. There is no day in traffic court for ignoring the existing escalator safety sign for the child treating the escalator like an amusement ride, or for the elderly with limited vision. Especially not for those of us on the smartphone, or in a rush – or both at the same time. Considering there are more than 1 billion escalator rides per year in the U.S., escalator accidents are a serious problem, with tens of thousands of injuries and fatalities annually. If only there were a way for an escalator to give each oncoming rider a nudge to pay attention and ride safely. Surprisingly, and somewhat counter-intuitively, researchers have found the optimal escalator safety nudge: it is vibrant, colorful graphics on handrails, steps, and risers: the visible moving parts of an escalator.

Introducing Heuristics, a Nudge Toward Escalator Safety

What is not a surprise to the folks in the escalator industry is that rider behavior is the leading cause of accidents. Indeed, industry efforts to improve safety are constant, but escalator design and maintenance issues are responsible for a scant 5% of rider accidents. Leading the charge to protect the remaining 95% is the venerable Escalator Elevator Safety Foundation (EESF), which coordinates between industry leaders with OSHA-like intensity. Through EESF, millions of dollars have been invested over decades to educate children, college students and older people on safe ridership. Unfortunately, even with impressive creative efforts including videos, workbooks and partnerships, their reach is limited.

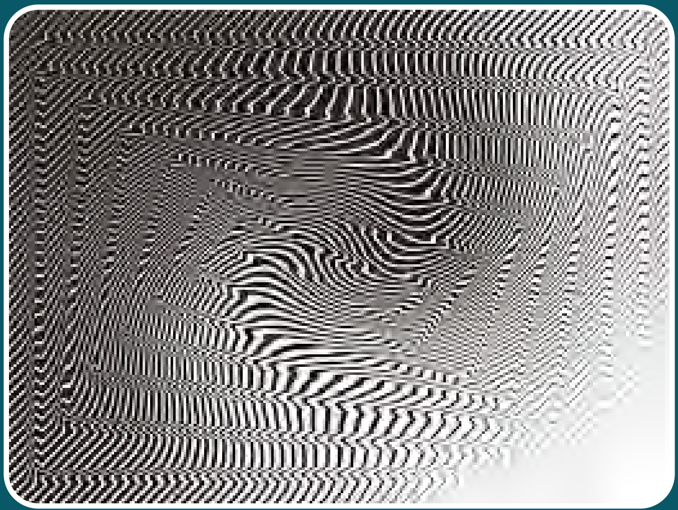
Meanwhile, airport operators and property managers alike continue to hope that riders take the time to review safety signage and engage in "reflective" thinking before embarking on that escalator journey. In reality, however, studies find that most people engage in "automatic" thinking. Nudge Theory, developed by American academics Richard H. Thaler and Cass R. Sunstein, seeks to "improve understanding and management of the 'heuristic' influences on human behavior, which is central to 'changing' people." The use of Nudge Theory is based on indirect means of influence instead of direct instruction or enforcement. For example, placing a bowl of fruit where it is easily reached is more effective than trying to enforce a "junk food" ban.

Breaking Down Unsafe Behaviors

To best identify the nudges that work for escalator safety, it helps to first define unsafe behaviors and identify the statistically likely victims by age group. According to data gathered by Cameron Nicolson in his "Risk Mitigation Associated with Airport Escalator and Moving Sidewalk" analysis, published in 2008, the leading statistical group for limbs becoming entrapped in and around escalator steps is children younger than 5, even when adult supervision is present. Nicolson identifies children seeing the escalator as an amusement ride, along with their natural curiosity, as causes for the accidents. On top of that, 51% of reported child injuries on escalators are due to falls; however, the majority of falls — 90% — are suffered by older riders. Contributing factors include poor vision, balance issues and sensory overload from the "wallpaper illusion." Identified by optometrists Theodore E. Cohn and David J. Lasley in 1988, the wallpaper illusion in escalators is defined as disorientation caused by the movement and pattern of the treads against the "featureless buffed stainless-steel skirts."

The remainder, which includes the majority of behavior-related escalator accidents, are caused by distracted adults. In 2008, shortly after the introduction of the iPhone, almost 20% of reported accidents were caused by the rider carrying out another task while riding an escalator. Given the

In another example, simply changing to a smaller-sized plate nudges people to eat healthier portions; © Pelle Guldborg Hansen.



To some, the movement of the escalator step treads against the skirts can have a dizzying effect, sometimes referred to as the "wallpaper illusion"; © George Peters/Getty Images.

Talking, texting or surfing the web, smart phones distract from safe escalator ridership behaviors; © Masterfile.

proliferation of smartphones since then, one can only imagine the current level of casualties. Finally, other identified contributing factors to accidents include not holding the handrail, faulty mounting/dismounting, carrying baggage, running, pileups and confusion about which direction the escalator is running. Nicolson concluded his study by stating, "Signage that reinforces the escalator safety messages are more helpful than involvement in community-based education programs."

Moving Graphics and the Nudge

When it comes to nudges, relevance matters. For example, if the Dalai Lama endorses a nudge relating to well-being, it is more likely to be more positively received than if it were endorsed by a corporate manager. Thus, while semiotics led to the design of current safety signage, broader, more advanced applications of semiotics can have better safety results. In language and signage design, "stimulus response compatibility" is a major area covering several individual heuristics.

An obvious example is the automatic association of green, not red, for "go." This simple concept was put into practice in a Swiss study by Dr. Alahi and Dr. Bagnato on escalator passenger flows using green ("walk left") and red ("stand right") handrails. Their investigation, using constant monitoring technologies, sought concrete proof of whether the color visual cues on escalator moving handrails influence a prescribed behavior. Their findings not only confirmed an instant impact, but also found an increase in the prescribed behavior in the month after the cues were removed. Furthermore, as behaviors were analyzed, researchers discovered that riders were also more likely to hold a clean-looking, colorful escalator handrail.

More recently, a 2016 statistical comparison by the Escalator Passenger Safety Strategy (EPSS) committee of the London Underground selected 12 initiatives that comprised a mix of both nudge techniques and direct information, such as traditional safety signage. The study was conducted over a course of six months on 20 escalators that had the highest occurrence of incidents and accidents. Of the 12, only seven initiatives passed the quantitative and qualitative criteria for success. Of the seven, the top three practical strategies with the highest impact on safety and modified behavior were:

- Passenger positional guides (simple step graphics): accidents, -27%, desired behavior +21%
- Step riser messages: desired behavior +13%
- Handrail messaging (simple graphics): accidents -24%, desired behavior +17.4%

Interestingly, the other initiatives that had a significant impact were holograms and bright red combs. This evidence supports the theory that bright colors and enhanced, moving visuals are more effective for passenger safety. A 2010 study published by Kusima, et al., in the Journal of Interactive Marketing supported the theory that vibrant moving graphics impact sensory and cognitive capacity, fostering a higher level of attention and awareness among recipients. Accordingly, researchers have attributed higher levels of visual attention to features such as colors, motion and orientation. What works in advertising can also be applied to safety.

Addressing Concerns and Overcoming Perceptions

Unfortunately, it is partly this association with advertising that has limited the scope and acceptance of colorful escalator graphics in the U.S. The escalator parts in motion are carefully calibrated, engineered, regulated and maintained. They perform an important function of crowd conveyance in bustling venues, not to mention the fact that escalators can be a critical part of a building's architectural aesthetic. It is understandable that there is reluctance from operators and owners alike to add NASCAR-like graphics to escalators.

Now, however, as robust technologies for escalator graphics on handrails, steps and risers are introduced to the U.S. from Europe and Japan, the options for effective safety graphics have increased. Furthermore, given COVID-19, antimicrobial handrail graphics are available to meet society's changing needs. Meanwhile, in an opportunity for

Using color cues to successfully modify escalator rider behaviors at the point of ridership; © SBB.

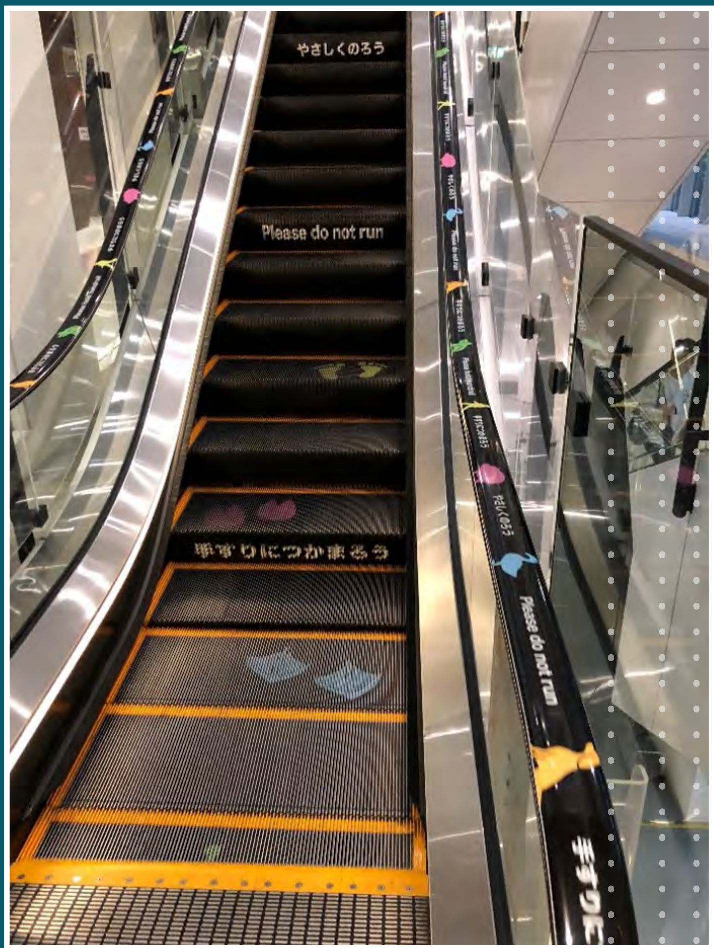
Even rudimentary step riser graphics prove to encourage a positive change of behavior; © Intelligent Transport, London Underground safety study.

established manufacturers, operators, and contractors of escalators, the idea of developing custom graphics is an exciting new domain.

Conclusion

The psychological study of heuristics has existed since the 1970s. The more recent concept of Nudge Theory seeks to democratize and simplify heuristics so it can be applied to countless daily problems that require an effective behavior modification. Advertisers have been using nudge techniques for decades, but in the service of safety for the billions of escalator riders around the world, these techniques have a greater purpose. Riders, who range from young children to the modern, distracted adult and the elderly deserve a safe escalator ride.

For best results, combine escalator handrail, step and riser graphics. Add a splash of color and a dash of safety messaging. Rather than provide distraction, escalator graphics on the moving steps, risers and handrails have proved successful in capturing the attention of distracted riders at a critical time. They help these people who are distracted or with limited vision easily perform the visual-based instant calculation required of relative step-to-handrail speeds necessary to embark and disembark safely; they promote holding of the handrail; and they indicate the safe part of the step for the curious young. The novelty of art and design on escalators can advance semiotics even while being exciting to behold. Most importantly, it places the focus on the moving – not the static – parts where the attention needs to be. After decades of service, stick figures in yellow and black attached to the side of an escalator have matured to the point where they can give escalator riders a little nudge.



An example of a safely dressed escalator near Tokyo, with images and messages on all the visible moving escalator parts; © Atif Bhanjee/RailEyes.

