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The European Stainless Steel Development Association

Stainless steel for outdoor swimming pools – A refurbishment and upgrading initiative in Munich

Stainless steel for public swimming baths

Public swimming pools are subject to a whole host of regulations and official guidelines. The legal requirements in terms of hygiene and safety must be met at the same time as keeping operating costs low and satisfying the ever-growing demands of pool users. Many older facilities fall short of today's expectations and so in recent years there has been an increased focus on refurbishment and modernisation.

Using stainless steel for the renovation of swimming baths brings an array of benefits. The excellent hygienic qualities of stainless steel, for example, are a very important argument for its use in pool facilities.

A further advantage comes from the high degree of prefabrication of components, which means shorter assembly times for the stainless steel pools, and therefore faster, more efficient renovation work. All the various pool fittings and components, as well as the water attractions, can be made of the same material. Altogether, stainless steel offers superb economy and low follow-on costs, thanks to the easy cleaning of its continuous, smooth surfaces and comparatively low maintenance costs.

As operators of the swimming pools in Munich, the local public utilities company (Stadtwerke München) was also convinced of the benefits of this material. They have been using stainless steel in their pool refurbishment programme for over ten years.

Munich's Michaelibad following renovation.

Munich's pool-renovation concept

The first public bathing facilities in Munich – two outdoor swimming pools – were inaugurated in 1858. In 1901, the first indoor facility, the Müller'sche Volksbad, went into service. This Jugendstil building is still well preserved today. In the Second World War, almost all the municipal swimming pools were badly damaged but after the war they were gradually modernised and reopened. When the city hosted the Olympic Games in 1972, some of these facilities were used as training pools, or as venues for the events. In 1991 the city council of Munich decided on a concept for extensive refurbishment of the municipal swimming baths. Basically, the aim was to transform these facilities, which until that point had been used mainly by keen swimmers, into modern pool centres with an emphasis on families and leisure. This would then increase their popularity and their commercial success.

Implementation of the concept started in 1996. Since that time, a total of ten swimming pools have been modernised, including four outdoor facilities. At present, the Prinzregentenstadion is undergoing renovation. This much-loved, inner-city leisure centre, erected in the 1930s, offers an outdoor pool in summer and ice-skating in winter.

A range of pools was created, and many attractions installed, such as water spouts, massage jets, a 'lazy river', waterslides and diving towers.

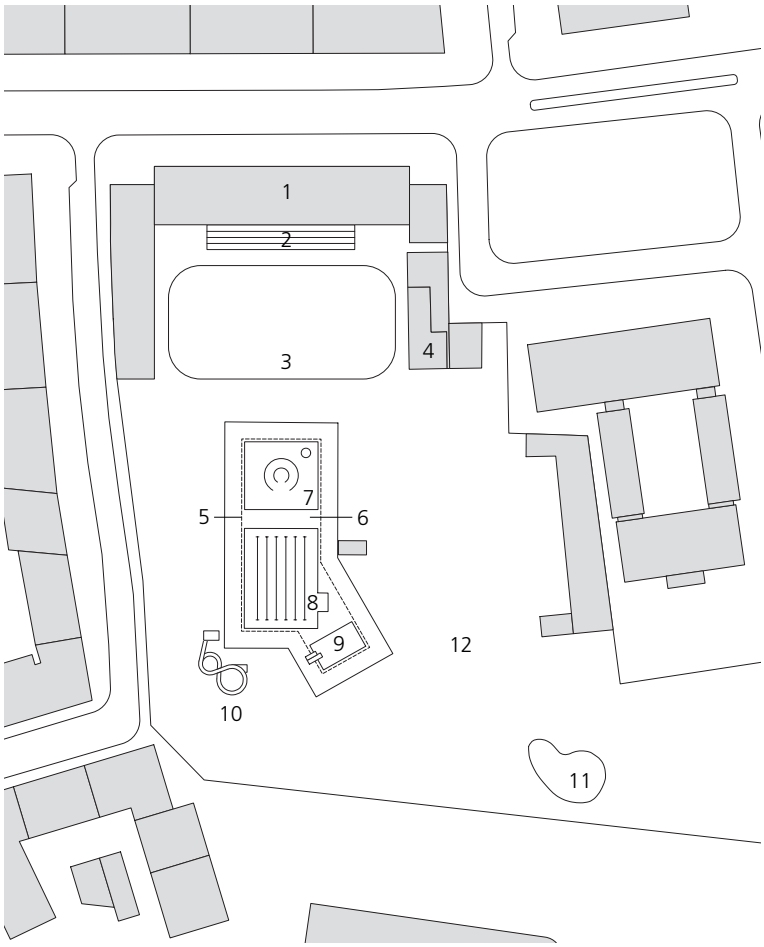
In 2002 alone, over one million people visited Munich's open-air pools. Following the renovation of the swimming pool at Prinzregentenstadion, the number of visitors has doubled, even though building work is not yet completely finished.

