SIKA AT WORK
TRIESTE AIRPORT FLOORING REFURBISHMENT

FLOORING: Sika ComfortFloor®, Sikafloor®
REFURBISHMENT: SikaDur®, SikaWrap®, Sika AnchorFix®
SEALING & BONDING: Sikaflex®, SikaHyflex®

BUILDING TRUST

TRIESTE AIRPORT FLOORING REFURBISHMENT

Sustainable solutions in accordance with the Life Cycle Assessment (LCA)

PROJECT DESCRIPTION

The project for the intermodal hub annexed to Trieste Airport is one of the most important objectives outlined by the Friuli Venezia Giulia Region in its regional transport plan in recent years. It represents the desire to achieve a strategic location that integrates the local and suburban public transport system. The infrastructure is a public work, carried out with funds that derive from EU and regional funding, built to improve accessibility of the airport.

The project, prepared by the Planning Office of Società di Gestione Aeroporto Friuli Venezia Giulia S.p.A., extends from the straight line comprising the pedestrian footbridge which, after crossing the state road, connects the airport to the car parks, the bus terminal and the train station.

As notified to the European Commission, the design includes: a new train station, a bus terminal for 16 lines, a car park with a capacity of 1,500 cars, 500 of them in a multi-story car park, connected by slip roads and internal roads. In this context, the hub will allow the interchange between the various means of transport (bus, car and train), permitting the improvement of the public transport system and improving the passenger mobility service in Friuli Venezia Giulia.

The work aims to be in line with the objectives set out in the White Paper on European transport policy in 2001, which encourages the use of environmentally friendly means of transport to develop alternatives to road transport.
From a strategic viewpoint, the hub is meant to represent the centre of regional intermodality and the interchange hub at the service of local mobility. The work will bring benefits for the Friuli Venezia Giulia region and the economic and social system with positive effects, in overall terms, on the efficiency of the regional transport system and, specifically, in terms of the increase in the number of airport passengers.

CUSTOMER'S REQUEST

Given the importance of the construction of the new Intermodal Hub, Trieste airport was equally in need of major restyling and some refurbishment work. The customer's request was first and foremost to replace most of the existing flooring, which was made up of old tiles, with a continuous resinous flooring that, in addition to providing superior styling value, proved modern in its appearance, owing to the absence of any joints that would mean easy cleaning, mechanical strength, elasticity and low VOC emissions during installation. Initially the customer had thought of a solution involving coating the existing tiles with epoxy paint, but this type of solution would not have had the characteristics desired initially, since the system was not elastic and would have had limited resistance to surface scratches. The customer also wanted to perform several maintenance works in the airport (e.g. structural reinforcement of reinforced concrete pillars and beams, reinforcement of joints between beams and pillars, etc.).

SIKA SOLUTION

Given the customer's requests and the passage every year of approx. 700,000 people (2,500 people per day), Sika created a system consisting of colored and elastic polyurethane resins: Sika ComfortFloor® PS-23.

Prior to installation of the actual resin flooring, the entire old tile flooring had to be removed. With shot blasting and sanding all the adhesive residue remaining on the substrate was entirely eliminated. Once all the dust had been removed, the concrete substrate was primed with Sikafloor®-156 thickened with quartz sand at a consumption rate of about 0.4 kg/m². Once the primer had hardened, colored, elastic and low VOC emission two-component polyurethane resin was applied, namely Sikafloor®-330, with a consumption of 2.8 kg/m² for a total thickness of 2 mm. Since this product is self-leveling, and easy to apply, it is perfect for large surfaces in a short space of time.

The following day the flooring was protected by a finishing layer comprising a water-based, colored, matt polyurethane resin, i.e. Sikafloor®-305 W, with a consumption of approx. 0.15 kg/m² per coat.

Thanks to the low VOC emission levels of all the above-mentioned products, the airport has been able to continue its normal activity without having to close or divert passengers to other gates due to the emissions of solvents that would normally be expected.

