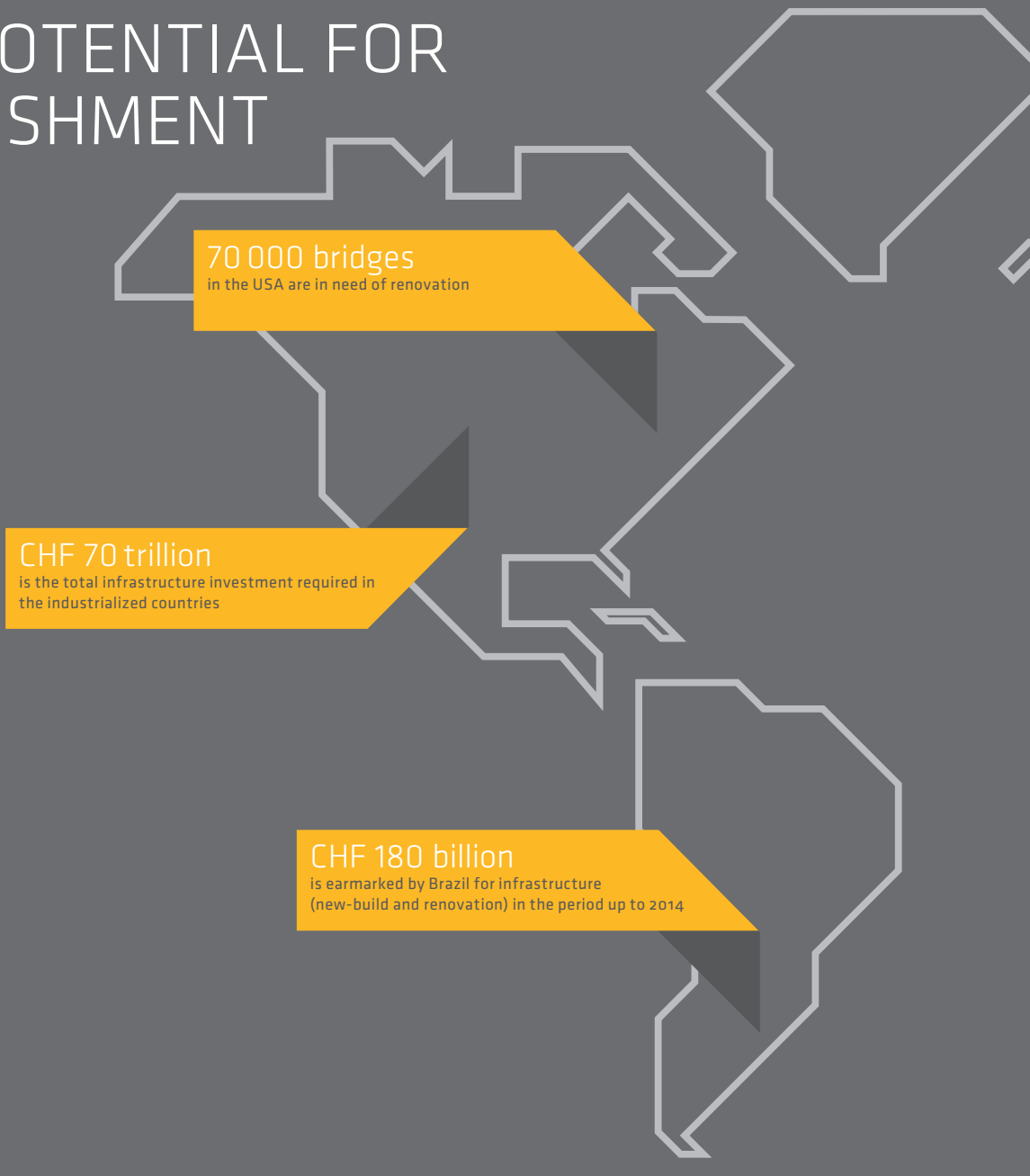
REFURBISHMENT
LONG LIFE CYCLES IN CONSTRUCTION

Facts **GREAT POTENTIAL FOR REFURBISHMENT** 2 *Story* **THE GLOBAL CONSTRUCTION PROJECT** 4 *Photo Essay* **"CITY ORGANISM"** 7 *Trend* **FOCUS ON THE BUILDING ENVELOPE** 11 *Portrait* **INNOVATION THROUGH MOTIVATION AND INSPIRATION** 13 *Cases* **EXTENDING THE LIFE CYCLE** 14 *Interview* **IN DISCUSSION WITH PROFESSOR DR. HANS-RUDOLF SCHALCHER** 20

BUILDING TRUST

GREAT POTENTIAL FOR REFURBISHMENT



SOON TWO-THIRDS OF THE WORLD'S population live in cities and towns. Mushrooming demands are placed on the efficiency of major buildings and infrastructure facilities, and the associated capacity expansion poses a fundamental challenge. Hundreds of thousands of high-rise buildings, bridges, highways, road tunnels, dams and subways are decades old and scarcely able to accommodate the growing loads. Nor do they meet contemporary economic and ecological standards. This inevitably leads to the "refurbish or new-build" dilemma. Its resolution depends on a project-specific appraisal

Source: OECD

of cost-effectiveness and sustainability, in the knowledge that the relevant facilities must not be viewed individually, but as part of overriding systems. Much of the built environment serves to promote mobility and, to safeguard this, there is often only a single economically and ecologically viable option, i.e. refurbishment, maintenance, repair or modernization. This is where Sika steps in: as with its new-build product and system range, Sika also offers in-depth know-how and tailored solutions for the repair, renewal and strengthening of existing facilities. The following pages show just what Sika is doing to make the built environment future-proof.

