



STRABAG
WORK ON PROGRESS

PRECAST INDUSTRIES



STRABAG

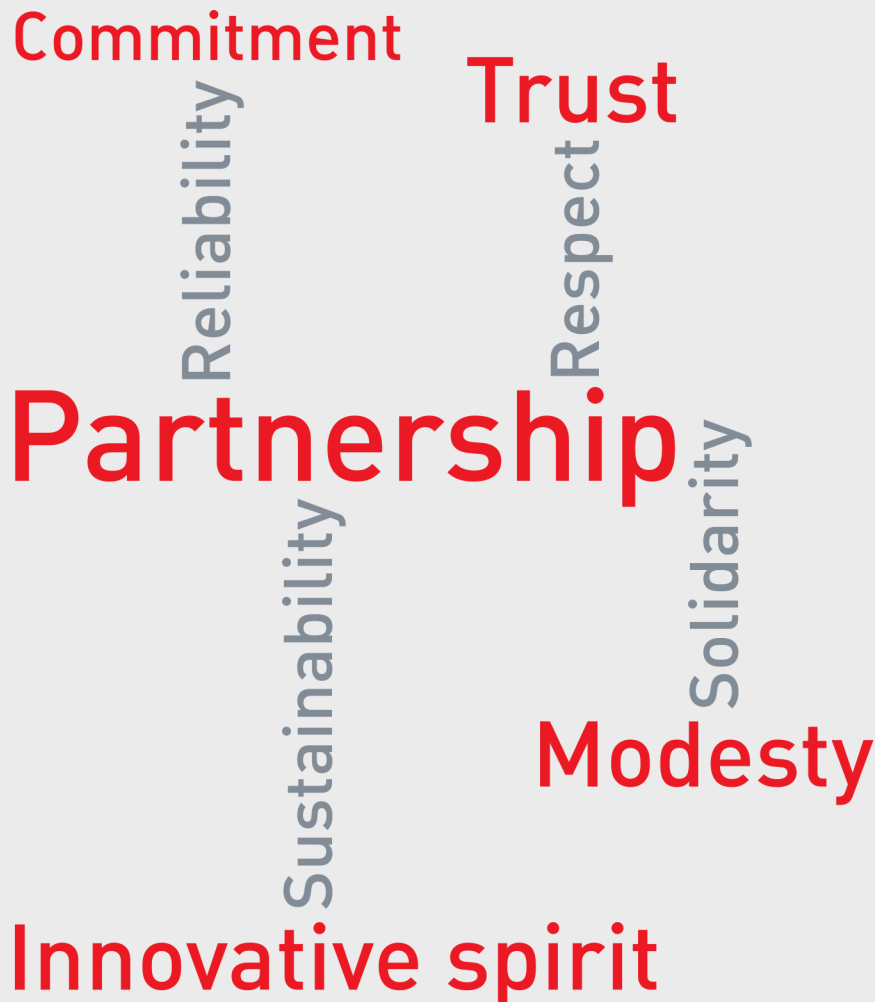
STRABAG
WORK ON PROGRESS

Our vision and guiding principles

Ed. Züblin AG is a member of STRABAG SE - the European-based technology group for construction services and leader in innovation and financial strength. Together, we create added value for our clients by our specialised entities integrating the most diverse services and assuming responsibility for them. We bring together people, materials and machinery at the right place and at the right time in order to realise even complex construction projects – on schedule, of the highest quality and at the best price. In short: We assume a part of the risk, thus relieving our clients.

Thanks to the hard work and dedication of our 73,000 employees, we are one of the few companies capable of offering services along the entire construction value chain – from design to planning, from construction to property and facility services, from operation all the way to demolition. In this way, we generate an annual output volume of about € 14 billion. At the same time, a dense network of numerous subsidiaries in many European countries and, increasingly, on other continents is helping to expand our area of operation far beyond the borders of Austria and Germany. This broad diversification puts us in a position to build cost- and resource effectively.

We keep our mission statement in mind when planning our future and distributing our resources – such as financial means or employee capacities – within the company. Moreover, we let the following principles guide us in all of our considerations.



For us, **partnership** means...

- Being appreciative in our interactions with one another.
- Meeting each other at eye level.