TRIESTE AIRPORT FLOORING REFURBISHMENT

Sustainable solutions in accordance with the Life Cycle Assessment (LCA)

The Sika ComfortFloor® PS-23 system is one of Sika's principal systems. This system is devised specifically for all those areas with high pedestrian traffic, considering its countless characteristics, such as:

- Resistance to furniture leg movement: no damage after 25,000 cycles (EN 425:1994)
- Tensile strength: approx. 8 MPa (DIN 53504)
- Elongation at break: approx. 150% (DIN 53504)
- Fire reaction: Bfl-s1 (EN 13501-1)
- Cigarette burn resistance: Class 4 (EN 1399)
- Impact sound reduction: 2 dB (EN ISO 140-8)
- Slip resistance: R10/R11 (DIN 51130)

As regards the toilet facilities, the customer picked the Sikafloor Multidur® ES-14 epoxy system, given that these locations are more susceptible to chemical attack. All the old floor tiles were removed and, with shot blasting and sanding all the adhesive residue was removed.
Once the substrate was ready, the whole flooring was primed with two layers of Sikafloor®-156 thickened with quartz sand, at a consumption rate of about 0.4 kg/m². On the second coat of primer, a slight dusting of quartz sand was performed in order to have a slightly non-slip surface on the final flooring. Once the primer had hardened and the excess sand had been removed with a sanding machine, the colored two-component epoxy resin Sikafloor®-264 was applied, at a consumption rate of approx. 0.3 kg/m². The same system used for the floor was applied on the walls of the toilet facilities, but during the mixing phase of each product, the Sika® Extender T thickening agent was added, to prevent the material from dripping.
In the corner between the wall and the floor, to ensure continuity between the wall and floor surfaces, a coating of Sikaflex® PRO-3 single-component polyurethane sealant was applied.

On completion of the work, Sika certified the slip resistance of all the floors directly on site using the pendulum test (governed by EN 14231). This tool is designed to perform the slip resistance test on smooth and rough surfaces, both wet and dry, depending on the value obtained, as indicated in the table below.

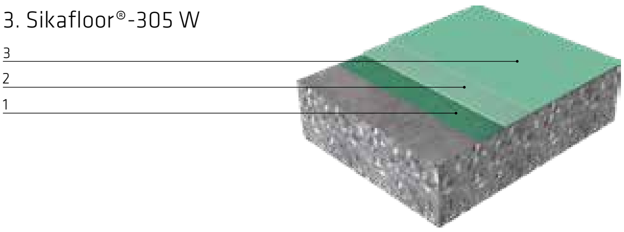
Sliding Potential	**Value**
High	Up to 24
Moderate	From 25 to 34
Low	From 35 to 64

The difference between this test and the inclined plane method (which provides the R rating) is that the latter has a sample of the floor to be tested applied onto a mobile ramp onto which an oil with regulated viscosity is placed. The tester wears regulated shoes and the surface is gradually inclined. When the person feels like (s)he is slipping, the angle of the inclined plane is measured, and it corresponds to an R rating. The DIN 51130 standard does not define characteristics concerning the perceived feeling of falling, and hence the feeling of slipperiness may vary from one person to another. At regulatory level, there are no laws which correlate the two tests, but based on our experience the pendulum test remains the most useful in determining in-situ the surface slipperiness of tiling.

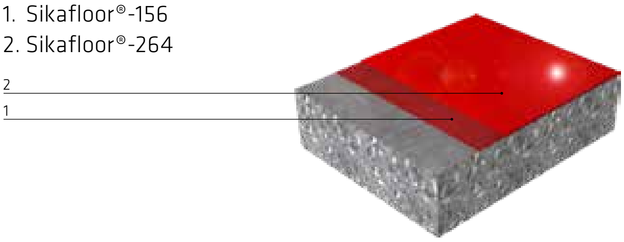
The result achieved with the pendulum test method in the communal areas on a dry surface is a value of between 67 and 74: this result allows the flooring to be ranked as having an “extremely low” slipping potential.
On the other hand, for communal areas on wet surfaces, a value of between 25 and 33 was achieved: this result means the flooring is ranked as having “moderate” slipping potential.
As regards the toilet facilities, the values obtained fall between 65 and 67 on a dry surface and between 30 and 33 on a wet surface, meaning the flooring is ranked as having “extremely low” and “moderate” slipping potential respectively.