THE GLOBAL CONSTRUCTION PROJECT

TEXT RODERICK HÖNIG – *PHOTO* JESSICA SIEGEL

SHOULD WE DEMOLISH AND RECONSTRUCT, or is it better to refurbish buildings for the future? This question is becoming ever more pressing as global growth continues apace. Does this change in perspective affect architects and planners only, or does it have an impact on society as a whole?

The world has already been built over – now let's set about renovating it! This could be the motto for construction in the 21st century. Declining reserves of oil and building materials, ambitious climate targets and global urbanization require us to rethink how we tackle the "Global Construction Project." It is not simply a question of constantly improving sustainability standards and labels, but rather, and above all, of taking integrated life-cycle considerations into account, both when planning new buildings and when renovating them. The next generation of construction experts will therefore not only have to construct shiny new buildings but also carry out the less prestigious work of refurbishing, renovating, converting, consolidating and extending existing infrastructures and houses.

Demographic and economic development forecasts also force us to reevaluate the current position: the UN predicts that the world population will stabilize at around nine billion people in about 2070 and not grow any further. By then, the process of urbanization in the densely populated countries such as China and India will be largely complete, with over three-quarters of the world's inhabitants living in towns and cities. This means that a great deal of work still remains to be done on the "Global Construction Project" before 2070, and also that growth and stagnation will balance each other out in two generations. It follows that a change of outlook is already required for the 21st century – the built environment is no longer just the objective, but will increasingly be the point of departure.

A short trip back to the beginnings of 200 years of ongoing exponential growth shows that social and economic development is usually sustainable when it is based on managing the resources available. Global growth started with industrialization, i.e. the switch from agrarian to industrial production in the 19th century. It turned society and the economy upside down and created a new world order which still holds today. Industrialization brought a massive increase in the movement of goods and people, which led to revolutionary technical achievements such as railroads, container ships, cars and passenger aircraft: today, these vehicles and transport systems are still vital lifelines for many countries and societies. These innovative means of transport led to the construction of roads, railway tracks, runways, bridges, tunnels and dams. Meanwhile, engineers pressed ahead with providing and standardizing the supply and safe disposal of electricity, water, gas and waste, first in towns, and then in rural areas. At the same time, telecommunications were steadily expanding – a construction project that is still experiencing frenzied growth today. This complex network of transport, supply and disposal systems formed the technical basis for huge economic and urban advances, especially in the 20th century.

The fruits of industrialization could then be harvested in the last century: in other words, the "capital infrastructure" was managed successfully. It was the century of tertiarization, when the industrial society was transformed into a service economy. By adding the supply of services to the technical infrastructure built up by their parents, our fathers and mothers paved the way for unprecedented growth and prosperity. This can be seen from the countless homes built in the 20th century. It is also evident from the technical infrastructure, the foundations of which were established by industrialization. This infrastructure underpins our society and economy. Transport and communication systems, utilities and waste disposal, protective structures – all are crucial to the smooth functioning of our social and economic coexistence.

In the 21st century, too, it is our task to manage the capital invested by our predecessors, and to do so as effectively and sustainably as we can. Here, managing does not simply mean building – it also means continuing to care for the existing stock. After all, most of the "Global Construction Project" consists of post-war infrastructure and housing.

However, historically significant buildings and monuments account for only a small proportion of this; the greater part is made up of faceless, mass-produced constructions built in the economic-miracle years from the 1950s to the 1970s. Renovating them will require care in formulating what is needed, as well as innovative technical solutions and fresh architectural ideas, for if we wish to achieve our climate targets and satisfy the demand for sustainable construction, we must reflect more deeply than before on the theme of renovation. It is necessary to develop ideas and techniques which will safeguard or at least convert the vast amounts of grey energy stored in the buildings dating from the post-war period.

A look at how the world is currently managing its resources reveals the importance of considering the life cycle of a building in an integrated manner, and reevaluating the "building stock resources." For example, the Global Footprint Network has calculated that mankind is currently consuming the resources of one-and-a-half planets. This means that the Earth takes over 18 months to produce the amount we consume in one year. Reevaluating the "building stock resources" means above all investigating the options of refurbishing, renovating, converting and consolidating before choosing the new-build option. It is only by working on the existing stock that we can optimally exploit the "production energy" contained in a building and not let it disappear uselessly.

A LOOK AT HOW THE WORLD IS CURRENTLY MANAGING ITS RESOURCES REVEALS THE IMPORTANCE OF CONSIDERING THE LIFE CYCLE OF A BUILDING IN AN INTEGRATED MANNER, AND REEVALUATING THE "BUILDING STOCK RESOURCES."

