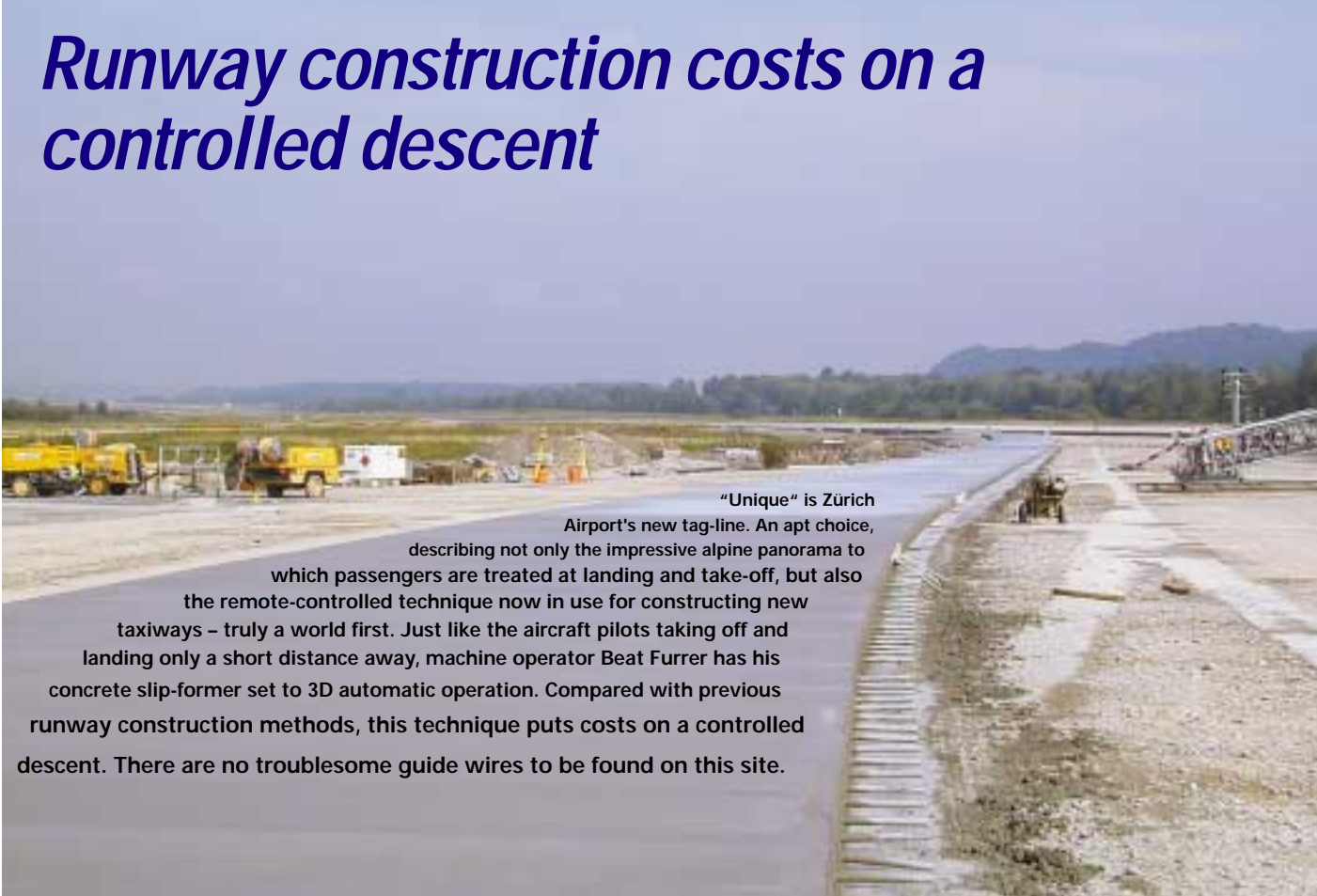


Runway construction costs on a controlled descent



“Unique” is Zürich Airport’s new tag-line. An apt choice, describing not only the impressive alpine panorama to which passengers are treated at landing and take-off, but also the remote-controlled technique now in use for constructing new taxiways – truly a world first. Just like the aircraft pilots taking off and landing only a short distance away, machine operator Beat Furrer has his concrete slip-former set to 3D automatic operation. Compared with previous runway construction methods, this technique puts costs on a controlled descent. There are no troublesome guide wires to be found on this site.

Under Beat Furrer’s watchful eye, a Gomaco GHP 2800 slip-former lays a swathe of concrete six metres wide and 36 centimetres thick with a precision of under one centimetre in the horizontal axis and three millimetres in the vertical axis, meeting the demanding tolerances specified for the 5th expansion of Unique Zürich Airport.