Consulting for the Future

Engineer Luis Sánchez Lebrero says Spanish firm Resuelve Transporte Vertical has built a reputation on completing difficult projects.

by Olga Quintanilla

A Resuelve building access system that includes smartphone operation

Resuelve Transporte Vertical, a Spanish consulting firm with more than 27 years of experience in the Spanish and international markets, credits its success to a commitment to excellence, service, honesty and independence. The company says personalized attention to its customers and persistent research aimed at reaching the best technological performance in the modernization of vertical transportation (VT) are its keys to success.

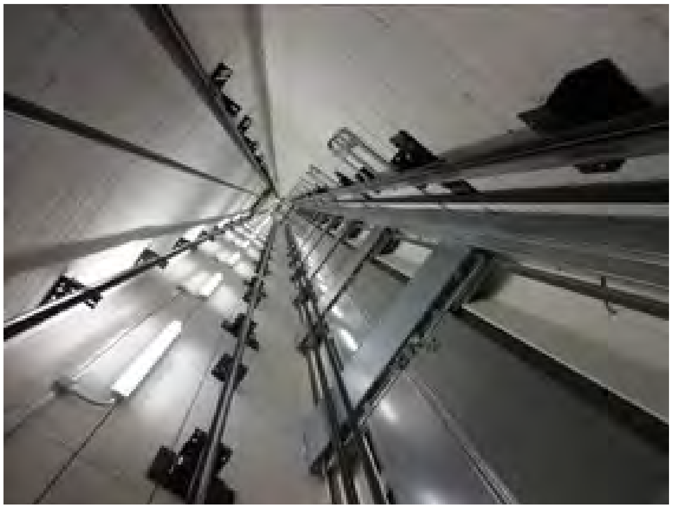
Luis Sánchez Lebrero (**LSL**), an industrial engineer, has been a partner-consultant for Resuelve since 1992. In this article, your author (**OQ**) asks him about the difficulties the company has faced because of COVID-19, the demands of customers in response to the pandemic, the transformations VT is undergoing, the importance of energy efficiency and the future that awaits the VT industry.

OQ: ***How is the pandemic affecting Resuelve in the development of its projects?***

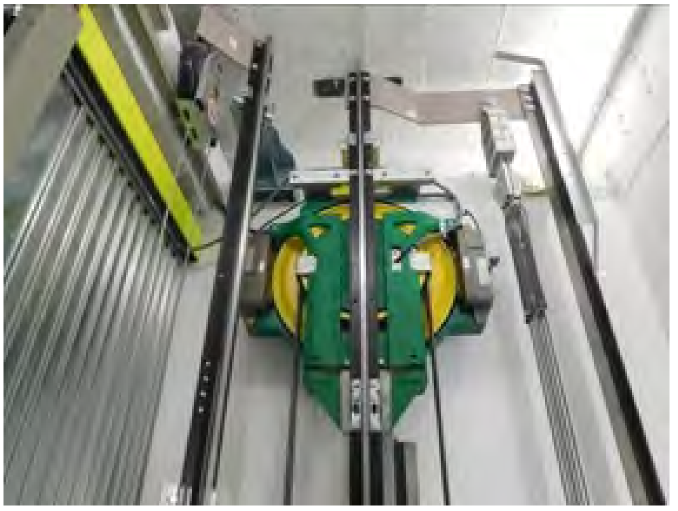
LSL: In relation to VT consultancy activity, the projects underway have followed the investment plan, although in some cases, investments were delayed by several months. In other cases, the investor, after evaluating the situation of the pandemic, has preferred to carry out the work of building and modernizing elevators during the pandemic period, because, as there are fewer users in the buildings, inconveniences and complaints have been considerably reduced.

Regarding the methodology of work and development of services, it is obvious there has been an appreciable limitation of face-to-face meetings. On the positive side, the high technological level and current connectivity have made possible the continuation of consultancy services. They are enhancing video conferences with customers and collaborators, optimizing time, providing added value we implemented during this

A Resuelve destination-control panel



A hoistway from a Resuelve project



A machine for a machine-room-less project by Resuelve

pandemic, and giving us immediacy of communication with engineers of elevator manufacturers so that we can deal with proposals and solutions. Before the pandemic, such meetings were held only in person, which added attendance limitations. Another advantage of remote meetings is they have made it possible to improve the reconciliation of work and family life. This is something that, in Spain, should be encouraged, in view of the experiences in other countries, especially those in Northern Europe.

With regard to investments during the initial phase of COVID-19, some customers revised strategic plans for some projects according to their perspectives of the evolution of the pandemic. However, later all projects were reactivated, reviving the same scope and level of quality seen prior to this contingency.

In relation to the technological equipment of VT facilities, in new projects and in those in the execution phase, customers are demanding integration of systems offering protection against COVID-19. However, it is important to point out that, in some projects before the pandemic, we had already begun implementing many of these technical advances before this situation, for reasons of technological image and hygiene.

In reference to the execution of works in VT facilities, we have observed delays in assembly due to mobility restrictions, as well as cases of COVID-19 infection in assembly companies or among the building's population. We have also observed worldwide delays in supplies of some materials.

OQ: ***Which area of your company's offerings have been most affected by COVID-19?***

LSL: We consider that we have been one of the lucky companies, at least until this moment, because we have been able to maintain the development of all our activities and services, including supervision and control visits of work. We hope the rest of the companies and sectors can find the way and realize the support of collaborators so they are able to maintain their activity at 100%, as has been our case.

OQ: ***Has the pandemic caused changes in customer demands?***

LSL: Customers are perceived to be more sensitive to high-performance, highly versatile control systems and the latest touchless technology systems, as a measure of protection against the transmission and infection of viruses, especially SARS-CoV-2, with which we are currently dealing.

We also observe a greater sensitivity to the size of the cabin, which, in Spain, has traditionally been of reduced dimensions, compared to those of other markets. Small cabins make it difficult for passengers to maintain adequate distance. Additionally, one of the measures now frequently implemented is placing limits on the number of people traveling in the cabin to maintain proper distance. Among the most demanded solutions are the disinfection systems of the cabins.

In addition to technological equipment, we consider architectural elements that influence social interaction, such as the rearrangement of users in the waiting halls, changes in traffic studies, a lower factor of cabin occupation, variation of user demand curves, more staggered accesses and different densities of building occupation, in all of our projects.

OQ: ***In the 27 years of experience of Resuelve, which aspects in the elevator field do you think have promoted a greater transformation?***

LSL: In our "elevator world," the changes, evolutions and transformations have been constant. We must recognize the important research and technological evolution that have allowed the progressive increase of building heights, which have riding distances now reaching almost 1 km. However, we are surprised that, in conversations with some of our customers, they state they do not see major technological changes in the elevator. This means we must improve our communication among manufacturers, service companies and consultants so these advances are perceived to a greater extent by the user.

I can assure that, in the 27 years of experience in elevator consultancy, these installations have improved considerably

Another hoistway

Overhead machines from a Resuelve project

in security, reliability, accessibility for people with disabilities, energy efficiency, travel experience, peripheral technology, display screens, content broadcasting, integration of elevators with building access control systems, monitoring of the operation of the elevators, etc. We have evolved from elevators controlled by relay technology or basic electronic systems to powerful controllers equipped with AI and extensive connectivity.

In addition, by means of computers or mobile devices, clients have the possibility of communicating with their elevators remotely from any place, having ample and updated information on the state of the elevators, breakdowns, etc. On the other hand, we are evolving to predictive maintenance through the incorporation of Big Data and AI technologies. The introduction into the elevator world of telecommunications, cell phone control, equipment operation monitoring, etc. has required the incorporation of other professional profiles and improved training in these fields.

Torre Europa in Madrid, where 12 elevators were modernized

Another view of Torre Europa

Not all the evolution has been positive, however. From the consultant's point of view, we are concerned about the negative drift toward customers basing their choice of elevators almost exclusively on price. This purchasing policy has led some manufacturers to design products that meet this need as a matter of survival in the market. Alternatively, installers offer customers solutions not in line with the intensive use of the elevators in the building. The final result of this situation is a technological "involution." Some elevators manufactured today are operating in installations meant for more intensive use and are thus registering numerous problems of operation, durability and comfort. As a result, we are participating in projects where almost-new elevators, with three, five and seven years of age, need to be replaced, causing serious inconvenience and economic cost. This is not to mention the ecological impact it implies.

OQ: ***Our country is safe in terms of VT, but to which causes do you attribute the occasional accidents that occur in elevators?***

LSL: Older elevators have significantly lower safety levels compared to those of more modern ones that have the benefit of continuously improved safety regulations. And, in our opinion, it is to these elevators that greater attention and vigilance should be paid.

However, it is important to distinguish between incident and accident. There is a small number of incidents in elevators (not very serious) and an even lower number of accidents (almost anecdotal), although, normally, these cases have a lot of media coverage, as they occur in lifts used daily by the majority of the population and have serious consequences for the occupants.

Today's elevators are very safe. In statistical terms, in other sectors, there are countless machines that record a greater number of incidents and accidents. Lifts are machines, and, as such, there is no such thing as zero risk. Today's elevators have countless safety systems. When an accident occurs, it is usually due to a sum of circumstances. Among them are failures in the installation phase or in later modernizations; inadequate maintenance; misuse or negligence; and, to a lesser extent, defects in components. (This is rare, thanks to the current quality controls implemented by the manufacturers of elevators and components.)

The risks endanger not only users, but also technicians. The most common ones are: trapping of fingers (usually in children), uncontrolled car movement with potentially very serious consequences, poor leveling at stops (which causes falls, probably the most frequent incidents) and the fall of technical staff down the elevator shaft. In our opinion, in most cases, the causes of accidents are technical, not human.

(u-d) before and after views of the machine room at Torre Europa

OQ: ***Why does the company say that one of its added values is that "Resuelve reaches where others do not"? How is Resuelve different from its competition?***

LSL: Our company offers a highly customer-oriented consultancy, which is our main asset. In fact, we still keep those clients with whom we started working 27 years ago. I believe this is because we strive to uphold principles of excellence, service, honesty and independence. Clients understand a company committing to their interests. We understand that experience and research result in expertise that offers solutions for clients.

To be more specific, we have carried out several high-speed projects with significantly reduced pit dimensions. We have executed cabin sizes in modernizations and rehabilitations, taking full advantage of the elevator shaft and thus gaining cabin capacity in most of them. We have executed atypical dispositions maintaining high levels of comfort. The summary of all this is that, in some cases, due to project needs, we have carried out executions and assemblies that some of the multinational elevator companies, having the support of their best engineers, have withdrawn from, because, although it was very important or of high economic benefit, they considered they could not execute it.

Manufacturers, installers and maintenance companies seek engineering and consulting that is very detailed and presented with a degree of commitment, control and supervision of the work. This situation not only occurs in Spain, but also in the rest of Europe and America, which are other continents where we have worked and provided services.

OQ: ***How important is energy efficiency in a project?***

LSL: The concept of energy efficiency has always had a very important influence on our projects, but it is increasing, especially because of our clients' interest in achieving buildings with environmental classifications, such as the BREEAM certificate, and because of the constant search for low- or zero-consumption buildings. Current and future regulations enhance this sensitivity in all areas, including the VT sector. We had applied this policy even before the arrival of sustainability certificates.

For example, the first system installed in Spain with a regenerative static variable-voltage, variable-frequency converter was a project of ours with our client Metrovacesa in the Cadagua Building in Madrid. Currently, all our projects have regenerative, gearless traction equipment, in addition to other equipment that improves energy efficiency. When an elevator finishes its installation, it undergoes independent control and measurements to evaluate and determine its energy efficiency.