Renovating the pools

In the project to modernise the pool at Prinzregentenstadion, a welded stainless steel construction was used. The new pools were permanently sealed and made corrosion-resistant without having to remove the old, partly defective lining. In other swimming baths existing plastic linings were replaced by stainless steel. At the Prinzregentenstadion baths, the top edge of the existing reinforced concrete pool was removed to make way for the new, box-shaped overflow gutters of 2 mm thick stainless steel sheet.

The new overflow gutter sits on the walls of the old pool.

The original, single pool was divided into three separate pools by inserting partition walls of reinforced concrete. Panels of 2 mm thick stainless were prefabricated in lengths of up to 6 m and fitted onto the interior walls of each basin. Once filled with water, the original walls of the pool took over the job of supporting the new metal lining. The floors were made from 1.5 mm thick stainless steel.



Site plan of the Prinzregentenstadion
scale 1:2000

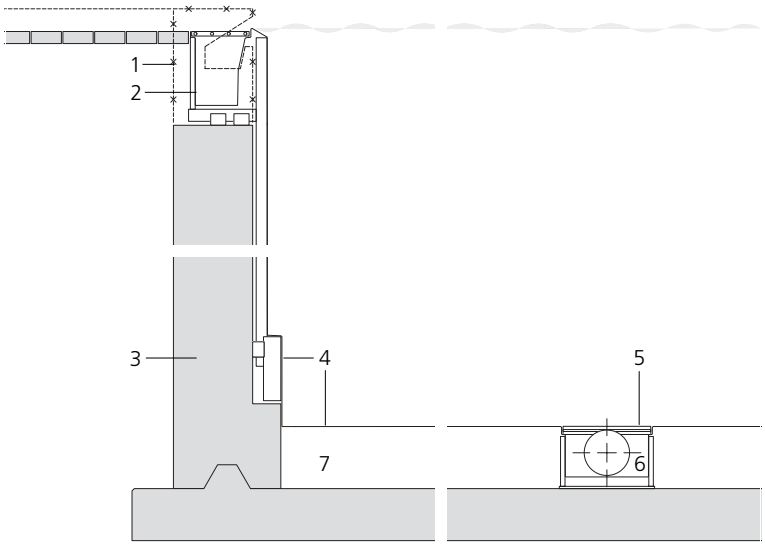
1 Main building
2 Stands
3 Ice-skating rink / Beach volleyball area
4 Restaurant
5 Outline of old pool
6 Overflow and rinsing water tanks
7 Leisure pool with 'lazy river' and 'mushroom'
8 Swimmers' pool
9 Diving pool and tower
10 Long slide
11 Toddlers' pool
12 Sunbathing lawns

Stainless steel used for the self-supporting walls of the 'lazy river'.

The black lane markings on the floor of the swimmers' pool were applied to the panels electrolytically.

Here loads are directed onto a base consisting of a gravel bed topped with a layer of sand.

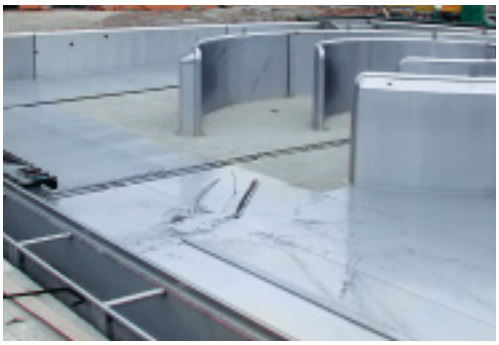
At water depths of around two metres, panels of stainless steel can also be erected as self-supporting structures. In such cases, 2.5 mm thick panels are affixed to a support frame. When welding stainless steel components together, a certain amount of staining occurs around the weld seams, so the panels are pickled after welding to prevent corrosion later on. This process produces a metallically clean surface which enables a protective 'passive' film to automatically reform on the surface of the stainless steel.



Schematic section scale 1:50
1 Top edge of old pool removed
2 Overflow gutter (water circulation) 2.0 mm stainless steel 1.4404, covered with plastic grid
3 Existing pool walls of reinforced concrete
4 Pool lining with integrated step, stainless steel 1.4404, 2 mm (wall) and 1.5 mm (floor)
5 Cover plate with inlet jets
6 Floor channel (water circulation)
7 Gravel layer on existing floor

The stainless steel pipes of the hydraulic system are on view here, prior to the fitting of the new floor.

The floor panels – just 1.5 mm thick – are laid directly onto a layer of sand.



To test the watertightness of the whole construction, the pool was filled with water and monitored over a period of five days. Then a dye test was performed, to check the proper functioning of the pool hydraulics.
Building work on the open-air pools at Prinzregentenstadion was carried out in the winter of 2001/02, without closing down the ice-skating rink. Thanks to stainless steel and the fact that it can be easily worked at low temperatures, the refurbishment could be carried out in the period from November to April, at a time when the outdoor pool is closed, in any case. By the start of the bathing season in 2002, the pool and its new attractions were ready to welcome visitors.

Three partitions were inserted into the old, tiled reinforced concrete basin to create three separate pools.