There is a multitude of post-war buildings requiring renovation, not only because they were often poorly built and have deteriorated over the years, but also because they are no longer able to meet the demands placed on them. This huge mass of buildings can be divided into three groups: technical infrastructure, commercial buildings and housing. Owners of high-rise blocks are being prompted to perform an energy upgrade on their buildings not only because of more demanding requirements in terms of utilization and comfort, but also for economic reasons. They can thus make huge savings on energy consumption and energy costs, particularly in post-war buildings. In this respect ecological considerations are backed up by economic arguments, since the

energy costs generated by a building during its lifetime can account for up to two-thirds of the original construction costs. A study by TH Projektmanagement in Berlin shows that post-war buildings in particular have a great deal of potential. It points out that houses in Europe that were built before 1980 account for 95% of the energy used for heating, hot water, cooling, lighting and ventilation. The energy costs saved were just one key factor in the decision to adapt a former large dairy (on the Toni site) in central Zurich. The vast industrial building dating from 1974 is now being converted into Switzerland's largest art college. Various departments which had previously been scattered over 44 different locations in the economic metropolis are being brought together on the 92 000 m^2 site. A 75-meter-high tower containing 100 rented apartments is also rising out of the old building. This means that the area will also be used at night. The project managers decided against a new-build for a number of reasons. First, the existing building was very robust and was always intended for high-capacity use. Second, planning regulations meant that a new-build would have resulted in significantly less usable space, running contrary to the principle of urban consolidation. Replacing the building would also have required enormous quantities of building materials and produced tonnes of waste. Furthermore, experts calculated that over 44 000 truck journeys will be saved by converting the building instead of constructing a new one. In fall 2013, around 5 000 students and workers will bring the old dairy back to life and transform the former industrial site into Zurich's new creative hub.

Technical infrastructure buildings are the second-large group for which the question of renovation or replacement looms large. Many of these are not keeping pace with the growth of the cities they serve, or they will soon reach that point. Specialists have outlined the scope for renovating infrastructure buildings throughout the world: CHF 40 000 billion will need to be invested worldwide in the next twenty years in order to renovate roads, rail links, and water and power utilities in the western world and build new ones in emerging nations, according to a study by Morgan Stanley Investment Management. Bridges in the United States are in a particularly parlous state. This is shown by figures from the American Society of Civil Engineers (ASCE): one in four of the 280 000 or so bridges are unstable or unfit for purpose. One of these is Bay Bridge, which links San Francisco with Oakland and had to be renovated after the 1989 earthquake. It was opened in 1936 after three years under construction, and has since been subject to a constant round of improvement, renovation and upgrading. Today about 280 000 vehicles drive over the bridge each day on two decks. After the 1989 earthquake, the authorities decided that this "lifeline" should be able to withstand a quake with a magnitude of 8.5. On the western span, the bearing capacity of the towers was increased and old steel replaced, old rivets were burnt out and replaced with new ones made of hardened steel, and more stress-resistant steel girders were substituted for transverse beams.

The situation regarding the eastern span was more complicated, and a decision had to be made as to whether to strengthen it or rebuild it. The local authority decided to replace the entire eastern span as far as the main bridge with a new construction. After a long and labyrinthine planning phase, construction began in 2002, with the first cars expected to drive over the strait in 2007. However, countless changes as the project developed completely upset both schedule and costs. The bridge is now due to open in fall 2013. Meanwhile the costs have soared, making the project the most expensive in the history of California. Today, the cost of the eastern span is estimated at an incredible USD 6.3 billion. The Bay Bridge project demonstrates how renovation often represents a more feasible solution than a risky new-build. Yet like the famous suspension bridge in California, many other constructions used for supply and disposal, transport systems and protection cannot be replaced so easily if this means closing them temporarily. Too many people and businesses depend on them.

DECLINING OIL RESERVES AND OTHER FOSSIL FUELS, ALONG WITH CLIMATE CHANGE, ARE HAVING A GREATER IMPACT ON GLOBAL SETTLEMENT AND CONSTRUCTION DEVELOPMENT IN THE 21ST CENTURY THAN WE IMAGINE, AND THIS REQUIRES US TO THINK IN NEW WAYS.

Declining oil reserves and other fossil fuels, along with climate change, are having a greater impact on global settlement and construction development in the 21st century than we imagine, and this requires us to think in new ways. The key concepts are refurbishment, renovation, revitalization, conversion, consolidation and extension. When tackling the ramshackle infrastructures and antiquated buildings of the post-war years, the new-build option will therefore receive significant competition from the refurbishment option.

With its life-cycle concept, Sika is in an ideal position to handle both options – new-build and refurbishment. Sika can be relied on throughout the entire life cycle of commercial buildings, residential properties and infrastructure constructions, from initial construction through decades of use up to the point when refurbishments, renovations or extensions are due or modifications to the building or its operations become necessary. Sika provides the optimum technologies for every phase of this life cycle: from "roof to floor" – available worldwide and adapted to local conditions anywhere in the world. Its extensive range of admixtures, waterproofing, flooring or system solutions for refurbishment and renovation provides Sika with enormous, fast-growing market potential: both in the constructed world and the one still to be built. ■


新興運輸倉庫


右折車は
直進車に注意
8-257

Jessica Siegel explores the metaphor of the city as an organism for the Sika annual report. Her subtle scenic vision of Tokyo overturns expectations of the city's image. Her photographs release the pulsating life of the city, transforming noisy stillness into an echo chamber.