We are actively participating in international publications and conferences related to R&D of energy efficiency in elevators. This same year, our colleague and consultant Juan Antonio Marcos Pérez presented to the Scientific and Technical Committee of the International Congress CONTART 2020 in Spain for the communication and publication "Energy Optimization of Elevators in High Buildings." In our opinion, it is one of the works that best explains all the concepts and equipment of the elevator that influence the determination and improvement of their energy efficiency. It brought the opinion and support of multinational engineers, and we want to express thanks for the support and the

About Luis Sánchez Lebrero

Luis Sánchez Lebrero has worked as an industrial engineer since 1992. He holds a degree in Civil Engineering from the University of Zaragoza in Spain and began his professional career in the first VT consultancy in Spain, Lift Consult S.L, reaching the position of consultant partner. In 2001, shareholders of Lift Consult decided to diversify the business and create architecture and engineering services company Interbuilding Consult S.L. Sanchez held various responsibilities, including project manager, director of project management, director of facilities management and head of the Coordination Team for Exclusive Building Works. He was appointed operations director until 2004, when he pursued a new professional course in real estate with Lualca S.L., where he was appointed facilities manager and participating in several shopping centers, office buildings and housing projects. In 2006, he became a partner in the society Resuelve Management S.L., which worked in nine principal activities, including VT consulting. In 2018, Resuelve Transporte Vertical S.L. was formed centered exclusively on VT consultancy.

Sánchez serves as VT consultant with a number of real estate companies in Spain, as well as other clients like investors, banks, hotels and architects. Over the course of his 25-plus years of experience, he has carried out projects, audits and inspections of more than 700 VT installations. He has been recognized by such international companies in the sector as KONE, Schindler, thyssenkrupp, Otis and Orona.

information that allowed this work to come to light and be admitted by the Scientific and Technical Committee of the congress.

OQ: ***What is the future of VT? Which will be most important: aesthetics, safety, sophistication or cost?***

LSL: VT facilities will be developed by improving specifications and performance in terms of accessibility for people with disabilities, digitalization, connectivity, predictive maintenance (Big Data), integration with building automation systems, integration with security systems and home automation, interaction with passengers, personalization of travel experiences and aesthetic improvements inside the cabin.

Another technological advance and challenge in high-rise buildings will be from the new technologies that will allow us to overcome the current limitation of maximum ride distance.

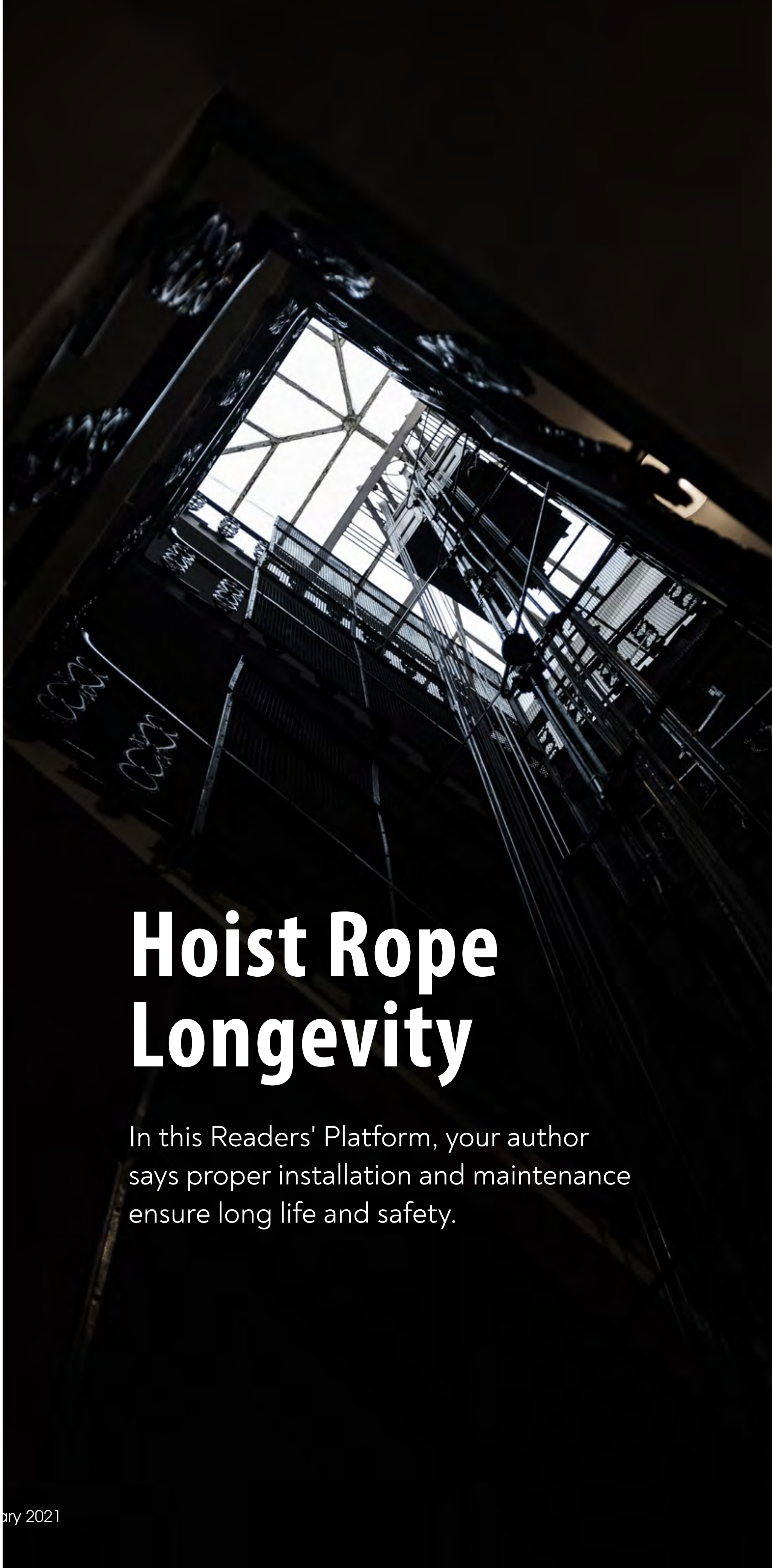
Currently, there is R&D underway on user detection systems, including biometric identification systems, which improve accessibility and operation. These systems allow calls to be made to elevators without the need for users to perform any operation. The systems also allow interaction with security and access control in the buildings. Some of these technological solutions, for which we are participating as consultants (and thanks to the support of some of our clients) will be implemented for the first time and will be future references for new projects. Another future bet will be active information systems that will interact according to the situation, the user and their destination, among other factors.

As for what will prevail most, we believe that price will continue to be important for a segment of demand in the elevator sector, but, for some investors who value standing out against their competition, the main objective will be focused on elevators with a greater sophistication, benefits, comfort, customization and singular decorations; in short, to obtain an optimal and singular experience of the trip.

OQ: ***What has been the most ambitious or interesting project in which you have participated?***

LSL: We have participated in many projects, but those that demand greater technical effort and dedication in work hours are those related to the modernization of elevators. Of each of these modernization projects, we keep a singular memory, since all the multinational installation companies present them as their best executions and take their clients to visit these installations. However, at this moment, if we had to highlight one of them, it would be the modernization project of 12 elevators in Torre Europa in Madrid, a building occupied by very demanding multinational companies. At Torre Europa, all mechanical parts were kept, and all the electronic controls and power parts were replaced by the most sophisticated available. The old DC motors were retained after checking and repairing them. In addition, the installer carried out the work using a control systems combiner (overlay) on old controllers from another manufacturer, which meant that the development of the project was more difficult and ambitious. In fact, the implementation of an overlay was only the second time it was done in Spain. The first time was in another of our projects, years earlier. The result was that our client obtained practically new elevators, while investing one-third of the cost of completely new ones. It was also accomplished in a significantly reduced time, compared to that of a replacement, and resulted in minimal inconvenience to the users.

Olga Quintanilla is media manager for the Spanish Professional Association of Fire Technicians (APTB) and a freelance journalist, community manager and blogger. Her experience includes collaborations with health institutions, tourism publications, social media responsibilities and, for 20 years, working as a parliamentary correspondent for a Balearic newspaper in Spain.



Hoist Rope Longevity

In this Readers' Platform, your author says proper installation and maintenance ensure long life and safety.

by Fartash Razmjoo

Many in the industry may have noticed that an excessive number of elevators have had their ropes replaced or scheduled for replacement much sooner than in the past. Hoist rope problems have become some of the most significant maintenance concerns for both elevator contractors and building owners. Rope replacement is expensive, increases the cost of maintenance and interrupts the normal operation of the building for days and even weeks.

Elevator manufacturers claim that the quality of the ropes is not as good as it used to be. On the other hand, hoist rope manufacturers claim that not only has the quality not decreased, it is better because of modern manufacturing technologies and tighter jurisdictions and standards. Rope manufacturers believe that the new elevator designs, with their smaller machines, rope sizes and more aggressive sheave designs, put more tension on the hoist ropes, and this eventually reduces the ropes' lifespan.

I think both claims are correct to a certain extent, but, apart from the quality of the ropes or the fact that newer designs may put more tension on them, installation techniques and proper maintenance play a crucial role for keeping the ropes in good condition and extending their lifespan.

Over the years, I have talked with many technicians and mechanics in the industry, and I can say that when it comes to installation and maintenance of ropes, there is a lot of room for improvement in the training of elevator personnel. In this article, I discuss some important areas that should be considered during installation and maintenance of hoist ropes to prolong their lifespan.

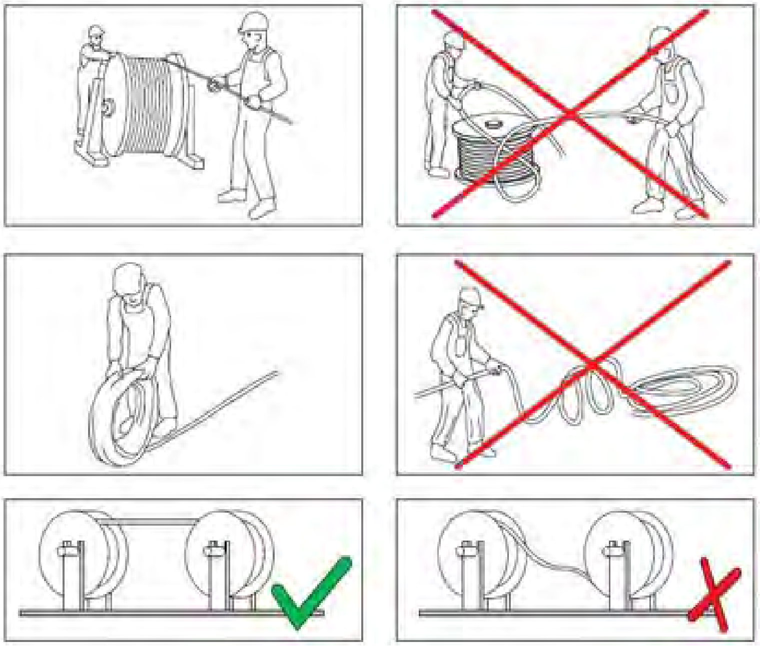
Storage and Handling

- Ropes should be stored in a clean and dry area and protected against

corrosion, dirt, rain and direct sunlight.
- Extra caution should be taken during transportation and handling to avoid physical damage to or twisting of the ropes.
- The floor should be cleaned before laying out ropes on the ground.

Installation

Rope installation methods may vary from manufacturer to manufacturer, but all installation techniques — no matter how demanding they are — should be followed and implemented correctly. Failure to follow the manufacturer procedures can damage the components and reduce rope life. Regardless of the installation techniques used, certain procedures must be followed to ensure ropes and sheaves are in good condition.