For us, **trust** means...

- Counting on each other.
- Being aware of our responsibility at all times.
- Allowing space for independent thinking and acting.

For us, **solidarity** means...

- Standing by one another.
- Living team spirit – also and especially in difficult situations.
- Taking responsibility for successes and failures.
- Standing together even in troubled times.

For us, **innovative spirit** means...

- Creating space for new ideas.
- Allowing ourselves to make mistakes and seeing them as valuable learning experiences.
- Actively and confidently shaping the future of the construction and real estate industry.



For us, **commitment** means...

- Defining and pursuing common goals.
- Getting actively involved.

For us, **modesty** means...

- Setting realistic expectations for ourselves and others.
- Staying down to earth.



For us, **sustainability** means...

- Taking on and sharing responsibility for ourselves, for our company and for our environment – now and tomorrow.
- Thinking in the long term.
- Seeking lasting successes rather than quick victories.

For us, **respect** means...

- Being open to different views and ideas.
- Being appreciative, civil and open in our interactions with one another.

For us, **reliability** means...

- Standing by our word.
- Saying what we do and doing what we say.

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Choose
Safety



Safety at STRABAG

The most important prerequisite for a satisfied working day is a healthy and safe life. On the construction site or at the office, the safety and health of all is a central priority and part of our corporate culture. To make sure things stay this way, a central guiding principle applies to the entire group: “1>2>3 Choose Safety”. This slogan sums up all matters of, and necessary measures, for work safety under a uniting roof. Our goal is clear: reducing the number of accidents and lost working hours to zero.

1 ▶ Stop!

Take your time and assess the situation before you act. The seconds before your next move are decisive!

2 ▶ Think!

Take a good look at the next workstep, prepare it well and stand up for a safe work environment.

3 ▶ Act!

Act responsibly and work safely. Choose safety – for you and your team.

“Vision Zero – Zero Accidents”





ZÜBLIN Precast Industries Sdn. Bhd.

Location:

Johor (Malaysia)
Kota Tinggi

Total Area:

90,000 m²

Production Capacity:

200 m³ / day
3 Production Lines

Production Start:

March 2015

Workforce:

50 Employees and up to 250 Workers

In 1997 Ed. Züblin AG established a branch in Singapore under the name of Ed. Züblin AG. Singapore Branch and subsequently established a factory for the production of precast concrete segments and reinforced concrete pipes in Thailand.

Recognising the necessity for pipes and segments in infrastructure projects in the Asia Pacific Region, the company established a new factory, in Malaysia in 2015, for the production of precast reinforced concrete elements under the name of Züblin Precast Industries Sdn, Bhd. The factory is located in Kota Tinggi, in the State of Johor only 50 km from Woodlands, Singapore. The state-of-the-art factory can produce elements with a service life of over 100 years.

The company's own design department has the capacity to design a diverse range of precast concrete products which conform to all international standards.

Although the business has evolved through several companies and over many years, the Züblin brand is well established and synonymous with excellent quality and service whilst developing and optimising new production processes.



Why Precast?

The use of precast concrete products in the construction industry provides clients with numerous financial and performance benefits, including:

- **Impressive design and application flexibility**
moulds can be built to suit many unique design requirements.
- **High strength tolerance**
precast concrete provides long life cycles, high loading capacities and long spans.
- **Durability and low maintenance**
precast concrete provides a longer lifespan for high-use applications.
- **Improved aesthetics**
precast manufacturing delivers grey off-form (made in steel casting beds) with a range of architectural finishes.
- **Faster construction**
with around 75% less construction time than traditional construction methods.
- **Lower costs**
precast construction can save time on site, thereby reducing propping/scaffolding costs, site labour costs, and materials storage costs.
- **Better site management**
construction sites are less cluttered and product deliveries can be timed to suit the project – just in time.
- **High quality product**
controlled and purpose-built factories provide a high-quality product for our clients.
- **Reliable production**
manufacturing in covered conditions avoids weather delays.
- **Reduced waste**
as exact elements are delivered to site there is no construction wastage on site.
- **Reduced environmental impact**
manufacturing in a controlled factory environment is more efficient than traditional construction, with less noise, air pollution and debris on site. The use of recycled materials in production allows for the benefits of thermal mass to be incorporated into designs.