Jessica Siegel lives and works in Würzburg and Berlin. She is rapidly making a name for herself in editorial photography and publishes in well-known journals and magazines.

FOCUS ON THE BUILDING ENVELOPE

TIGHTNESS OF THE BUILDING ENVELOPE is becoming an ever more important factor in terms of enhancing energy efficiency and increasing the life span of a building. The purpose of sealing and protecting the building enclosure is to prevent the passage of air or water, to provide thermal and sound insulation, and to enhance the visual appearance of the whole construction.

A building needs a high-performance envelope that provides unyielding protection from the elements. Every portion of the building's outer structure, from roof and exterior walls to basement, may be vulnerable to water intrusion and weathering causing wet insulation, air leakage and premature deterioration of construction materials. These problems often result in costly maintenance and repair, exorbitant energy costs, poor indoor air quality – even a shortened life span for the building itself. Sika provides a broad range of solutions to completely seal the building enclosure, stop water intrusion and control air leakage for both new construction and restoration: for instance high-performance roofing products, concrete protection, repair mortars, façade sealants, fenestration and structural glazing sealants, joint sealing, protective coatings and waterproofing systems.

A good example of a building envelope renewal project is the ongoing renovation of a property on 215 East 68th Street in New York City. The building was completed in 1962 and includes office rental space as well as 608 residential apartments. The owner has a long-range perspective and focus on using materials that will provide the best value and longevity. A long-term façade repair solution was needed, which the owner also took as an opportunity to improve the energy efficiency of the building by adding insulation and installing an air/water barrier membrane.

Sikagard®-560, a waterborne vapor-permeable water and air barrier membrane, was selected. It was important to the building owner for the product to be free from strong odor and toxic fumes and that the cured membrane would tolerate substrate movement. The early strength gaining repair mortar SikaRepair®-223 was selected to repair and patch the mortar joints, cracks and voids of the existing concrete wall structure to provide a uniform substrate before applying the membrane. It was also decided that the roof and balcony waterproofing systems would be replaced as part of the project remit. The old membrane is being removed and the surfaces waterproofed with the Sikalastic® RoofPro system.

The project will span over 3 years, but the length of time for the repair and construction work going on outside each residence is limited to 5 days. With such tight time windows it is of the utmost importance that the selected products and systems work flawlessly and are mutually compatible. What is more, Sika was chosen as it was the only company that could provide the owner with a single-source solution for the entire project.

According to the American environmental protection agency EPA, buildings are responsible for 39% of total energy consumption and account for 68% of electricity use. Sika has the full range of integrated, compatible products and systems to produce superior protection for the building envelope. And the technical knowledge needed to fully support designers and building owners with building envelope solutions that safeguard structures from deterioration, that help them to maximize their return on investment and to promote sustainability. ■

An ongoing building envelope renewal project is the renovation of the property on 215 East 68th Street in New York City. The owner looked for a long-term façade repair solution which should also improve the energy efficiency of the building.

Repair mortar SikaRepair®-223 was selected to repair and patch the mortar joints, cracks and voids of the existing concrete wall structure to provide a uniform substrate before applying the membrane.

Sikagard®-560, a waterborne vapor permeable membrane was applied as a water and air barrier before installing the insulation and the new exterior rain screen cladding system.

Refurbishment of buildings and infrastructure is very important in today's construction business. Sika is a global player in the refurbishment market. Different technologies can be used in refurbishment, from ready-to-use cementitious mortars to structural strengthening solutions.

The driving forces behind Sika's Research and Development activities are multi-faceted: On the one hand, global trends and corporate R & D strategy have an impact on our research work, on the other hand, products have to be extensively adapted to local markets.

At Sika, ten Technology Centers in America, Europe and Asia are responsible for triggering innovation and for developing products that meet customer requirements. The Technology Center in Spain has primary responsibility for developments in the area of refurbishment. The technology strategy for refurbishment balances market needs with corporate needs. Market needs vary from country to country. To adapt to these needs, Sika sets up facilities close to the consumer market and uses local raw materials. Great effort goes into fulfilling restrictive "green" regulations with new products. At the same time, the Technology Center has to keep costs under control and make sure that the new developments are profitable.

In general, there are three main market trends in refurbishment :

- → Speed to market: This means simplified planning, reduced demolition and being able to reuse or recycle materials from existing buildings or infrastructure, which results in shorter construction time.
- → Optimization of costs: Avoiding total demolition and reconstructing major existing elements should result in capital cost savings of at least 20%, even on major projects.
- → Sustainability: The reuse of construction fabric and improvements to the buildings' performance in use mean that the overall environmental impact of refurbishment is likely to be lower than that of a newly built building or infrastructure.

To fulfil these market needs, R & D has to find the right balance between economic and ecological considerations with its new, innovative products. One example of a product innovation Sika is working on is a "green grout." SikaGrout® is a high-performance cementitious mortar. Continuously improved over the years, it is widely used in construction and refurbishment. R & D has developed ways to partly replace the cement content with industrial by-products such as fly ash. SikaGrout®-324 RC will have a low carbon footprint and will lead to cost optimization in terms of energy and CO_2 taxes. It will set an industry benchmark.