PRODUCTS/SYSTEMSS USED

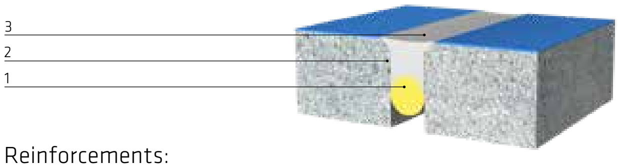
Flooring in communal areas – Sika ComfortFloor® PS-23
1. Sikafloor®-156
2. Sikafloor®-330
3. Sikafloor®-305 W



Flooring and wall tiling in toilet facilities – Sikafloor® Multidur ES-14
1. Sikafloor®-156
2. Sikafloor®-264



Sealant:
1. Ethafoam
2. Sika® Primer-3N
3. Sikaflex® PRO-3
   Sikaflex® PRO-3SL
   SikaHyflex®-250 Facade

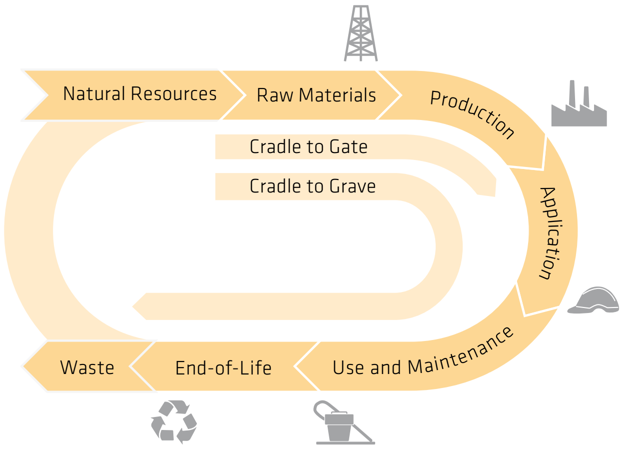


Reinforcements:
SikaDur®-30
SikaWrap®-300C
Sikadur®-330
Sikadur®-31
Sika AnchorFix®-3
Sikadur®-52

TRIESTE AIRPORT FLOORING REFURBISHMENT

Sustainable solutions in accordance with the Life Cycle Assessment (LCA)

LCA stands for Life Cycle Assessment and is a standardized method that assesses the impact of a product or system on the environment, considering the partial life cycle (from cradle to gate) or the total life cycle (from cradle to grave). This assessment includes the pre-production (therefore, extraction and production of materials as well), production, application, use and maintenance phases, as well as end of life and final disposal. The LCA procedure is standardized at international level by the ISO 14040 and 14044 standards.



For this project, the LCA assessment was performed by comparing a self-leveling epoxy system initially envisaged with the Sika system implementing Sika ComfortFloor® PS-23.

Sika System	Primer (kg/m²)	Self levelling (kg/m²)	Finishing (kg/m²)
Sika ComfortFloor® PS-23	Sikafloor®-156 (0.3 kg/m²)	Sikafloor®-330 (2.8 kg/m²)	Sikafloor®-305 W (0.3 kg/m²)

Competitor system	Primer (kg/m²)	Self levelling (kg/m²)	Finishing (kg/m²)
Self levelling epoxy system	Epoxy (0.3 kg/m²)	Epoxy (4 kg/m²)	–

LCA CYCLE ASSESSMENT PARAMETERS

The LCA results are identified using three indicators:

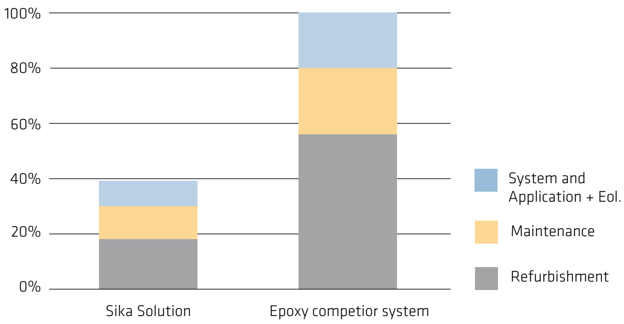
- Cumulative Energy Demand (CED)
  The cumulative energy demand (CED) quantifies the consumption of energy resources, in other words the total quantity of primary energy from renewable and non-renewable sources.
- Global Warming Potential (GWP)
  The global warming potential (GWP) measures the potential contribution to climate change by focusing on greenhouse gas emissions, such as carbon dioxide (CO_2), which increase the absorption of heat from the atmosphere, causing a rise in the temperature of the earth's surface.
- Photochemical Ozone Creation Potential (POCP)
  Photochemical ozone creation potential (POCP), or summer smog, is the formation of reactive chemical compounds, such as ozone, through the action of the sun's rays on volatile organic compounds (VOC) and nitrogen oxides (NOx). It is common in large cities, where large quantities of VOC and NOx are released (for example, industrial emissions and vehicles) and in particular during the summer when solar radiation is more intense.

