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FLOORS & SCREEDS

Self-stressing SFRC, digitising surfaces and high-load hardstandings

GETTING A FACELIFT

Concrete façade restoration – a building envelope solution

MOLECULAR SOLUTION

Can graphene-enhanced concrete help the road to net zero?

MAIN IMAGE: Completed hardstandings at Siemens Train Manufacturing Facility, Goole.

GOOLE RAIL VILLAGE: CREATING A LASTING LEGACY

In 2018, Siemens Mobility announced that it was investing £200 million in the creation of a 271,000ft^2 (25,180m^2) train manufacturing facility in Goole. From the outset, the project had a clear focus on innovation and sustainability, with the ambition of creating a lasting legacy for the rail industry. With the facility soon to begin manufacturing, **Calvin Pretorius** of **Danley** explores how concrete hardstanding design contributed to the project's sustainability credentials, improved installation time and saved money.

With innovation and decarbonisation both key concerns of the UK rail industry, one of the key objectives for the Goole site was to create a carbon net-zero factory – not only in its construction phase, but also in its operations over the next 60 years. To achieve this, the construction of the 271,000ft^2 (25,180m^2) site used innovative, forward-thinking technologies to reduce the environmental impact and ensure longevity.

A critical part of the facility, a 24,000m^2 concrete external hardstanding external slab was required to store and manoeuvre train carriages during their construction.

A key consideration in the hardstanding design would be the creation of areas that could

handle the extremely high loads anticipated at various points across the site. Among the most high-profile projects to go through the site when it opens is the manufacture of 94 new and innovative trains for Transport for London's (TfL's) Piccadilly line, which are due to go into service in 2025. In addition to the highly practical considerations required to accommodate the end-to-end production of these weighty rail vehicles, the site also needed to be constructed within set timeframes, using sustainable solutions that would ensure its longevity.

While using concrete to create the slab was a logical choice, its method of construction needed to be carefully considered. Steel fabric reinforcement is a broadly accepted approach in industrial slab-on-ground applications, but there was concern that the extremely high loads involved when moving train carriages around may result in load transfer issues, leading to ongoing deterioration and maintenance-related downtime.

According to the American Concrete Pavement Association (APCA), "most performance problems with concrete pavement are a result of poorly performing joints. Distress, such as faulting, pumping and corner breaks occur in-part from joints with poor load transfer efficiency. All of these problems worsen when joints deflect greatly under loads." Put simply, poor load transfer creates high slab stresses and reduces service life, while adequate load transfer is vital to rigid pavement performance and longevity. For the project at Goole, avoiding this issue – while also optimising material usage and labour costs – was paramount.

OVERCOME PROBLEMS

To overcome these potential problems, GMI Construction, the key contractor at the Goole site, worked with the concrete slab design engineer, Adept Consulting, to specify Danley's Strategic Reinforcement Design. Having worked with Danley in the past, both contractors saw the solution as value-added engineering which would increase the functionality and value of a standard concrete hardstanding installation, while maintaining product quality and driving down cost.

With poor joint performance a known issue in slab-on-ground and industrial pavement applications, and the weighty carriages likely to cause slab deflection, the solution overcomes the issue by removing the steel reinforcement from the mid-panel – as it would be in fabric reinforcement – and put it at the joints.

Using a tapered dowel and sleeve system, the joints were placed at strategic intervals across the concrete hardstanding. This approach allows the concrete to shrink freely in both the lateral and longitudinal horizontal plane, without inducing restraint that leads to joint spalling and out-of-joint cracking. The solution allows installers to maintain the structural integrity of the concrete slabs and offer more consistent joint performance over the full design life of the concrete floor or pavement. The construction itself is also simplified, reducing the extra time on-site that can be caused by misalignments, staking, drilling or spinning of round dowels in other construction methods.

It also provides the highest deflection control tolerance in line with ACI 360R-10[1], as well as complying with Concrete Society TR66[2], Britpave *Concrete Hardstanding Design Handbook*[3] and ACI 330.2R-17[4].

COST AND CARBON SAVINGS

In addition to extending the service life of the large hardstanding external slab by avoiding cracking and deflection, the chosen solution has played a significant role in reducing the carbon footprint of the project. With improved load transfer capacity at every joint, individual panels can be designed to accommodate less load than in conventional fabric slabs. This enables the use of thinner slabs, offering a more sustainable solution by significantly reducing the amount of steel and concrete used to deliver the project. Over the course of the construction phase, the solution meant 15% less concrete and 90% less steel was required to create the hardstanding when compared with traditional designs.

The reduction in steel and concrete saved in excess of 19% on installation costs when compared to traditional methods of construction. Fewer materials also meant 158 fewer deliveries to site, further reducing emissions and lessening the impact of construction on the local area. The innovative design of the hardstanding also means a longer service life, reducing the environmental impact of materials over its service life.

For the team at Goole Village, the Danley solution ticked multiple boxes, allowing them to reap the benefits of concrete as a building material while avoiding known risks that might shorten its lifespan. The result? A more sustainable hardstanding, delivered on time, on budget and in line with the project manager's vision of an innovative and forward-thinking site.

References:

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4. AMERICAN CONCRETE INSTITUTE, ACI 330.2R-17. *Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities*. ACI, Farmington Hills, MI, USA, 2017.