Our R & D activities have to cope with very different situations in the local markets, thereby adapting properly in order to constantly reach the highest quality standards and provide outstanding Sika service to customers worldwide. ■

DR. LUZ GRANIZO
Corporate Technology Head Refurbishment
Head Technology Center Spain

INNOVATION THROUGH MOTIVATION AND INSPIRATION

OUR TECHNOLOGY CENTER TAKES GLOBAL trends and local market needs into consideration when developing technologically advanced products and systems. The goal is to develop successful products for the refurbishment of buildings and infrastructure facilities.

EXTENDING THE LIFE CYCLE

THE BUILT ENVIRONMENT IS IN need of refurbishment. Maintenance and renewal make both economic and ecological sense. Sika has embraced the challenge. Armed with innovative products and new processes, it is well prepared to make ageing buildings and infrastructure facilities fit for the decades ahead.

1 EMPIRE STATE BUILDING
Transforming to New York's greenest building

New York has some 6 000 buildings that are more than 32 stories tall. Well over 50 of these are 200-m-plus skyscrapers. And, though never designed for such a long service life, several thousand of them are more than 50 years old. Much of what, from afar, appears intact falls short of contemporary technical and ecological standards upon closer inspection.

Erected in 1930/1931, the Empire State Building ranks among New York's most heavily frequented buildings, attracting some 4 million visitors each year. As an architectural monument of global standing, it merits particularly careful maintenance. As a result, roughly half a billion US dollars have been committed in recent years on its ongoing renovation and transformation into the city's most eco-friendly building. The overhaul is set to achieve energy savings in the order of 38%. Hence, the comprehensive, holistic refurbishment is not only designed to preserve a piece of the city's architectural and cultural heritage, but to lay the foundations for sustainable economic and ecological gains. The Empire State Building has a total of 6 500 windows that had to be renovated in the course of the project. The refurbishment process was simplified by the use of a special on-site processing center, where the windows were upgraded to contemporary standards. Here they were sealed with Sikaglaze® IG-4429 HM to increase their insulation value. Applying Sikasil®-200 MJS, they were then refitted water- and airtight. 95% of the original glass could be reused. Official measurements attest that in 2011 this method saved some CHF 400 000 in energy costs. At the same time, 10 000 m^2 of cornices, roof terraces and cladding elements were renovated and made watertight using the Sikalastic® RoofPro-621 waterproofing system. Now the very part of the building is being renewed that makes it at all usable: the elevator shafts. SikaTop®-123 repair mortar is used to secure the inside walls of the shafts.

The fact that all products and systems come from a single source plays no small part in Sika being able to carry out a cross-building renovation of this nature with such success. Sika's range of services and processes for renovating and renewing building structures will be in use in the construction industry all over the world in the near future: the global potential is huge. ■

ROBERT CLARKE
Senior Director Commercial Sales
Alpen High Performance Products

↘ WITH THE HELP OF OUR OWN ON-SITE PROCESSING CENTER, WE WERE ABLE TO UPGRADE THE EMPIRE STATE BUILDING'S 6 500 WINDOWS TO CONTEMPORARY STANDARDS WHILE REUSING 95% OF THE GLASS.

↗ **The Empire State Building has** undergone several years of renovation resulting in a significant reduction of the skyscraper's ecological footprint. The cuts in energy use, achieved despite the rigorous demands placed on utility and comfort, will save millions of dollars each year.

2

SYDNEY HARBOUR BRIDGE
Two weekends bring decades-long benefits

The existing built environment – and infrastructure facilities in particular – harbor many of the construction sector's main opportunities and challenges. Hundreds of thousands of bridges worldwide have now aged to an extent that they are overstretched by the increasing loads and capacity demands. At the same time, their economic significance as key nodes in the transport network is far too great to permit any disruption through demolition and rebuilding. The lifelines of the economy cannot be interrupted. Bridges, like high-rise blocks, road tunnels and dams, suffer an immense renovation backlog, which opens up new markets for Sika.

The Sydney Harbour Bridge is a prime illustration. An irreplaceable engineering monument and cultural icon, the bridge has long been the city's most familiar landmark. Construction of the 1 140 m long bridge, which has a maximum span of 503 m, started in 1924. It was inaugurated in 1932. It is wide enough to accommodate railroad and tram lines, eight lanes of traffic, plus sidewalk and cycle path. Some 160 000 vehicles cross the bridge every day despite the alternative route offered by the Harbour Tunnel, which was opened in 1992 to relieve congestion. The Sydney Harbour Bridge remains one of the key routes into the city center.

Like hundreds of thousands of other bridges worldwide, this structure faced a series of problems – increasing age, loads and user numbers – which, in combination, became even more acute. After 80 years of service, the concrete surfacing of the carriageway began to leak, leading to corrosion of the steelwork and compromising structural stability. However, use of the new fast-curing Sikalastic® waterproofing system made it possible to seal the bridge and successfully halt corrosion. The system consists of primers, a waterproofing liquid membrane and the newly developed Sikalastic®-827 HT hot melt pellets, which ensure durable bonding between the asphalt overlay and the membrane. Two weekends, during which the entire 10 000 m² bridge surface was renovated, were sufficient to make the structure fit for the coming decades.