Proper handling of hoist ropes; images provided by the author

Rope and Sheave Relation

- In any rope replacement, the new ropes should be the same type and size as the original ropes.
- Hoist ropes and sheaves are in contact with each other more than any other components in the elevator system and, thus, have a great effect on each other. Over time, friction between rope and sheave gradually reduces the ropes' diameter. This reduction allows the worn hoist ropes to sit more deeply into the sheave grooves and creates a new groove within the original groove (Figure 1). When this happens, a replacement rope in the worn sheave groove creates pinch points that reduce the lifespan of the new rope. Because of this, many manufacturers and experts recommend that the ropes and sheaves be replaced at the same time.
- Misalignment will damage the ropes and sheaves. According to Brugg Lifting, a fleet angle as small as 4° can reduce rope life by 33%. Extra caution should be taken to minimize the fleet angle (Figure 2). This can be accomplished by making sure that the drive and counterweight sheaves are aligned; making sure that, in 1:1 roping, the center rope on the drive sheave is aligned with the center of the car and counterweight; and by making sure that, in 2:1 roping, the drive and deflector sheaves are aligned with the pulley (sheave) of the car and counterweight.
- Reviewing the ropes to ensure none sits lower in the sheave groove. If one does, it could indicate either improper rope tensioning or damage to a sheave groove (Figure 3).
- All sheave grooves should be inspected for excessive wear or damage. Sometimes, soft sheave material will allow the ropes to imprint the sheave groove. Figures 4 and 5 show examples of excessive damage to sheave grooves. All these damages should be found and prevented well before such a condition exists. This will happen if proper maintenance is in place.

Twisting and Untwisting Ropes

Rotation and twisting have significant effects on rope life. Rotation, especially in high rises and using steel-core ropes, can cause the outer strands to untwist, placing the majority of the load on the rope cores, which deteriorates the rope over time. Anti-rotation devices and torsion locks should be installed properly to avoid this condition on ropes. (Figures 5 and 6).

- Twisting can put extra pressure on the ropes, causing excessive friction between strands. It is important to make sure the ropes are not twisted during installation (in either direction). This is more challenging in situations like machine-room-less devices or double wrapped ropes with complicated configurations. Failure to avoid twisting of the ropes during installation will reduce their lifespan significantly.
- To ensure proper installation without any torsion or twisting, the ropes should be checked for the number of rotations. The easiest way to check this is to observe the line painted along the ropes during one full trip. Stand in the machine room near the hoist machine and count the rope rotations. The number of rope rotations must not exceed one for about every 100 ft of rope length (Figures 7 and 8).

Hoist Rope Load Equalization

Although equal load tension on the hoist ropes is a code requirement, this is often not taken seriously enough and requires more attention from the industry. Equal load tension on ropes plays a crucial role in performance of the

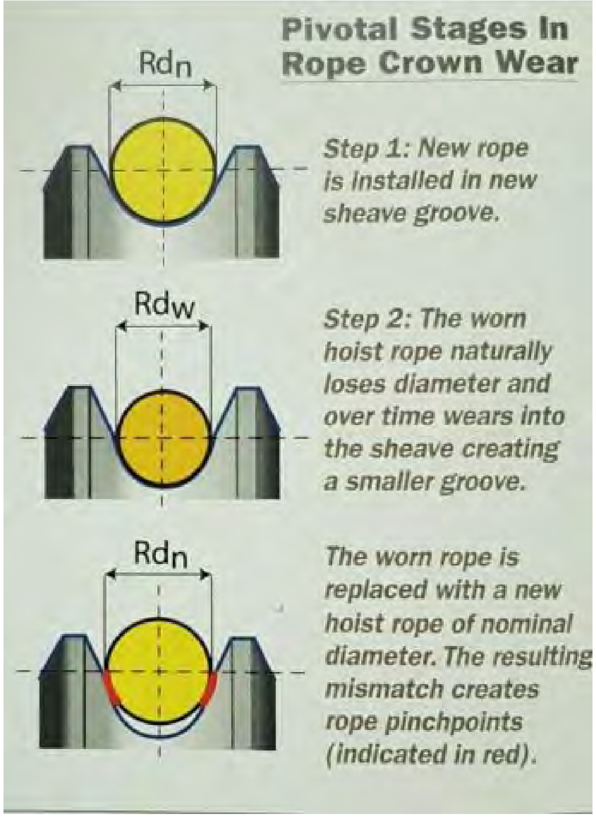


Figure 1: From the Brugg Lifting manual

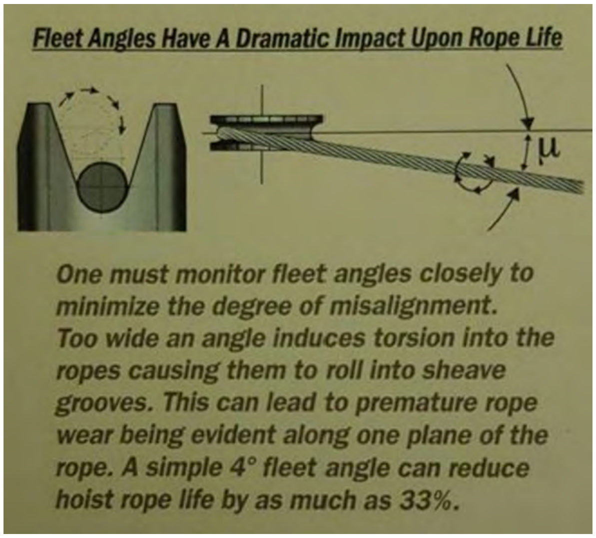


Figure 2: From the Brugg Lifting manual

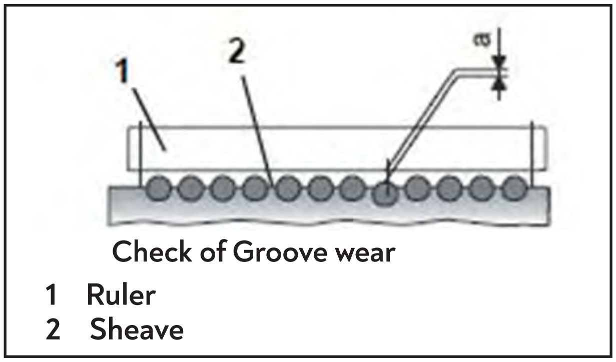


Figure 3: A ruler or other straightedge can be used to check rope depths within sheave grooves.

system, as well as in life expectancy of both ropes and sheaves. When there is uneven load on the hoist ropes, the rope that has to carry more of the load causes greater sheave groove wear and sits deeper in the groove. An unbalanced load reduces the life expectancy of both the ropes and sheaves. Meanwhile, the ropes carrying less of the load will slip over the sheave as a result of different speeds. This phenomenon reduces the performance and safety of the system, in addition to damaging the ropes and sheaves. To prevent such problems, rope tension should be equalized during installation/replacement, and be reviewed and adjusted regularly as part of a regular maintenance routine.

Unequal hoist rope tension can be caused by several conditions:

- Missing or broken anti-rotation device
- Unequal rope stretches due to installation mistakes, such as twisting the ropes or insufficient time allowed for initial rope stretch
- Unequal sheave grooves when new ropes are installed on existing sheaves
- Rouge on hoist ropes, which, over time, changes the diameter of the rope and changes the sheave groove pattern
- Hoist rope vibration

There are different methods of rope tension measurement and equalization; while all methods have degrees of errors, newer tension devices are more reliable and faster to implement.

Using tension gauges and tensiometers is a common method of balancing rope tension (Figure 11). In this method, the technician should measure each rope's tension repeatedly and use the results to balance the tension of all ropes. It is important that the location of the device be the same for all ropes during the process and that proper care is taken to reduce human error. Using this method can be challenging in more complicated arrangements, such as 2:1 roping.

Figure 4: Excessive damage to a sheave groove

Rope tension should be equalized during installation/ replacement, and be reviewed and adjusted regularly as part of a regular maintenance routine.

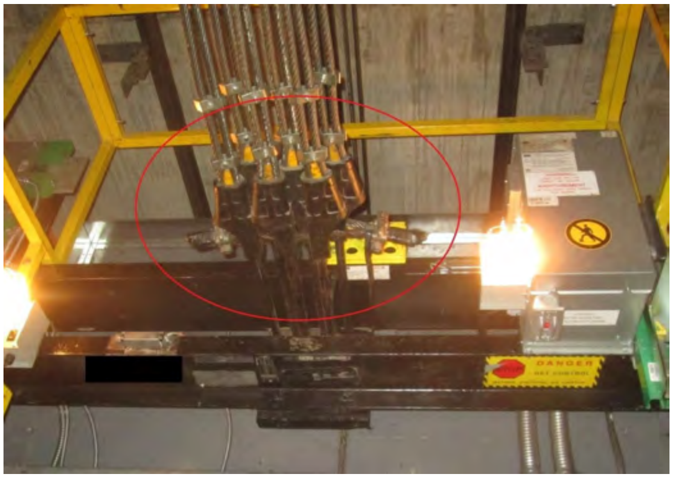


Figure 5: Anti-rotation devices


Figure 6: Torsion locks.

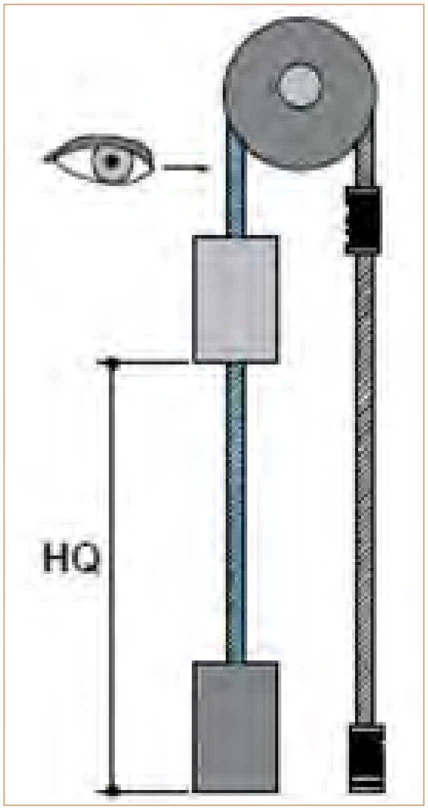


Figure 7: Visually checking rope rotations

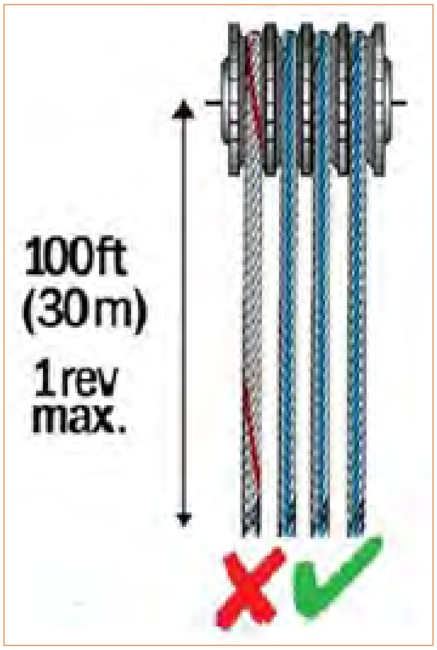


Figure 8: The painted line on hoistway ropes; if the line rotates more than one full turn per 100 ft of travel, the rope has been improperly installed.