Benefits of Precast

- **Safety**
 - Reduced use of scaffolding thus minimising the risk of working at height
- **Cost Savings**
 - Through enhanced productivity in manpower and equipment
- **Environmentally Friendly**
 - Less emissions due to shorter construction period
 - Less equipment on site required
 - Less concrete waste
- **Public Relations**
 - Reduced exposure to noise, dust and waste
 - Reduced construction duration
 - Reduced refurbishment on the concrete structure
- **Improved Quality**
 - Enhancement of quality and lifespan

Quality Management

The Factory has all required accreditations necessary for international markets and all products are tested in accordance to international standards.

Factory Certification

- ISO 9001:2015 Quality Management System
- ISO 14001:2015 Environmental Management System
- ISO 45001:2018 Occupational Health and Safety Management System
- ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories
 - Compressive Strength Test BS EN 12390-3
 - Sieve Analysis (Coarse & Fine) BS EN 933-1
 - Depth of Penetration Water Under Pressure BS EN 12390-8
 - Tensile Splitting Strength of Test Specimens BS EN 12390-6
 - Measuring the Flexural Tensile Strength BS EN 14651
- BCA: Licensed as General Builder Class 1 and Specialist Builder (Precast Concrete Work)
- Certificate of Conformity Ready Mixed Concrete Certification



MS ISO/IEC 17025
TESTING
SAMM NO.887





“Green” Production

Concrete Recycling Plant

With our concrete recycling systems, we are able to separate the concrete waste into individual components, such as aggregates, sand and water for re-use in production.

The importance of environmental responsibility continues to increase. For a cleaner world for future generations, we remain focused on the environment and enforce specific rules and standards in our production of concrete precast elements to minimise our environmental impact.

Water Treatment Plant

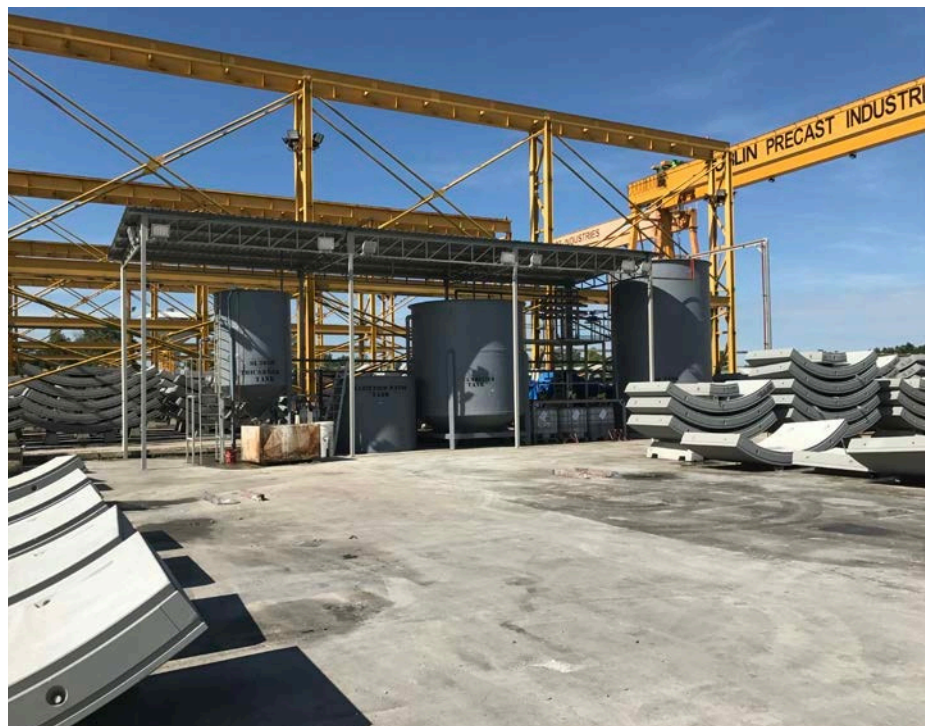
Excess water which cannot be used directly in the mixing process is treated at the factory, so that clean water is available. This can be used in the production process or discharged into the public system.