The Sydney Harbour Bridge is a perfect illustration of how, using Sika's state-of-the-art technology, infrastructure facilities can be sustainably renovated in line with future demands without any major operational disruption. ■

ANTHONY ROBERTS
CEO and Owner
Concrete Remedial Services

ALEX DARE
Operations Manager
Concrete Remedial Services

THANKS TO SIKA'S NEW WATERPROOFING SYSTEM, TWO WEEKENDS' WORK WAS SUFFICIENT TO RENOVATE THE BRIDGE CARRIAGEWAY AND PUT THE STEEL STRUCTURE INTO AN ADEQUATE CONDITION TO ACCOMMODATE THE LOADS FOR DECADES TO COME.

Corrosion can cause serious damage to loadbearing structures. Specially developed for the efficient execution of renovation projects, Sika's waterproofing technologies deliver effective and lasting protection.

3

LONDON UNDERGROUND
Putting things to rights while the city sleeps

The London Underground, commonly known as "the Tube," is the oldest, and still the second-largest, subway system in the world. Its overall length runs to 402 km, most of the lines having been built in the early twentieth century, so they are now between 60 and 150 years old. Around 1.2 billion journeys were recorded in 2011/2012. The Tube is used by up to four million passengers each weekday.

At Embankment station, two tunnel tubes run at different depths. The uppermost tunnel was constructed using the cut-and-cover method, i.e., a large trench was first excavated and then roofed over. The cast-iron tunnel ceiling beams, which carry the full weight of the structures above, date from 1870 and now, some 140 years later, were urgently in need of renewal. Yet, this subway line alone carries hundreds of thousands of passengers per day. Around 2 million of them get on or off at Embankment station each year, equivalent to 30 000 a day. These passenger volumes made a new-build solution absolutely unfeasible: renovation – without any disruption to services – was the only option.

The primary aim of the renovation program in the District Line tunnels on either side of Embankment station was to enhance safety by strengthening the "age-old" cast-iron beams. This was achieved using the innovative Sika® CarboDur® UHM carbon-fiber-reinforced polymer (CFRP) system: being only 4.7 mm thick, the strengthening plates reduced tunnel headroom only minimally. The plates were installed every weekday night during the so-called engineering hours, i.e., between 1 a.m. and 5 a.m. when no trains were running. Every night, the scaffolding was relocated, the cast-iron beams cleaned and primed, then coated with Sikadur® epoxy adhesive. The Sika® CarboDur® CFRP plates were then fixed to the beams. In all, some 1 300 m of strengthening plates were installed within five months, at a rate of two beams per night. Thanks to Sika's solution, the overall project was completed bang on schedule and without any disruption to services. The 90 tunnel ceiling beams are now well equipped to support the loads of another 100 years.

The Embankment station tunnel project is just one of many examples that showcase the use of Sika products and systems in infrastructure maintenance. Sika is active worldwide in refurbishment projects where the aim is to make existing structures fit for the future. Indeed, for Sika, it can truly be claimed that the past is a future market. ■

KEVIN JONES
Regional Manager
Concrete Repairs Ltd.

↘
THANKS TO SIKA'S SOLUTION, THE OVERALL PROJECT WAS COMPLETED BANG ON SCHEDULE AND WITHOUT ANY DISRUPTION TO SERVICES.

↗ **A new, cutting-edge technique** using the Sika® CarboDur® UHM system has given the 140-year-old cast-iron beams a new lease of life. The beams supporting the tunnel ceiling and structure above were strengthened during the engineering hours between 1 a.m. and 5 a.m.

4

TD GARDEN BOSTON
A new, recycled roof

"Time is money." Yet, on some construction projects, speed is not the only decisive factor – especially where any disruption to a facility's operation is out of the question. Here, the 20 000-seat TD Garden in Boston, one of the premier sports and entertainment arenas in the US, is a case in point. The venue hosts the home games of the Boston Celtics and the Boston Bruins with their legacy of championships. It is also graced by pop stars such as Madonna and Lady Gaga. Any temporary closure would have been unthinkable, for spectators, celebrities and operator alike.

Yet, the TD Garden roof showed signs of ageing and needed urgent replacement, without any disruption to the game schedule. Moreover, given its commitment to sustainable business practice, the building owner, Delaware North Companies, demanded an eco-friendly renovation concept for the TD Garden project.

One particular focus was on the strategy of "urban mining," an increasingly common component in sustainable building solutions: this is founded on a view of the urban landscape not only as an ensemble of buildings and infrastructure, but also as a storehouse for raw materials. Accordingly, whenever a building is deconstructed or renovated, the existing materials are recycled and reused. Incorporating reclaimed materials in new buildings and avoiding tons of waste makes a major contribution to sustainability.

When the TD Garden roof was removed, the existing polymer membranes were salvaged and used in the production of new Sika® Sarnafil® membranes. The insulation was also recycled. To achieve long-term improvements in energy efficiency, a white Sika® Sarnafil® EnergySmart Roof® with 10 cm insulation was specified as the replacement. The gutters were waterproofed using Sikalastic® RoofPro liquid applied membrane. Since this product is fully compatible with the Sika Sarnafil roof membranes, the two systems integrated seamlessly and came with a single-source warranty.