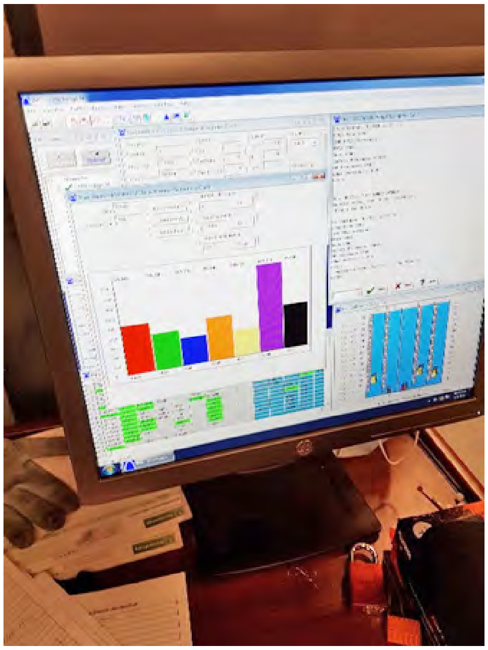


Figure 9: A monitoring system can reveal unequal rope tension.

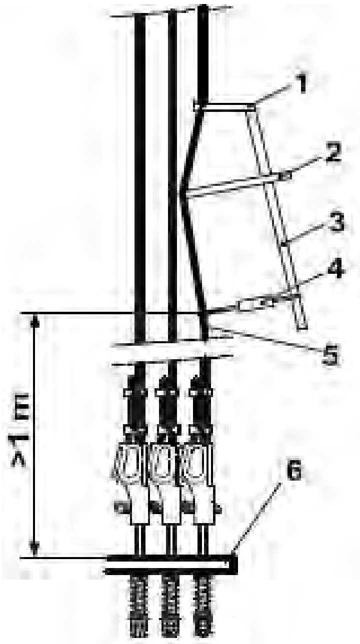


Figure 10: Tension gauges and tensiometers are effective tools for balancing rope tension.

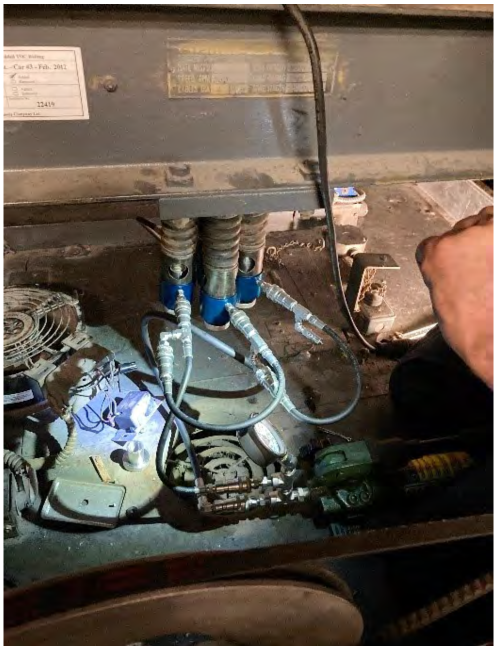


Figure 11: A hydraulic rope tension equalizer in use

For better results, hydraulic tools that use hydraulic pressure to equalize rope tension help avoid flawed measurement and human error (Figure 11).

There are also automatic hydraulic rope tension equalizing devices. These devices are installed permanently at the endpoint of the hoist ropes, producing constant equalization and tension of the ropes. These devices help to reduce the risk of error and cost of maintenance by working independently (Figure 12).

Figure 12: A permanently installed hydraulic rope tension equalizing device

Lubrication

Lubrication is a key factor for greater rope longevity, and this process needs more attention and awareness. We all know that lubrication is essential to protect the rope against excessive friction within its strands, core and wires. Likewise, we know it protects ropes against moisture and corrosion. But, this very important issue is not always taken seriously and is surrounded by many misunderstandings.

It is important to monitor the ropes' condition regularly and lubricate them per the manufacturer's instructions. A simple way to check the ropes for proper lubrication is to touch them. A lubricated rope will leave a mark on the finger; if there is no mark, the ropes should be lubricated (Figure 13).

There are many improper methods of manual lubrication, such as pouring, dripping or swabbing oil onto the rope. Using a roller applicator is the best way to manually lubricate hoist ropes, but it is important to make sure the ropes are lubricated from both sides.

There are also automatic lubrication methods. In an automatic lubrication system, oil is applied to the rope through a felt strip via an electrostatic charge. The adjustment of the gap between the felt and rope is very important; an improperly adjusted and positioned device can damage the felt or allow the oil reservoir to run empty. Another issue with automatic lubricating systems is they often create a false sense of trust that prompts the mechanic to overlook the status of the ropes' lubrication. The elevator mechanic should always review and ensure proper operation of the automatic lubricator,

Current arguments about rope designs and quality notwithstanding, proper installation and maintenance are the most important aspects of extending the life of hoist ropes.

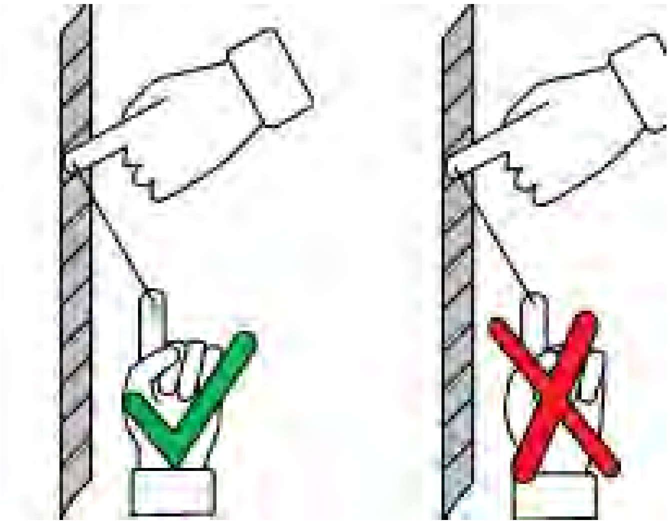


Figure 13: Touching a lubricated rope should leave a mark on the finger; no mark means the rope is due for lubrication.

Figure 14: automatic rope lubrication system

as well as the condition of lubrication on the hoist ropes (Figure 14).

Too much lubrication can also be a problem, as this might reduce traction, attract dust and can even throw oil onto the machine and brake surfaces, causing a safety issue.

Another common mistake is when technicians apply extra lubrication on the rope when there is rouge on them. Lubrication cannot restore ropes from rouge effects; in fact, this could worsen the condition by overlubricating and covering the rouge effects. Ropes should be replaced if there is rouge and other unfavorable conditions.

Conclusion

Hoist ropes are constantly under tension and subject to wear from friction, both internally between strands and externally with other components, like sheaves. This harsh working environment requires extra caution and attention to the ropes to ensure they are working properly and are in good condition. Proper lubrication, rope tension equalization and twisting prevention are important for smooth, safe operation of elevators. Current arguments about rope designs and quality notwithstanding, proper installation and maintenance are the most important aspects of extending the life of hoist ropes.

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[3] Draka Rope Installation Guide.
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Fartash Razmjoo is a mechanical engineer with many years of experience in various industries, including more than 15 years in the elevator and escalator industry. Razmjoo currently works with KJA Consultants Inc., where he is involved in all aspects of the firm's operations, including design, modernization, inspection, project supervision and code consulting. Prior to joining KJA, Razmjoo worked for one of the world's largest elevator companies for more than eight years and served as head of the escalator division in Iran. He has many years of experience in all aspects of the industry, including maintenance, service and new construction. He has taught elevator and escalator courses at Koosha Technology College in Iran for four years and is coauthor of Escalator Safety (available from elevatorbooks.com), as well as many papers published in Iran.

Engineering for Safety

Cab manufacturers' involvement in design and testing of safety gears is vital to protect the riding public.

by Muharrem B. Çakirer

One day, several years ago, I parked my car on a busy street in Ankara, Turkey. I had two problems: to take the elevator construction project documents to the building audit company and have them approved by the engineers there, and to get back to my car before it was ticketed. I entered the building almost breathlessly, but there were no engineers in the office — only a secretary for the building audit company. I was going to leave the documents there and then come back to get them after they were approved by the mechanical and electrical engineers. I was about to hand them to the secretary and leave the office when she asked me to wait and went to the next room. The noise of three stamps broke the short silence. The secretary returned and gave me the documents and told me it was done. I checked the documents; the projects were indeed approved completely. I was happy to finish my task quickly, but I was also surprised because the signatures were given, but there were no engineers around!

I experienced this incident when I was working at an elevator installation company. For me, it is noteworthy, as it indicates how engineers are positioned within the industry. Considering all the calculations, designs, projects and so forth, the elevator industry could be a wonderful working field; however, in our country, Turkey, where there are thousands of elevator companies, the situation of the sector and the position of the engineers do not seem good at all. Although there are good examples in which the engineers offer added value and demonstrate their engineering skills, the general condition at elevator companies is similar to the example above.

A parachute system, which is vital for the safety of elevators, is a complete engineering subject, as it requires delicate calculations, design and legislation knowledge. Contributing to the industry with original designs and creating new products is directly related to the employment of engineers.

Safety gear installed on upper girder

Safety gear installed on lower girder

Parachute systems are vital in high-speed elevator in terms of passenger comfort and safety but are not appreciated as much as they should be. Finding cheap safety gears on the market is an indicator of this. When the manufacturers and the contractors sign contracts, safety gears are generally in the shadow of cabin model choices. However, the less-dangerous parts of the elevators are the parts visible to the end users, while the invisible parts — like safety gears — are the parts that come with more risks. In this article, we will evaluate the progressive safety gears that are obligatory for elevators with a rated speed that exceeds 1 m/s.

Directive 2014/33/EU defines six products as safety components. Two of them, the overspeed governor and safety gear, work together to maintain safety. The function of the overspeed governor is to keep the safety rope stretched enough and to stop the elevator when the rope loosens. If the suspension ropes carrying the elevator shear off or the downward speed increases extremely, the safety rope, one side of which is connected to the cabin, is pulled. The electrical safety device on the safety gear cuts off the power supply to the traction system and stops the drive machine; meanwhile, the progressive safety gear grips the guide rails, clamping the elevator to the rails.

The simplest way to stop a moving object within a certain time is to absorb its kinetic energy by converting it into heat through friction. In general, when a safety gear mechanism is activated, half of the safety gear connected to the cabin contacts the rail through springs, while its other half is pressed to the rail through the wheelhouse, or "roller." The rail is clamped between these two parts. The normal force generated turns

Skid mark assesment tested in rated speed of 1m/s	
for $0,2.g_n$ $V^2=(V_0)^2+2.g_n.h$ $0^2=1^2+2.(0,2).(9,81).h$ h= 0,25 m= 25 cm	*for* $1.g_n$ $V^2=(V_0)^2+2.g_n.h$ $0^2=1^2+2.(9,81).h$ h= 0,05 m= 5 cm
As the average retardation in the case of free fall of the car shall lie between 0.2 g_n *and 1* g_n*;* **5 cm < h < 25 cm**	
V: speed at stop V_0*: Rated Speed* g_n*: acceleration of free fall (9,81 m/s2)* *h: skid mark*	

The braking distance, based on the activation of the overspeed governor at a rated speed of 1 m/s, is calculated with the above formula.

Safety gear test stand

into friction force and starts using the kinetic energy of the cabin. The friction continues until the cabin stops.

The progressive safety gear is a mechanical system. It can be installed to the lower or upper supporting girders of the cabin sling. If there is a living space like a residence or office under the lift well, the counterweight should also be equipped with a progressive safety gear.