Novel machine guidance system for easier working

“It was unnecessary to invest in a new slip-former, we simply retrofitted our existing Gomaco machine with the new Leica 3-D machine guidance system. It simply attaches to the driver’s cab”, explains civil engineer Martin Bänziger of Kloten-based construction company Specogna Bau AG. The cement slip-former receives automatic three-dimensional control commands direct from the Leica system. Measurement engineering support is provided by Schällibaum AG, an engineering and surveying firm appointed to handle constructional survey work by a consortium comprised of Walo Bertschinger AG, Batigroup AG, Specogna Bau AG and Heilit + Wörner. When the Reporter visited the site on a September morning, surveyor David Zimmermann had set up a pair of LEICA TCA2003

Construction costs: one million francs a day

The 5th airport expansion at Unique Zürich Airport (see illustration right) includes an additional terminal (midfield dock), the Airside Centre and a new check-in concourse directly above the railway station, for increased passenger handling capacity and improved services. The project also includes new private and public delivery access and tunnels. The total budget is 2.3 billion Swiss francs, with 403 million francs earmarked for taxiways and aircraft de-icing areas alone. This translates into expenditure of over one million francs a day during the five-year construction period. Follow-on investments will total a further three billion francs.

Two LEICA TCA2003 total stations track the slip-former position in real time.





total stations adjacent to a projected section of taxiway, to keep the slip-former precisely on course.

The perfect edge

Precision automation allows the machine operator to concentrate on construction site procedures, like ensuring an optimal supply of concrete from the delivery lorries. Beat Furrer: "My work got easier after the Leica system was installed. I can now devote even more time to quality monitoring and improvement. Take the edges of the taxiway, for example: with the machine

under automatic control, I can concentrate more on ensuring that cement is fed right to the outer extremes of the operating width and properly compacted. Just take a look at those edges – perfect!"

Safety first

Martin Bänziger of Specogna Bau AG is the man responsible for deploying the system to save time and expense on the gigantic Unique Airport Zürich construction project. It is the 30-year-old site manager's job to see that the clients' and planners'



exacting quality, cost and deadline specifications are met or even exceeded. No mean feat, considering that regular airport operations and construction work must

A slip-former lays a perfect taxiway at Unique Airport Zürich, thanks to automated 3-D control by a Leica Geosystems machine guidance system.



Unique Airport Zürich: building for the future

The boom in air travel is outstripping all other forms of transport. An expert study predicts a 60 per cent increase in passenger volume for Switzerland over the next two decades, compared to just 30 per cent growth in road and rail travel. Switzerland's largest airport is already of major economic significance, with around 90,000 people depending on it for their income.

Zürich airport has seen phased growth over the past fifty years, and now handles 21 million passengers and 270,000 aircraft movements annually. The 5th expansion currently underway will upgrade existing infrastructure, replace ageing systems and enhance current facilities to establish a modern air traffic hub fit for the 21st century.



Left: The 5th expansion of Unique Airport Zürich: construction includes an additional terminal with underground access (marked in red on the model). Just like the taxiways, building work is in full swing here as well.



proceed in tandem, and aviation safety is the utmost priority.

A big success in the field

"The first three months of site operations proved that we had made the right decision to construct cement taxiways with the help of a Leica Geosystems machine guidance system", says Martin Bänziger. Despite initial scepticism from some quarters, no one involved with this time-critical site would now want to forfeit the benefits, since everything depends on rapid construction progress.



Martin Bänziger: "We halved the time needed to prepare the site for putting down the cement! And the pace of cement laying is around 20 per cent up on previous performance." Further benefits include better surface quality, coupled with increased precision and reliability. M. Bänziger: "With this new machine guidance system attached to our concrete slip-former, we can transform the project plan into finished work on the ground practically 1:1, with unparalleled speed and precision. A guide wire would never be this exact – not to mention the continual obstruction to construction site logistics."



Construction manager Martin Bänziger is responsible for maintaining or even exceeding the exacting quality, scheduling and cost specifications. The Leica machine guidance system has been very helpful in producing 50% time savings for site preparatory work, and around 20% additional construction performance.

Leica 3-D machine guidance system for closed-loop automation

The Gomaco slip-former was individually adjusted by Schällibaum engineers and Jürgen Maier of Leica Geosystems when the machine guidance system was installed. A one-off calibration procedure compensates for vagaries in slip-former geometry. LEICA TCA2003 total stations, once positioned, deliver a continuous stream of measurement data to the machine guidance system. The system determines the cement slip-former's position in real time, and sends appropriate control parameters to the machine.