JOHN KARMAN
Senior Project Manager
Wessling Architects

↘

DELAWARE NORTH IS COMMITTED TO SUSTAINABLE BUSINESS PRACTICES AND INCORPORATED THAT THINKING INTO THE TD GARDEN PROJECT. THE EXISTING MEMBRANES WERE REMOVED AND USED IN THE PRODUCTION OF NEW SIKA® SARNAFIL® MEMBRANES. A NEW ENERGY-EFFICIENT ROOFING SYSTEM WAS INSTALLED AS REPLACEMENT.

The project team, comprising Wessling Architects, Shawmut Design and Construction, Greenwood Industries and Sika® Sarnafil®, managed to renew the entire, approximately 14 500 m² barrel roof within 15 months while maintaining business-as-usual operation of the venue below. The renovation project not only significantly improved the building's energy and ecological performance, but also enhanced its aesthetic appeal.

TD Garden perfectly illustrates how the right team armed with the right products can successfully deliver a tough reroofing project even under the most taxing conditions. ■

↗ **Any idea of shutting down** the TD Garden – one of the premier arenas in the US – for months on end to renovate the roof was completely unrealistic. Sika® Sarnafil®'s products and know-how neatly resolved the problem to the full satisfaction of both owner and spectators.

JORGE RENDÓN
Product Engineer for Structural Rehabilitation
Sika Colombia

NOW THAT THE PUMAREJO BRIDGE HAS BEEN SUCCESSFULLY RENOVATED USING SIKA PRODUCTS AND SYSTEMS, IT WILL NEED ONLY ROUTINE MAINTENANCE IN THE COMING DECADES. THE INVESTMENT HAS PAID DIVIDENDS FOR ALL CONCERNED.

5 PUMAREJO BRIDGE

Strengthening a major traffic artery in Colombia

Bridges – and existing bridges in particular – offer immense market potential for Sika and its customers. Most are in need of repair or even full-scale rehabilitation some 30–40 years after original construction.

As a single-source provider for the full range of concrete and steel bridge renovation products, Sika is ideally positioned. Not only does it offer mutually compatible products and systems to meet any particular requirement, it is above all able to provide customer advice and support based on in-depth know-how and 100 years of experience. These are indispensable prerequisites for sustainable solutions on projects such as bridge renovations.

Colombia's Pumarejo Bridge is one of the latest and most spectacular examples in this regard. It illustrates why, how and where bridges age rapidly, along with the options for remedial action.

As the most important bridge in Colombia, measuring 1 500 m from shore to shore, the Pumarejo Bridge was opened in the 1970s and now carries one of the country's major traffic arteries. It is supported by 56 piers, with maximum spans of 140 m, and its concrete structure is widely regarded as an engineering icon.

Yet, after nearly 40 years in service, the bridge began to show its age and, as of 2006, underwent a progressive rehabilitation program that recently came to a successful conclusion. In the course of the project only Sika products were used.

The Pumarejo Bridge is exposed to virtually all types of action that are harmful to bridges – capillary water, static and dynamic loads, temperature fluctuations, carbonation, saltwater, erosion and abrasion –, which additionally complicated the repair process. Sika's products and systems such as corrosion inhibitors, repair mortars, protective coatings and carbon-fiber-based strengthening systems, nonetheless allowed the full eco-efficient rehabilitation of the bridge such that only routine maintenance will be required in the decades ahead. ■

The full-scale renovation project has given this engineering icon a new future. The Pumarejo Bridge will now be able to handle the rising traffic volumes, increased loads and fluctuating environmental actions for years to come.

SUSTAINABLE DEVELOPMENT IS A PROCESS, NOT A FIXED STATE

INTERVIEW RODERICK HÖNIG – *PHOTO* MARC EGGIMANN

WHAT IS THE FUTURE ROLE of renovation? How has the construction industry changed with regard to optimizing operation and maintenance? Hans-Rudolf Schalcher, Professor Emeritus for Planning and Management in Construction at the Swiss Federal Institute of Technology (ETH) Zurich, talks about the construction needs of the 21st century.

As Prof. Dr. Hans Rudolf Schalcher sees it, "the more affluent a society, the greater its need for buildings and infrastructure."

RODERICK HÖNIG: Major cities across the globe continue to grow. By 2030, two thirds of the world's inhabitants will live in urban centers. How will this trend affect the way we handle the existing built stock?

HANS-RUDOLF SCHALCHER: The global urban ization we are witnessing today is an irreversible process. The expansion of the big cities has major implications, above all, for the technical infra structure at these locations, the reason being that growing development densities place a greater strain on infrastructure facilities. Their renewal always involves the question as to whether a capacity increase is needed.

What factors nowadays determine which of the two options renovation or replacement to adopt?

While the foremost criteria are financial and eco logical, the decision should always be governed by an overall perspective. Take a heavily trafficked bridge, for instance. Whenever important and valuable facilities like this get long in the tooth, the same question always arises: should we retain and repair them or should we replace them and increase capacity and loadability at the same time? Renovation is inherently more eco friendly than replacement. This is because new builds tie up vast amounts of materials and energy at one site for one purpose. Moreover, demolishing exist ing facilities automatically entails considerable transportation volumes.

Futurologists predict an even balance between growth and stagnation towards the end of the 21st century. Would such a scenario bring about any shift in the importance afforded to renovat ing the built environment?