The average retardation for a progressive safety gear in the case of free-fall of the car with rated load or the counterweight shall lie between 0.2 gn and 1 gn. (gn, which is standard acceleration of freefall, is equal to 9.81 m/s^2.) To maintain the safety of life and property, ideally, the brake should engage with an average retardation of 0.6 gn. High retardation means the cab is stopped within a short distance. For example, if an elevator brakes with average retardation of 1.0 gn, it will stop sharply, as the shifting distance is short. If it is higher, sudden braking poses a greater risk for children, the elderly, the sick and pregnant women. In cases in which it is lower than 0.2 gn, the braking distance will be long.

Safety Gear Tests During Registry Inspections

With the full-load braking test, rails, console connections and the conformity of the machine frame installation are tested, in addition to the safety gear, before the elevator is placed into service. During safety gear tests at registry inspections, the total braking distance has always been the subject of debate.

For the registry inspection of elevators installed in accordance with 2014/33/EU Directive, EN 81-20, Article 6.3.4 of the safety gear test is made while the cabin is loaded with 125% of its rated load.

After the safety gear test, the cabin is positioned in a way that allows for measurement of the marks on the rails. Both sides of the rail are checked for brake marks, the height and width of the marks on the rails is measured, and inspectors check to see if there is distortion or breakdown evident on the cabin. According to the results of the load test, an elevator that brakes with a rated speed of 1 m/s is considered compliant if the safety gear slides 5 cm minimum and 25 cm maximum.

To release a safety gear on the car, a command to move in the opposite direction shall be sufficient. This should automatically reset its pre-test mode, and the cabin and sling should be freed from the rails. The elevator should not, however, be returned to service immediately after the safety gear is released; commissioning should only be allowed after the intervention of competent maintenance personnel.

The safety gear blocks that form the brake band are connected to each other with transfer rods that facilitate simultaneous engagement of the brake blocks. The synchronization of two brake blocks will be better if a solid material is used in these connections.

As an engineer working in the manufacturing industry, I feel it is necessary that the cabin manufacturers also provide the safety gear to be used with their cabins. This way, if there is a problem with the safety gear, the customers will be able to find a single responsible party, and the cabin manufacturer will have to find a solution.

I strongly recommend that safety gear manufacturers attend the Type-Examination of safety gear carried out by a Notified Body. It may sound strange, but the first tests should fail. When this happens, the manufacturer will see that the braking acceleration of the tested safety gear is beyond the ranges allowed by the standard. It should even see that the brakes fail, and the elevator crashes. In this way, the manufacturer can understand the importance of its work and have the opportunity to see, before the product is put on the market, the negative scenarios that may be experienced in the future. Seeing that a safety gear is tested dozens of times, the manufacturer will learn its approach and design from failures and change. As a result, it may manufacture a product closest to the ideal — just as Edison invented the lightbulb after thousands of failures. All manufacturers should know that disasters are likely unavoidable after the product is placed on the market.

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ISO Approves New Standard

ISO/TC 178 chairman discusses the "United Nations of standardization" publication of ISO 8100-32:2020.

by Undine Stricker-Berghoff

The International Organization for Standardization (ISO), after a six-year, intensive international effort, has published ISO 8100, Lifts for the transportation of persons and goods, Part 32, a completely new standard for the "planning and selection of passenger lifts to be installed in office, hotel and residential buildings." With its publication in June 2020, ISO 8100-32:2020, Planning and selection of passenger lifts to be installed in office, hotel and residential buildings, will begin to be applied step-by-step to the elevator industry, as well as demands by customers that the new standard be met.

In September 2020, your author (**USB**) talked with Gero Gschwendtner (**GG**), chairman of ISO/TC 178 and responsible for the ISO Technical Committee, which developed this standard via a focused working group (WG). Gschwendtner is based in Vienna, Austria, and currently focuses on his mandates within ISO/CEN. He stresses the importance of promoting the standard, as its acceptance will guarantee uniform procedure all over the world, thus shaping the future of the overall elevator industry.

According to Gschwendtner, the ISO WG included experts from major elevator companies, renowned academics and elevator consultants (e.g., from Israel, Germany, the U.S. and the U.K.) with known expertise in elevator traffic analysis and elevator code. In the beginning, 17 people were nominated from the national standards bodies; in the last meeting, 14 of them representing eight countries took part.

USB: Which forerunners in elevator planning standardization existed before the new ISO standard?

GG: ISO 4190-6:1984, on elevator selection in residential buildings, was in use in the industry. It helped to determine the appropriate number, rated load and speed of the elevators. The methods relied on probability models. Conventional control – as described in the standard – operates such that passengers select a direction from the elevator lobby and enter their specific floor destination after boarding the elevator car. But, the latest control systems and simulation were both missing. And the standard dealt only with residential use. Thus, it saw less use in recent years.

USB: What is the relation of ISO 8100-32 to EN 81-20/-50?

GG: EN 81-20/-50 is dedicated to safety for construction and installation, whereas ISO 8100-32 is dedicated to traffic planning.

USB: And then there was also the migration of the ISO number series.

GG: For easier use, the ISO standard series for lifts, escalators and moving walks (e.g., ISO 4190, ISO 7465, ISO 18738) is now migrated to the new numbering ISO series 8100, which was luckily available. The new ISO structure is similar the CEN system, as even China is aware of the EN 81 numbering. When an old ISO standard is revised, it will be converted to the new number. The old number will be kept until the next revision. Several numbers will not be transferred at all (if no further revision will be carried out). They are too widely used and/or are indicated in national regulations (e.g., ISO 14798 Risk Assessment or ISO 25745 Energy Performance).

USB: There has also been a "political" discussion whether to adapt EN 81-20/-50 as ISO 8100 parts.

GG: EN 81-20/-50 is accepted practically everywhere – except in the U.S. and Japan. Thus, it was a logical

Gero Gschwendtner, chairman of ISO/TC 178

The terminology, analysis methods and design criteria should be updated to the state of the art. Office buildings and hotels should be included, along with residential buildings. Destination control systems should be considered in addition to conventional collective control systems. A simulation method, in addition to a calculation method, should be provided.

— Gero Gschwendtner

decision to take over EN 81-20/-50 and publish it as ISO 8100-1/-2. This was agreed within the ISO voting process by all member states. All regional lift associations support the development of ISO standards which is captured in the Global Technical Barrier-Free Trade agreement. The contents of ISO 8100-32 did not yet exist as a CEN standard. So, in this case, there would have been no problem anyway. Due to the change of the ISO standards numbering scheme, it was converted from ISO 4190-6 to ISO 8100-32.

USB: Who came up with the idea for this standard?

GG: All standards must be reviewed every five years. They are sent to all standards bodies for comments. These were then passed to WG 6 of ISO TC 178. Also, several manufacturers made an analysis with their own criteria, finding that no appropriate standard was available. Then, in 2013, at the 25th plenary meeting in NYC, ISO TC 178 decided to update the standard. The first meeting took place on April 15, 2014. The WG had several face-to-face meetings, generally twice per year. In total, about 50 meetings — mostly via video — were held.

USB: Were there any major contributions to the contents?

GG: All members cooperated to create the new standard. They made their contributions covering their different viewpoints. Marja-Liisa Siikonen, convener of ISO TC 178 WG 6/SG 5 and representing the Finnish Standards Association, invited everybody to the meetings, made the organizational arrangements and wrote the agenda. She chaired the meetings, kept them on schedule and coordinated information between WG 6 and SG 5. The participants edited the standard from scratch together online. It was a common effort, and they reviewed the texts sentence by sentence. They received many comments from the ISO TC 178 member countries within the ballots and revised the text accordingly, too. The final standard was approved by the final voting of the national bodies within ISO before publication.

USB: Was there a special trigger leading to the new standard?

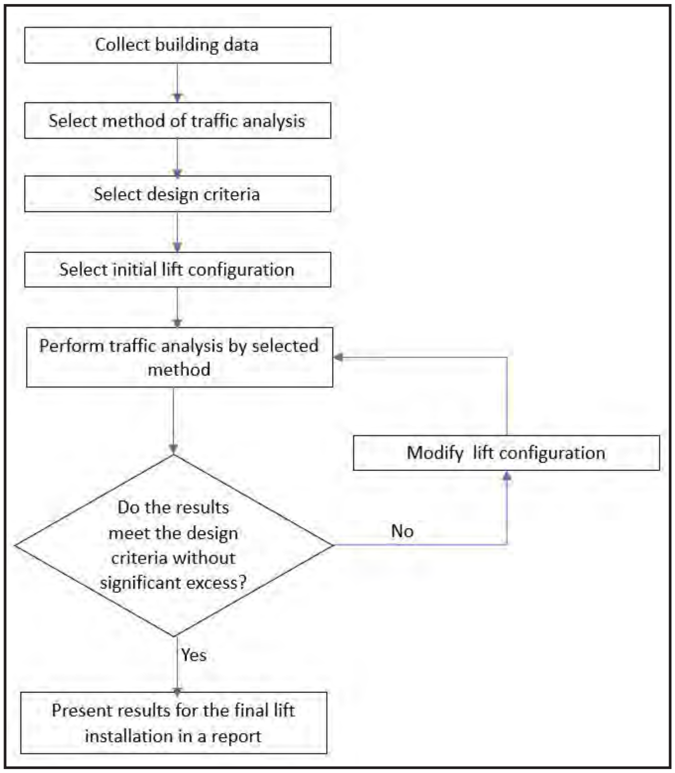
GG: The terminology, analysis methods and design criteria should be updated to the state of the art. Office buildings and hotels should be included, along with residential buildings. Destination control systems should be considered, in addition to conventional collective control systems. A simulation method, in addition to a calculation method, should be provided.

USB: What are the objectives of the new standard?

GG: As the title of the standards states, its objective is to reduce difficulties in comparing elevator analyses provided by different manufacturers and consulting firms. The methods should be easy to understand for all involved. As a help, additional descriptions and selection charts are given in the annex. We provided the theory and made sure it can be used immediately. We deliver the knowledge to customers and to small and medium-sized enterprises (SME), too. By this means, we also fulfill our objective of knowledge transfer. Both objectives contribute to reach the third objective: making sure that the vertical-transportation (VT) system fulfills the expectation.

USB: Can you please give a more precise description of the contents of the new standard?

GG: The paper details methods of evaluating potential elevator performance in a given building to determine the number, size and other characteristics of an appropriate elevator system. It also gives exact definitions for specific elevator terms to promote consistency between elevator practitioners.



Design Process for elevators according to ISO 8100-32

USB: Let's follow the flowchart "Design Process" in Figure 1, which was adapted from ISO 8100-32:2020 Annex F.

GG: "Collect building data" stands at the very beginning of the design process. Generally, you get these data from the customers. Concerning the building data, people rely on the architectural drawings, but these data can change significantly even after one month. It is always important to work with the latest data, even if the design process stretches over, say, four years. The existing data must be revised regularly. In addition, several assumptions to be made will always remain. The differing outcomes on the different databases must be compared. There will be a best case and a worst case. According to the new standard, you should now work with the maximum occupation of the building. And, you have to think about the long-term usage of the building, too.

USB: What comes next in the process?

GG: Next, you "select method of traffic analysis." Simulations deliver the most accurate results. In annexes B and C of the standard, you will find an initial elevator group estimation based on building height, number of floors and population. But the more complex the building is, the more often you end up applying simulation tools.

USB: How do you "select design criteria?"

GG: This is determined by the combination of the building-type information from the first step and the method of traffic analysis selected in the second step. In tall buildings, consultants generally specify the elevators. Different manufacturers apply the standard to their traffic analysis according to the consultants' specification. The consultant compares the analyses to find the best product for the client.