On the 'lazy river' the water jets are integrated into the side walls.

Choice of material

For reasons of hygiene, the water in all public swimming pools has to be specially treated. In most cases where a pool is renovated, it is also necessary to modernise the water treatment installations. In the Prinzregentenstadion a vertical mixing system is operated. Treated water is fed into the pool via jets located on the floor, then 100% recirculated back into the collector tank of the treatment system via the overflow gutters. The rapid, efficient mixing that occurs through this system means less disinfectant is required.

Although the open-air pools are generally filled with drinking water, which has a low chloride ion content, levels of between 200 and 500 mg/l can occur as the water is recycled within the system. The water temperature in the pools varies from 26 to 32°C. Higher temperatures increase the chemical aggressiveness still further.

Because of these corrosive conditions, grade 1.4404 stainless steel (approx. 17% chrome, 12% nickel, 2% molybdenum) was chosen. This grade is also used on components that are not in permanent contact with the water, protecting them, too, from the corrosive effects of chlorinated water.

Overflow gutters transport the pool water back to the collector tank.

Treated water flows into the pool through jets in channels on the floor.

High air and water temperatures, coupled with constant water movement, raise the chloride content close to the pool, even in outdoor facilities.

Stainless steel attractions

Part of the renovation programme of Munich swimming pools also involves building a whole range of attractions or water amusements. The non-swimmers' pools, for example, are turned into real adventure worlds. Here, stainless steel proves to be an ideal material, as all the installations – water spouts, 'lazy rivers', massage jets and diving towers – can be made of the same material as the pool and its technical installations, thus creating a pleasing visual harmony.

For the flume slides, rounded sheets of stainless steel sheet were used. The segments were ground and polished after being welded together offsite, and stainless steel tube fitted to the top edges of the flume, to provide a smooth, safe finish while also bracing the whole structure.

Corrosion is generally not a problem with slides, as water constantly runs down the inner surfaces, which are also kept polished by the users. The slide surfaces are also resistant to mechanical wear. At times, the outer sides may be sprayed with water and a coloured paint coating is applied to these surfaces to hide flowmarks and deposits etc., helping to reduce the cleaning effort.

The benefits of stainless steel are obvious in the leisure pool. The material can be used for a wide range of applications.

After assembly, the stainless steel flume slide presents a homogeneous profile, evenly shaped in the direction of the slide. The welds are undetectable to the touch.

The support frame for the diving tower is made entirely of stainless steel sections.

Cleaning and maintenance

During the summer season, dirt inevitably finds its way into an open-air pool, either from the surroundings or brought in by the bathers themselves. Distributed throughout the pool, most of the particles are captured by the water treatment system. Nevertheless a certain proportion stays in the pool where it can affix itself to walls and floors. However, these deposits do not adhere for long on the entirely smooth surfaces of the stainless steel. Algae, too, the formation of which cannot entirely be prevented in outdoor pools, even under optimum water treatment conditions, find little purchase in a stainless steel pool, unlike in tiled pools with their many joints.

On stainless steel components that are not constantly immersed in water, spray water drying on the surfaces can lead to the formation of deposits and a concentration of chlorides. To protect these components against corrosion, they need to be cleaned regularly, mainly with agents containing phosphoric acid. Cleaning materials based on hydrochloric acid are unsuitable as they cause corrosion and lead to staining.

At the end of the summer season, the water level in the pool is reduced, so that the pool can accommodate the volume of rainfall that will occur in winter. At the same time an

Water spray can cause deposits on stainless steel and an increase in the concentration of chlorides. Regular cleaning and maintenance protects these components against corrosion.

No special measures need to be taken to protect stainless steel pools for the winter.

Geothermal heat is sufficient to prevent ice freezing on the sides of the pool.

anti-scale agent is added to prevent deposits forming in the pool over the winter months.
In the Prinzregentenstadion pool, no complicated procedures with ice-pressure cushions are needed. Experience has shown that even in extremely low temperatures, rising geothermal heat is sufficient to prevent ice freezing on the wall of the pool. The maintenance carried out each year after the winter break involves emptying the pool, and then simply thoroughly cleaning and checking the water jets and channels in the pool floor. Strong cleaning agents do remove dirt more efficiently, but they are also more aggressive on the material. The consumption of cleaning materials on stainless steel surfaces is comparatively low – which of course means lower maintenance costs and less environmental pollution.
In the programme to renovate Munich's open-air swimming pools, stainless steel has been found to offer long-term, trouble-free performance, even in outdoor situations. The material displays no detectable signs of ageing. And annual costs for maintenance and repair of the pools and associated plant are low when compared to reinforced concrete pools with tiled linings. Through the high elasticity and ductility of the material, stainless steel basins are largely tolerant of settlement and temperature fluctuations.

The covers of the inlet channels are removed for cleaning and inspection as part of the annual maintenance programme.

Light refracting in the stainless steel pool gives a fresh, blue appearance to the water.

Bathers benefit from the outstanding hygiene qualities of stainless steel.

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