The sludge produced during the water treatment process can also be used, as far as possible, for special precast elements, again in the mixing process to form a closed circuit.

Waste Management

Waste generated from our production operations is kept to a minimum and is managed in accordance with our ISO 14001/2015 policy.

A quarantine area is set up on the factory premises for the purpose of control, storage and record of all hazardous material which enters and leaves the factory.





Product Range

The state-of-the-art factory can produce elements with a service life of over 100 years.

Product Portfolio

- Jacking Pipes
- Tunnel Lining Segments
- Caisson Segments
- Manhole Chamber Rings
- Pipe Cladding
- Customised Precast Elements
- Crash Barriers





Precast Tunnel Lining Segments

Steel Reinforced and Fibre-Reinforced Tunnel Segments

Precast concrete segmental linings have been produced traditionally as reinforced concrete (RC), steel fibre reinforced (SFRC) and a combination of this as Hybrid Segment concrete.

The application of steel fibre reinforced concrete is increasingly more common as a result of the increased durability and sustainability. The production process is more efficient, minimising edge cracks during handling and greatly reduces crack width and depth, due to a higher resistance against corrosion and impact resistance.

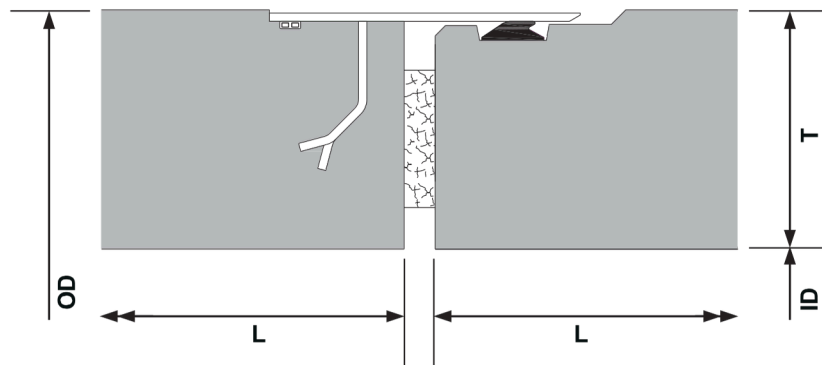


Standard Jacking Pipes

Our concrete jacking pipes are durable, highly resistant to abrasions and designed to withstand heavy loads, ZÜBLIN's state-of-the-art Precast factory, situated in Kota Tinggi Malaysia, produces elements with a service life of over 100 years. The Jacking pipes can be produced with or without an HDPE liner.

Notes:

- Lubrication ports and one-way valves are included
- Concrete Grade is C45/55 but other grades are available
- Steel collars are steel grade S316 or S275JR other collar materials are available
- HDPE Liner with 2.5mm thickness and 360° if required.
- HDPE welding rod, capping strip and patches can be supplied
- Pressure transfer rings can be supplied
- Gaskets and seals are included
- Intermediate jacking stations (IJS) are available



DN	ID	OD	T	L	Weight		Jacking Force
					kg/m	kg/pipe	
	mm	mm	Mm	m			kN
600	600	860	130	2.00	735	1,470	1,385
700	700	960	130	2.00	850	1,700	2,534
800	800	1280	240	3.00	1,958	5,875	3,401
1000	1000	1280	140	3.00	1,250	3,750	1,969
1000	1000	1400	200	3.00	1,880	5,640	3,200
1200	1200	1490	145	3.00	1,533	4,600	3,089
1200	1200	1580	190	3.00	2,080	6,240	3,313
1500	1500	1820	160	3.00	2,080	6,240	4,527
1800	1800	2120	160	3.00	2,467	7,400	8,122
1800	1800	2200	200	3.00	3,140	9,420	6,945
2000	2000	2450	225	3.00	3,990	11,790	9,445
2100	2100	2500	200	3.00	3,617	10,850	8,516
2100	2100	2550	275	3.00	4,108	12,325	10,127
2400	2400	2860	230	3.00	4,750	14,250	9,591
2500	2500	2980	240	3.00	5,170	15,590	11,027
2800	2800	3370	285	3.00	6,910	20,730	16,415
3000	3000	3600	300	3.00	7,770	23,310	21,822
3100	3100	3600	250	3.00	6,575	19,725	20,251
3100	3100	3720	310	3.00	8,300	24,900	27,619

All weights and jacking forces shown are approximate and subject to change. Other diameters are possible upon request.