USB: How does the process come to an end?

GG: The last step, "perform traffic analysis by selected method," is followed by an iteration leading to the final result.

USB: Did you perform some tests in the WG?

GG: Yes. The group found that some simulations may lead to differences in results. The reason generally lies in different control systems of each manufacturer or the traffic simulation provider used in the traffic simulations.

USB: EN 8100-32 is the first modern standard on this topic. Will it be adopted by the whole industry? For example, will SMEs perform simulations?

GG: The standard includes selection charts for simple cases. Also, a calculation method is described. Concerning the use of simulations, the standard provides guidance. Not every company must have its own simulation tool. They could use software from somebody else. The standard helps with the application for more complex buildings. If a company provides, for example, destination-control software, it is generally available in the company's simulation tool. Please keep in mind, if your elevator is faster than 7 m/s, you will need a simulation, but you are also outside the scope of the standard. Simulation nowadays is state of the art.

USB: What are the advantages by applying the standard, especially for customers?

GG: It provides a consistency of terminology, evaluation methods and recommended metrics among various providers. The customers of the manufacturers are consultants or building developers. Though the method is not completely new, the standard compiles the many existing experiences. It raises the customer's faith that the installed elevator will fulfill its promises.

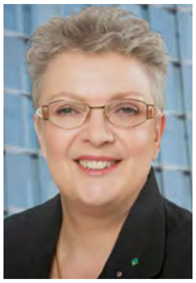
USB: And for the producers?

GG: It increases the certainty that the proposed elevator plan will meet the building's needs.

USB: Do you have a message to ELEVATOR WORLD Europe readers?

GG: The ISO standard is now available and already being used globally, especially for high-rise systems in Asia. It is based on best practices and contains a lot of knowledge that can be used easily, thanks to the inclusion of examples and charts. It helps all stakeholders build a reliable VT system meeting all expectations. The standard is practical and useful. The state of the art is applied. Embrace it, use it!

For further information and to purchase the standard, visit bit.ly/2IJ39oc.



Undine Stricker-Berghoff is the owner of ProEconomy, a Luebeck- Travemuende, Germanybased engineering office through which she works as a coach and consultant for management and marketing mainly in energy and building services. From 2008 until 2013, she was the managing director of VFA-Interlift e.V. in Hamburg, Germany. She studied Mechanical Engineering at Ruhr-University Bochum, Germany, and, immediately after graduation, worked as an energy consultant for ERPAG in Lugano, Switzerland, and Campione, Italy. Prior to joining VFA-Interlift, Stricker-Berghoff worked for VDI, the Association of German Engineers in Duesseldorf, Germany, as secretary for Building Services, and was in charge of the VDI-Standards department. She also served one term as director general for the Luebeck Chamber of Commerce and Industry. She has operated ProEconomy since 2005.

Position of Industrial Associations

Several associations offer their views of the new ISO 8100-32:2020, Planning and selection of passenger lifts to be installed in office, hotel and residential buildings.

Europe: European Federation for Elevator Small and Medium-Sized Enterprises

This standard is positive because it is appropriately written taking into account also the needs of those operators who, like small and medium-sized enterprises, are not always familiar with the calculations and the relevant necessary information that need to be considered to successfully make up a reasonable proposal to their would-be customers.

Europe: European Lift Association

ISO 8100-32 is the first modern standard for planning elevators that has been approved by many national standards organizations. It is replacing the old and outdated standard ISO 4190 Part 6 from 1984. It was prepared by experts from the industry, including notable consultants and the major elevator companies. The planning methods now consider — in addition to selection charts and calculations — a simulation based on full details for even complex buildings and mixed traffic. Simulation is the most beneficial planning method for customers and suppliers. The simulation method in ISO 8100-32 makes a separate simulation for each traffic mix (e.g., 40% incoming/40% outgoing/20% inter-floor) and passenger demand, uses constant traffic demand in each simulation and makes long simulations (to reduce variation of results). The commitment to facilitate dissemination of ISO standards worldwide was also reiterated (in April 2019) by 11 associations of the World Elevator Federation, which has become the World Elevator & Escalator Federation, to include escalators.

Austria: TÜV Austria Services

By the nature of things, for us, as an inspection and Notified Body, mainly dealing with the safety of lifts, this standard is of secondary importance. Nevertheless, it has to be said that this standard is a result of interesting discussions and considerations with a broad consensus. It provides a calculation method and a method for simulation of applications with a certain complexity: for example, buildings with a group of lifts equipped with destination control systems. Additionally, it provides selection tools, examples of calculations and diagrams for common applications in the annex. While the application of the standard will probably require a minimum level of experience, it is still fairly user-friendly. Last but not least, it makes systems comparable.

Germany: VDMA Elevators and Escalators (Aufzüge und Fahrtreppen)

DIN has approved the standard.

Switzerland: VSA (Association of Swiss Elevator Companies)

ISO 8100-32:2020 is the common reference for elevator companies and their customers when selecting lifts in buildings. This is useful for smaller and larger installations thanks to the various selection methods provided.

ISO 8100-32:2020: Planning and Selection of Passenger Lifts

EFESME discusses the new standard and what its implications are for lift SMEs and future SME-friendly standards.

submitted by EFESME

ISO TC 178 Working Group (WG) 6, “Lift Installation,” discussed ISO 8100-32:2020, "Planning and selection of passenger lifts to be installed in office, hotel and residential buildings," which was published in June 2020. At the October 2020 virtual meeting, WG members learned of great interest in this standard by the Chinese market. The country is requesting the standard be made available to it soon, especially because there are tens of thousands of small and medium-sized enterprises (SMEs) installing and maintaining lifts in very tall buildings that require careful planning for their lifts to cope with traffic expectations.

This standard was developed by the WG6 subgroup, also taking into account the needs of SMEs not familiar with all the calculations and data needed to make a reasonable proposal for elevatoring very tall buildings. The standard provides all definitions needed to understand and interpret the various phases of lift evaluation and selection to be considered. This information is suitable even for buildings of up to 40 floors and large lift groups that may also include lifts with express zones.

Another highly appreciated aspect of this standard is annexes of very comprehensive (yet easily understandable) charts that enable visual identification of the necessary parameters of the building environment being assumed and the consequent resulting performances of the lifts being selected. These are:

- Annex A, for selecting car size and rated load, supported by examples
- Annex B, with a colored table for selecting car speed based on the type and rating of the concerned buildings
- Annex C, providing charts by which many possible solutions may be identified by linking the major parameters to be considered for the different types of lifts (number, size and speed) and buildings (total population, number of floors and population per floor)
- Annexes D and E also provide examples for calculations and simulation methods and relevant reports.
- Annex F joins D and E to help the user keep track of the assumptions on which all the results obtained were based.
- Annex G terminates the standard with a simple flowchart that suggests how to iterate the process for better results.

The standard is supplemented by charts intended to be easy to use. We at the European Federation for Elevator Small and Medium-Sized Enterprises (EFESME) believe the charts in the many annexes are exceptional in making this standard far more SME-friendly than other lift standards. We also feel that one of the most valuable portions of this standard is the simple but meaningful flowchart in Annex G. This is especially true for SMEs, because they are often less familiar with the need to implement recorded procedures on how to appropriately reiterate the lift selection process. This can aid them in their results and meeting their customers' expectations.

EFESME joins Small Business Standards in looking forward to being further involved, soon, in International Organization for Standardization (ISO) and CEN WGs willing to introduce a similar approach to the development or revision of other standards intended to be as SME-friendly.

Sky Ring Inclined Elevators

Suzhou Rhine installs intricate system in project that bridges the gap of a massive high-end tourist attraction.

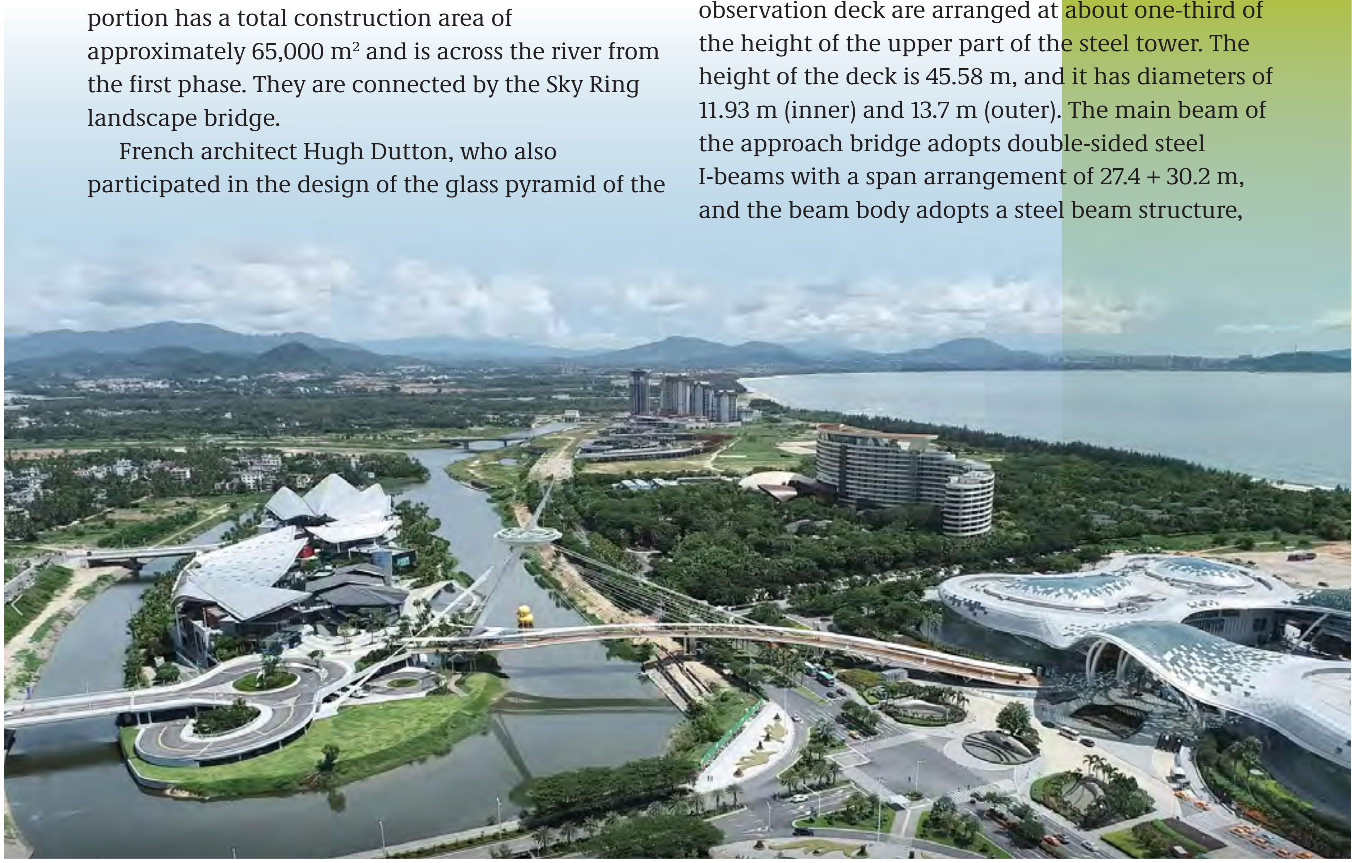
by Jiang Liming

Located in the internationally renowned tourist attraction Sanya City in Hainan Province, China, the first phase of Sanya International Duty Free City was opened in September 2014. With a commercial area of more than 70,000 m^2, it is a collection of tax-free shopping, dining and entertainment, and cultural exhibitions. The high-end retail commercial complex is the world's largest single duty-free shop. Nearly 300 internationally renowned brands have settled in, and it brings together five functional areas of national specialty products, Hainan specialties, outdoor sports, food, entertainment and leisure areas. Its second phase opened in January 2020. This portion has a total construction area of approximately 65,000 m^2 and is across the river from the first phase. They are connected by the Sky Ring landscape bridge.

