Construction Sector Group Publication
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Composites UK
Trade Association

Extending the Life of a London Sewer

STRUCTeam

Location	King's Scholar Pond Sewer, beneath the junction of Marylebone Road and Baker Street, London, UK
Description	The King's Scholar Pond sewer rehabilitation was a £20 million construction scheme undertaken beneath one of London's busiest rail and road districts. STRUCTeam assisted in this challenging repair project that united a range of architectural and design specialists.
Client	Thames Water.
The challenge	In 2009, Thames Water conducted a quality inspection inside a section of a Victorian sewer that lies deep beneath the streets of central London. Significant internal degradation and deterioration was detected within the 170-year-old brick structure. This included significant cracking of the brickwork caused by the settlement of the railway tunnel beneath. Constructed between 1848-1856, the King's Scholar Pond sewer is located two metres beneath one of the capital's busiest intersections between Baker Street and Marylebone Road. The wastewater line is supported by a bridge structure that crosses between the walls of the Underground tube tunnel. Due to the tunnel's location, closing the Underground to repair this segment of the sewer from below would be hugely problematic and cost an estimated £1 million each day. Equally, closing the junction of Marylebone Road and Baker Street would have caused major disruption for 5-6 months. The chosen repair solution also needed to keep the existing structure intact, allowing it to remain in full wastewater operation throughout the project.
The solution	To extend the sewer's life, a unique and complex keyhole repair process was devised by Thames Water and technical partners, eight²O. This involved the construction of a modular, 9.5 metre duplex stainless-steel bridge truss lined with 58 GFRP (glass fibre reinforced polymer) composite panels. The panels were then secured to the outer frame.
Material used	Both the steel structure and interior composite panels were manufactured off site using a detailed modelling system.The secondary structure, manufactured with composite panels, was also lowered through the same small opening, and attached to the arches of the steel cage. Both structures were then bolted together and sealed to form a watertight bridge within the existing sewer and spanning the Underground tunnel beneath. The application of composites and steel provided an exceptionally strong and durable solution. Composites also resist corrosion– an essential consideration in a wastewater environment where pH values and temperatures regularly fluctuate. The liner had to be capable of operating at a pressure of 0.3 bar with no leakage, whilst withstanding external pressure when the sewer was empty.
Specific design details	STRUCTeam has broad experience performing Cat III and independent third-party checks on a variety of high-performance structures. The company's engineers were responsible for conducting all the structural checks on the composite panels. This included analysis of load cases, how the panels were secured to the steel structure, and secondary functions including water tightness of the panels. STRUCTeam's experience within the civil and renewables sectors enabled the KSP sewer project team to benefit from the use of composites in the most effective manner, and in tandem with more traditional materials.
Benefits	Both the steel structure and interior composite panels were manufactured off site using a detailed modelling system. This allowed the construction teams to visualise the assembly process. The individual components were then lowered underground, a single piece at a time, through a street level maintenance cover measuring 600mm x 750mm. This highly efficient strategy ensured the busy road above remained in constant use with no significant disruption.
Measurable outcomes	The rehabilitation of the KSP sewer means the structure should not require any significant maintenance for around 120 years. The composites liner, which has a lifespan of 50 years, has been constructed so the individual panels can be removed to allow the sewer bricks to be inspected in future with minimal disruption. Thames Water estimates the unique keyhole repairs, combined with the adoption of modular, lightweight materials, meant a significant amount of disruption was avoided. It has also eliminated the need for any large-scale excavations in the future saving 26,443 tonnes of embodied carbon and £23 million.
Further details	www.structeam-ltd.com