Jacking Pipes and Intermediate Jacking Station (IJS)

Precast Concrete Jacking Pipes

Jacking Concrete Pipes are a specialised tunnelling pipe. The jacking pipe is lowered into a shaft behind a TBM (tunnel boring machine) then pushed underground by hydraulic jacks creating a pipeline without the need to excavate an open trench. Reinforced concrete jacking pipes are designed to withstand the effects of external loads.

Standards:

- BS EN 1916
- BS 5911-1
- AS/ NZS 4058
- SS EN 206-1
- BS EN 197-1
- SS 544-1 & 2
- BS 4449
- SS 560
- AS/ NZS 4671
- SS 183
- EN 681-1
- EN 934-2
- AS 1478-1
- DIN V 1201

Intermediate Jacking Station (IJS)

An IJS consist of two pipes, a Lead pipe and a trail pipe with an Interjack system (supplied by customer) between the two lead pipes as shown in the image below. Interjacks are commonly used on long drives where jacking forces exceed the maximum forces that the pipes or main jacks are capable of withstanding.

1 Standard Jacking
Pipe 2 IJS – Trail Pipe

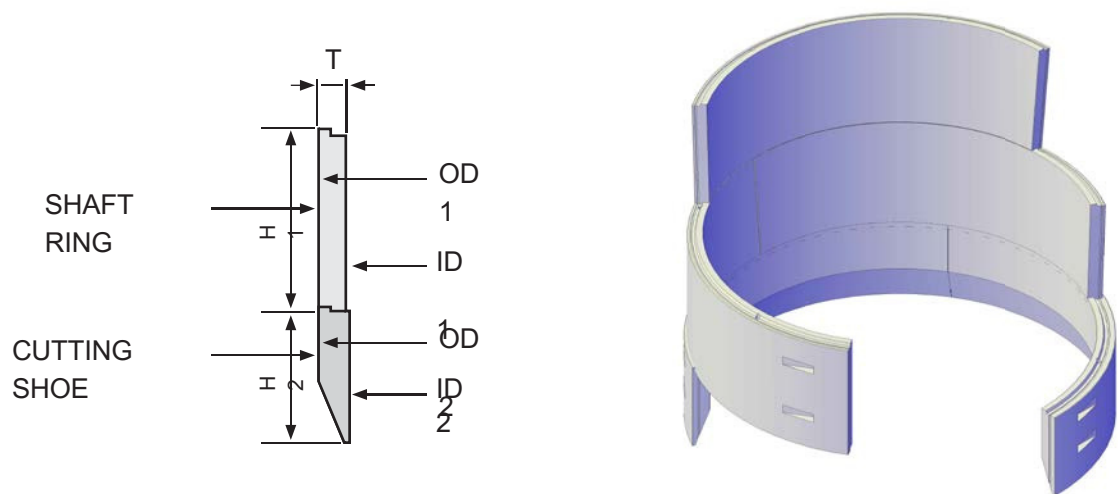


Caisson Shaft Rings

The reinforced precast concrete shaft rings are specially designed for sinking by using the caisson method. This is achieved by using precast concrete elements designed for several diameters and depths which are widely used for the construction of temporary shafts, wet wells and pumping stations.

Notes:

- Concrete Grade is C35/45 but other grades are available
- The vertical and horizontal tie rods are not included, but are available
- Grout ports and one-way valves are available
- Shaft Rings with soft eyes are available
- Steel jackets for the cutting shoe are available