French architect Hugh Dutton, who also participated in the design of the glass pyramid of the Louvre, personally designed the Sky Ring. Intended to look like a silver diamond ring pointing to the sky, it is currently the only single-tower, universal-hinge, cable-stayed pedestrian landscape bridge in the world, serving as an artistic landmark of the city.

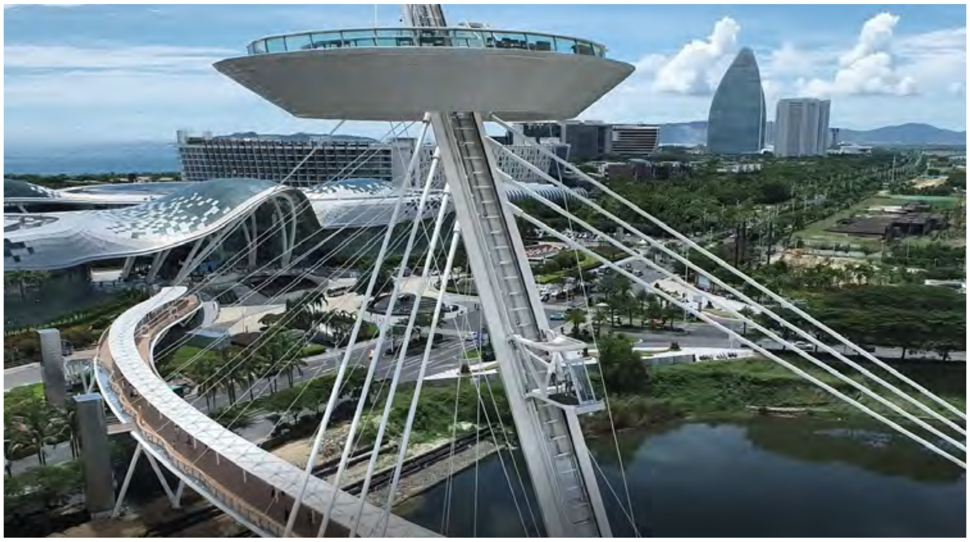
Sky Ring Observation Deck

The total length of the bridge's steel deck is 233.4 m. The main bridge is a double-sided I-beam, single-tower cable-stayed bridge with a length of 175.8 m. The span layout is 99.8 + 51 + 25 m, and the length of the inclined tower is 84.59 m. A single-column steel leaning tower and a Sky Ring observation deck are arranged at about one-third of the height of the upper part of the steel tower. The height of the deck is 45.58 m, and it has diameters of 11.93 m (inner) and 13.7 m (outer). The main beam of the approach bridge adopts double-sided steel I-beams with a span arrangement of 27.4 + 30.2 m, and the beam body adopts a steel beam structure,



Combined, the commercial form and content of Sanya International Duty Free City provide tourists and locals with one-stop tourism, leisure and shopping services.

The Sky Ring observation deck



The inclined elevator

S/No.	Specification	Data	S/No.	Specification	Data
1	Quantity	1	7	Traveling Height (M)	40
2	Rated Capacity (KG/Persons)	800/10	8	Traveling Length (M)	46.2
3	Rated Speed (M/S)	1.0	9	Working Environment	Outdoors
4	Inclination	60°	10	Machine Room Location	Top of Shaft
5	Suspension	1:1	11	Door Arrangement	Front
6	Number of Stops	2			

Elevator specifications

Bridge tower under construction

The cabin

which leads to the Sky Ring from the beam surface via an inclined elevator.

The Inclined Elevator

Developer China (Sanya) Travel Investment Development Co., Ltd. chose Suzhou Rhine Lift Manufacture Co., Ltd. to manufacture and install an inclined elevator for the landscape bridge to satisfy the demand for safe transportation for passengers from the ground to the observation deck.

Installation

The bottom of the tower is thick, and the top is thin. The space of the machine room is small, so installation of the hoist could not be implemented in accordance with conventional procedures. By communicating with the contractor during the preliminary phase of the installation, the hoist was transported to the site and set on the tower at the ground before it was erected.

A landing door

The working surface was tilted and very smooth, with no suitable place for workers to set their feet, when the H-steel and guide rails were installed. Therefore, a high degree of cooperation between workers and machines when lifting and installing the guide rails was required. Additionally, because of the constant wind from the sea, tower shaking and other factors increased installation risk and difficulty. To ensure safety and quality of installation, three temporary hanging points were welded every 1.5 m on the working surface to facilitate the work. When installing the guide rails, guide rails at the bottom were installed first. Then, workers continued installing the guide rails and brackets by using a temporary installation platform and the hoist.

The landing doors and car door of this elevator are both inclined, and the door operator is at the bottom. This is the first such domestic adoption in China, and the installation of the landing doors was tricky: there is no pit in the traditional sense, and the distance between the ground and landing door on the first floor is nearly 7 m. Right below the elevator cabin are the foundation and equipment of the tower. Due to its oval shape across a wide area, scaffolding was impossible, and aerial ladder trucks were unable to enter the site. Instead, large-scale lifting equipment in the form of a hanging cage was used to complete the installation.

Technology Implemented

Under the precondition of ensuring the safety of passengers and not affecting the elevator performance, while not compromising the viewing function of the installation, technicians specially designed an open cabin. Given this one-off design, Suzhou Rhine adopted a tilted car door and landing doors, as well as a lower door-opening mechanism. This was designed to not only ensure smooth opening and closing of the car door and landing doors, but also to minimize the impact they may have on passengers.

If the Sky Ring bridge is like a diamond ring worn on the ring finger, the inclined elevator Suzhou Rhine installed is the diamond on the ring, which has become the finishing touch of the entire landscape bridge. The project was completed in March 2020.

Jiang Liming is chairman of Suzhou Rhine Lift Manufacture Co., Ltd. in Jiangsu, China.

New Construction Hoist for Elevator Shafts

The Alimak LSH, rendered here installed in an elevator shaft, is engineered and manufactured in China, where it launched in November 2020.

Alimak of Skellefteå, Sweden, has launched the new Alimak LSH construction hoist in China. Designed for use inside elevator shafts during building construction, the hoist can serve "the highest floors" of projects and "can be installed quickly with jumping operations doubling in efficiency," the company touted. Its internal size is 1.8 X 1.5 m and 2.8 m tall. Its cabin can transport multiple workers or goods up to 2000 kg. Its rack-and-pinion technology precludes the need for a counterweight or machine room. Before being dismantled, it can also support the installation of elevator guide rails inside the shaft. The Alimak LSH can then be dismantled by tower crane upon completion of the construction work if the shaft is still open at the top. If that is not the case, the bolted design of the hoist still allows for easy dismantling and removal when the shaft is already closed.

The construction hoist's bolted design allows for dismantling in smaller parts.

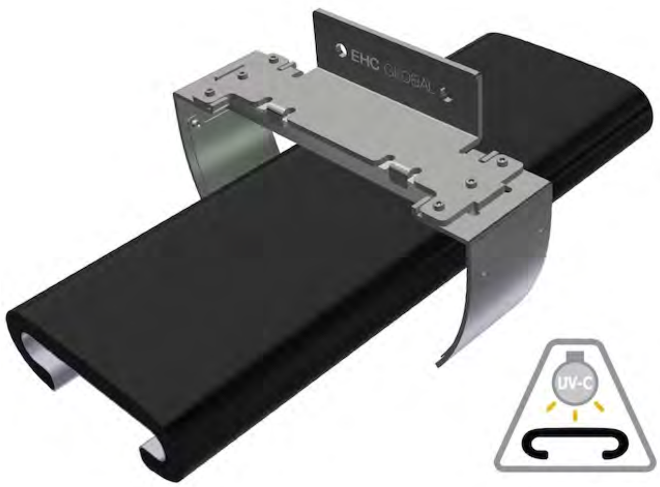
The product has safety rails and fall protection on its roof. It is also equipped with a large-display, stainless-steel control panel and a 7-in. touchscreen with protective glass and IP54 ingress protection. Alimak's "intelligent hoist monitoring system" delivers real-time hoist status information.

alimak.com

Handrail Sterilization Solution

Ansan, South Korea-based Seoul Viosys, a compound semiconductor solutions provider, has applied its Violeds disinfection technology to an escalator and moving-walk handrail product from Canada-based EHC Global. According to Seoul Viosys, Violeds uses ultraviolet LED light to provide robust disinfection for handrails. The technology "is optimally designed to match the speed, area and distance of the handrail to disinfect 99.9% of harmful viruses and bacteria in the areas exposed to the light," Seoul Viosys asserts. EHC Global Vice President of Sales Patrick Bothwell says thousands of installations have been completed around the world, and demand is anticipated to continue through 2021 and beyond. Handrails implementing Violeds can be found in airports, public-transit systems, commercial buildings, shopping malls, healthcare facilities, sports venues, museums and government buildings.

seoulviosys.com/en



New Elevator Line Focuses on Aesthetics

IGV Group SpA of Milan, Italy, has introduced the Ad Hoc elevator line. Calling it ”the evolution of IGV's DNA, which has its own vocation in the special project," it concentrates effort on design in what IGV calls an industry "generally characterized by standardization." The company said it chose Giulio Cappellini as art director to promote the concept of the lift becoming an integral part of architecture.

IGV's goal is making the lift an integral part of architecture.

IGV says it draws from its technical expertise to meet architects' most challenging design requirements.

New Mitsubishi Escalator Focuses on Safety, Energy Savings

Tokyo-based Mitsubishi Electric Corp. has launched its new u series of escalators, designed to improve passenger safety while achieving significant energy savings over previous models, the company announced in December 2020. The u series will feature a "slow-stop" function to slowly decelerate the escalator during an emergency stop and will offer an optional "speed change operation," which allows for low-speed running of the unit. These functions are designed to reduce the risk of passengers falling. Another option, built-in UV light, can lower microbial infection risks.

For energy savings, the u series has a variable-voltage, variable-frequency controller to optimize motor efficiency. An optional function can slow or stop the unit when there are no passengers, cutting energy consumption by up to 30%. Other energy cost savings are achieved by a regenerative converter that creates electricity for other uses in the building and optional low-consumption, long-life LED lights. Finally, the new model is available with optimized equipment space and features a 25% reduction in truss weight without any loss of structural strength.

mitsubishielectric.com

Mitsubishi Electric says its new u series escalators are safer and offer energy savings.

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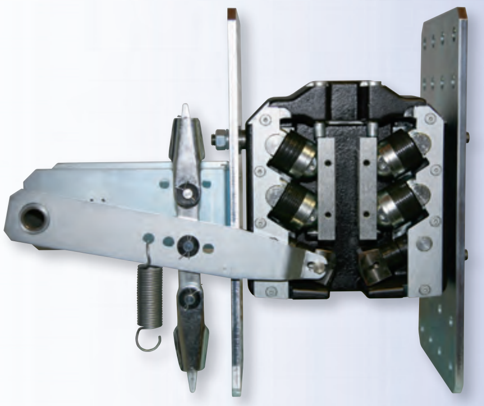
Q & P max. **6‘951 kg**

va max. 3,50 m/s

Q & P max. **5‘000 kg**

va max. 5,06 m/s



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