In order to assess the LCA, the airport life was assumed as lasting 60 years, during which the epoxy system used is to be restored every 5 years, whereas the Sika ComfortFloor® PS-23 system is to have a partial refurbishment with Sikafloor®-305 W in the tenth year and total refurbishment with Sikafloor®-330 and Sikafloor®-305 W in the twentieth year. Moreover, the simulation considered the distance from the production site (approx. 1,000 km), the distance from the disposal site (approx. 100 km) and all the resources necessary for cleaning the flooring used over 60 years of life of the facility.

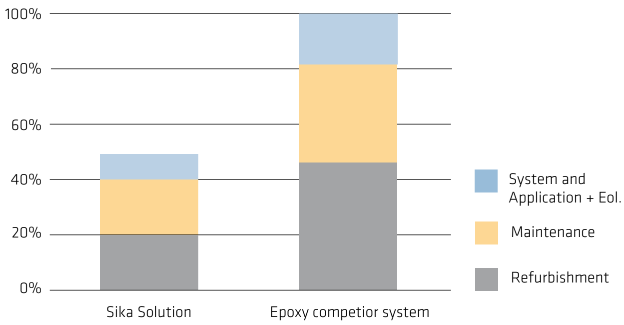
RESULTS

The following graphs show, in the form of a percentage, the impacts of the indicators outlined above (CED, GWP, POCP) on all 5,000 m² of Sika Comfortfloor® PS-23 in comparison with a self-leveling epoxy system.
From what can be seen from the tables below, the epoxy system has 61% more global warming potential than the Sika Comfortfloor® PS-23 system. Also, in terms of the total quantity of energy from renewable and non-renewable sources (CED), the result is in favour of the Sika system, with 50% less energy consumed compared with the epoxy system.
The difference is even more evident if we look at the Photochemical Ozone Creation Potential (POCP) graph, where the impact of the epoxy cycle is 72% higher compared with the Sika system.

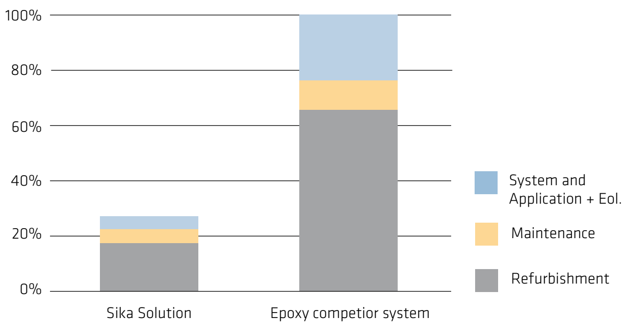
Global Warming Potential (CWP) [kg CO_2-eq/5,000 m²) after 60 years



Cumulative Energy Demand (CED) [MJ/5,000 m²) after 60 years



Photochemical Ozone Creation Potential (POCP) [kg C_2H_4-gq/5,000 m²) after 60 years



CONCLUSIONS

Thanks to the LCA assessment, the potential environmental impacts of the systems throughout the life cycle can be assessed, to demonstrate that a contribution to sustainable construction can be made by choosing Sika ComfortFloor®: a long-lasting, high-performance flooring system with low energy consumption levels compared with traditional epoxy systems, affording high resistance, fewer maintenance requirements (less cleaning) and a considerable reduction in operating costs during its useful life. The frequency of the refurbishment of the Sika ComfortFloor® system is lower than that of the competitor's epoxy solution, as is the frequency of cleaning, which helps reduce the economic costs during the useful life of the building. The project has enabled Sika to demonstrate its expertise and experience in terms of sustainability, including all quantitative contributions relating to a bespoke high-performance flooring system to meet the needs of the customer from a technical, financial and environmental perspective.

TRIESTE AIRPORT FLOORING REFURBISHMENT

PROJECT DESCRIPTION
Surface area: 5000 m^2

OWNER
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