There is no universal answer to this question as it depends on the level of development in the re gion concerned. China is currently experiencing 8% growth, in both economic and demographic terms. Europe, on the other hand, is hit by stag nating economic and population trends. There can be no balanced solution at global level to the renovation needs of the built stock: some regions are struggling with growth, others are in the grips of stagnation, and these are two very differ ent propositions.

Although the end of the 21st century is still far away, a long term view is nonetheless essential for planning and design. What horizons are nor mal for today's construction facilities?

This varies according to the level of development. 60 to 70 years are now standard for technical infrastructure while 30 years i.e. a single genera tion tend to be the norm for buildings. In the early days of industrialization, buildings, road and rail networks or energy supply systems were designed for a service life of 20 to 30 years. Highly

developed countries can no longer afford such short term thinking and we have significantly extended the projected life span of our facilities. Yet as horizons lengthen, the uncertainty surrounding the accuracy of forecasts automatically increases.

Does it make sense, despite this uncer tainty, to design and build facilities for the next 60 to 70 years?
Yes, because it is ridiculous to design and produce systems that are so expensive to construct, operate and maintain for a service life of only 20 to 30 years. Quite apart from that, the additional investment needed to double a structure s life span is often relatively low compared to the cost of constructing a facility built to last for only a single generation.

Is greater weight now attached to life cycle analysis in design and construction?
Yes, without a doubt. Today, life cycle analy sis is not just used for consumer products, but is also widely applied in the construction industry. The relevant issues are addressed as early as the design stage: what is the targeted service life of the facility? How well equipped is it to accommodate a potential rise in demand? How can it be renovated and, ultimately, deconstructed ?

Are sustainability criteria given adequate priority today when facilities are undergo ing renovation?
Economic factors are still prioritized over environmental and social considerations. Yet, here too, we should not over generalize: various major infrastructure refurbishment projects can be cited that give extremely high priority to ecological issues. Sustain able development is a process, not a fixed state. In Switzerland, for example, we are on the right path and our efforts compare well with those of our international partners. But we are still a long way from where we need to be.

Doesn't the move to sustainable refurbish ment also mean reappraising our comfort demands?
Yes, unfortunately, it does. We will not be able to meet the requirements imposed by sustainable development without tightening our belts. If the highly industrialized coun tries are genuinely committed to sustain able development, they will have to accept a somewhat lower level of affluence. The question we need to ask is: how can we use the existing facilities and infrastructure to meet our growing needs?

What other sectors "compete" for funding with, say, major infrastructure refurbish ment projects?
The more affluent a society, the greater its need for buildings and infrastructure. Yet, the tight controls on public sector spending in every country have inevitably sparked a battle for the available resources. Refurbishment s most serious competi tors include health care and education. The demand of the world s population for a long and healthy life is unbroken and no where near being satisfied. Similarly, the spiraling requirements placed on education reflect the view of a comprehensive school ing as the best means of safeguarding competitiveness. However, not all wishes can be granted. This balancing act in sharing out the available funds is a highly sensitive political and social issue.

Due to their status as common property, they are financed and maintained primarily through taxation. I personally think that the consumer pays principle should also apply to transport by means of a mobility pricing system.

What changes have there been in the construction process to factor in future refurbishment?
Surface mounted piping and wiring was once standard practice in residential proper ties. This was very convenient for main tenance, renovation and replacement. In the 1960s, house builders began to cast in or brick up these installations. In terms of maintenance, this practice is counter productive and completely at odds with sus tainable construction. At that time, though, people wanted to banish unsightly installa tions from their living environment. Today, much more thought is given to building maintenance and renovation, so mechanical and electrical equipment is installed so as to guarantee easy access.

↘
THE ADDITIONAL INVESTMENT NEEDED TO DOUBLE A STRUCTURE'S LIFE SPAN IS OFTEN RELATIVELY LOW COMPARED TO THE COST OF CONSTRUCTING A FACILITY BUILT TO LAST FOR ONLY A SINGLE GENERATION.

In a study, you have quantified the renova tion requirement for Switzerland's techni cal infrastructure. You estimate that CHF 65 billion is needed over the next 20 years to keep the Swiss built environment in good condition. Is the legacy of our fathers and forefathers a burden rather than an asset?
No. As I see it, infrastructure facilities are clearly an asset rather than a burden. They are normally well constructed and serve society and the economy as a whole rather than individuals. Like any other asset, how ever, they need to be managed properly.

How can the refurbishment of technical infrastructure be financed?
There are two possible models: one reflects consumption while the other relies on basic funding. With electricity, water or waste disposal, we always pay according to consumption. Only transport systems are subject to a different modus operandi.

Have construction materials also changed in response to maintenance and refurbish ment needs?
Yes. At one time, buildings were put togeth er from simple elements. Most were made of timber. Such buildings were easy to dis mantle and reassemble. Then came the age of composite materials, such as reinforced concrete, and later synthetic products were also used for building applications. However, they are not at all recycling friendly and their disposal is problematic. Here too, the right lessons have been learnt: today, materials recyclability and disposability is scrutinized much more closely before they are incorpo rated in buildings. ■

SIKA PRODUCTS FOR REFURBISHMENT IN CONSTRUCTION

Below an overview of Sika products that were used in the projects described in this magazine.