The Leica machine guidance system not only stores all the project data, but is also linked with the construction machine controller. Continuous comparison of the current position with project specifications allows cement to be laid within ± 3 mm of the desired height profile, while guiding the machine along the required horizontal course. All this is achieved with greater speed and precision than a visual/manual approach using conventional surveying and control techniques.

Flat, homogenous concrete surface

Taxiways for large jet aircraft are among the most demanding surfaces from a construction engineering standpoint. The aircraft wheels bear down with a weight of 30 tonnes at each of three points, and a homogenous cement surface is vital to avoiding large expanses of rainwater and ice. The combination of a slip-former and a Leica machine guidance system delivers first-class results. A laboratory technician working on-site checks every concrete delivery to ensure consistently high material standards.

Site preparation at twice the speed

What is the reason for the fifty per cent site preparation time savings delivered by the machine guidance system?

Foreman Jürgen Indlekofer, the company's site specialist for highway and civil engineering construction projects: "Previously, we had to stake out and string



David Zimmermann is responsible for the surveying aspects of the project: "The surface is perfectly smooth and homogenous!" The reflector prism is visible in the right hand photo. Total stations track it automatically, never losing focus.



up the entire carriageway. Every six metres, or much less with clothoids, we would drive metal stakes into the ground and then level the guide wire at just the right height, with millimetre exactitude – although we knew that this order of precision was practically unattainable, owing to the thickness of the wire itself. Plus, there was always the risk of someone stumbling over it and disturbing the arrangement. Then we needed extra space to accommodate construction traffic entering and leaving the site, and complex logistics to allow incoming and outgoing vehicles to get past each other.” Clearly, the foreman and his crew are far from nostalgic about the „good old days“.

Making the most of scarce time

The only thing that frustrates Jürgen Indlekofer about this construction site are operational restrictions during foggy weather. Fog has repeatedly held up work, and caused delays to pilots and passengers. Says the foreman: “Fog is no problem for the machine

guidance system itself – we have already used it in darkness – but it does affect airport safety and quality. And these of course have

Linked taxiways for faster takeoffs

Additional finger docks and taxiways with passing places are being constructed for improved aircraft handling and new generations of aircraft. The extended taxiway network will mean that aircraft have less distance to travel to the takeoff runway. Specogna Bau AG and Batigroup AG are working on this portion of the construction site using a Gomaco GPH2800 slip-former fitted with a Leica machine guidance system. Also on-site at Unique Airport Zürich is a smaller slip-former operated by the Walo Bertschinger AG construction company, equipped with the same 3-D machine guidance system.



Machine operator Beat Furrer is relieved of control chores by the Leica Geosystems machine guidance system (white box) fitted in the driver's cab – not unlike the aircraft guidance systems which pilots now take for granted. Now he can concentrate wholly on the production process: “Our taxiways are absolutely perfect!”.



Foreman Jürg Indlekofer is glad about simplified logistics, without stakes and guide wires.

No more obstructive guide wires! With a Leica Geosystems machine guidance system running the automatically controlled slip-former, construction proceeds swiftly alongside regular airport operation, with horizontal and vertical precision of ≤ 1 cm and ± 3 mm respectively.



Applications in road and railway construction

Leica Geosystems' machine guidance systems have also taken 3-D control of other construction projects. They can be found on Wirtgen track-laying equipment deployed on the high-speed ICE rail link between Cologne and Frankfurt, and on the machines putting down tarmac on a replacement stretch of the Swiss N1 highway between St. Gall and the Unique Airport. Here too, the Schällibaum surveying company is responsible for deployment of the Leica 3-D machine control systems.

priority." Rain, snow and frost also make it impossible to mix cement of the required quality. Jürgen Indlekofer: "Unfortunately, there is nothing we can do about these weather-related glitches during the cold season in our hemisphere. But thanks to the halved survey setup time, in winter, summer and autumn we can make more use of brief weather openings to lay considerably longer strips of cement than before. It all adds up and helps us to stay ahead." Following interruptions caused by the weather, the precision afforded by the machine guidance systems makes for faster and more accurate resumption of work than would be possible with manual control, with seamless continuation of the previously laid section. From a construction and survey engineering viewpoint alone, Unique Airport Zürich is already living up to its name.

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LEICA GPS500 also in use

The company is also using the LEICA GPS500 system for general positioning and planning work on the Unique site. Leica GPS systems were used in 1999 for precise measurement of the existing taxiways, mainly during nightly airport shutdowns, in order to draw up definitive construction plans.