Type	ID mm	OD mm	T mm	Height m	Pcs / Ring set	Weight to / pcs
Segment Cutting Shoe	2500 2500	2860 2960	180 230	2.00 1.50	1	7.7 7.5
Segment Cutting Shoe	3000 3000	3400 3500	200 250	2.00 1.65	1	10.5 10.7
Segment Cutting Shoe	3200 3200	3600 3700	200 250	2.00 1.50	1	10.8 10.3
Segment Cutting Shoe	3900 3900	4300 4400	200 250	2.00 1.65	2	13.1 13.7
Segment Cutting Shoe	4080 4080	4530 4630	225 275	1.30 1.00	6	1.65
Segment Cutting Shoe	4400 4400	4900 5000	250 300	2.00 1.50	2	18.6 16.9
Segment Cutting Shoe	5000 5000	5500 5600	250 300	2.00 1.65	2	21.0 21.0
Segment Cutting Shoe	6000 6000	6500 6600	250 300	2.00 1.65	2	25.0 24.9
Segment Cutting Shoe	6300 6300	6800 6900	250 300	2.00 1.50	3	26.2 23.8
Segment Cutting Shoe	6580 6580	7180 7280	300 350	1.60 1.00	7	3.70
Segment Cutting Shoe	7200 7200	7800 7900	350 350	2.00 1.50	3	36.0 31.7
Segment Cutting Shoe	8800 8800	9500 9600	350 400	2.00 1.50	4	51.3 44.2

All weights and jacking forces shown are approximate and subject to change. Other diameters are possible upon request.

Technology and Production



Concrete Mix Design

TPA – Organisation

The TPA “Gesellschaft für Qualitätssicherung und Innovation GmbH” (TPA) is our global materials technology competence center for asphalt, concrete, earthwork and geotechnical engineering.

As an independent laboratory organisation, TPA Aims:

- To constantly improve quality standards in the construction industry
- To provide top-level services
- To continually extend our range of services
- Total customer satisfaction



Fibre Reinforced Concrete (FRC)

FRC is constituted of fibres as a replacement / combination for standard reinforcement bars. This product has been tested by us to achieve compressive strengths of up to 60 N/mm². Several projects have utilised FRC as a product including the notable Katzenberg Tunnel (Germany) and Deep Tunnel Sewage System (Singapore).

Corrosion Resistant Concrete

We produce concrete products which are durable and corrosion resistant under adverse conditions. Our high-quality concrete products provide:

- Sulphate resistance
- Chloride resistance
- Micro-biological Influenced resistance (MIC)

ASBM



Reinforcement Preparation

Automatic Stirrup Bending Machine (ASBM)

Our ASBM is the most innovative stirrup bender, designed to produce stirrups out of coil or stock rebar according to the different production requirements in a fully automatic way, guaranteeing maximum flexibility, productivity and quality of the finished product. Our ASBM is the first equipment in the world to use nearly 100% of the bar's length without generating additional wastage.

Automatic Cage Welding Machine (Pipe)

Automatic welding machines designed by Zublin for the manufacture of cylindrical cages for reinforced concrete pipes. The machines are designed to produce spot welded reinforcement cages with or without bell and/or spigot joint in different lengths for a wide range of pipe diameters.

Cage Welding Machine



The rigid machine structure ensures extremely straight twist-free and accurate reinforcement cages, essential for the trouble-free production of good quality concrete pipes.

The pre-cut longitudinal wires are fed into the machine manually. All necessary parameters such as cage length, winding wire pitch, welding intensity, bell angle, rotational speed, etc. are infinitely adjustable for each type of reinforcement cage and can be stored in menus.

Only one operator is required to run the pipe cage welding machine.

- Cage Diameter (mm) 800 – 3640
- Number of longitudinal wires 9 / 12 / 18 / 36
- Longitudinal wire diameter (mm) 5 – 16
- Winding wire pitch (mm) 50 – 150
- Winding wire diameter (mm) 5 - 16



Technology and Production

Curing

All the beneficial properties of precast concrete, including strength, durability and water tightness, are enhanced through appropriate curing techniques. In some instances, the curing of precast concrete products is one of the last, and perhaps most neglected, steps in the manufacturing progress, especially in a rapid production environment.

- The primary goal of curing is to keep the concrete saturated.
- Adequate curing is even more important when the water-cement ratio is low. The prevention of water loss is essential to achieve the required concrete strength and, at the same time reduces the permeability of the precast concrete.
- During prolonged hydration, the cement in the mix develops into a gel, which reduces the size of the concrete's internal voids and greatly increases the water tightness of the concrete.

Fully Automatic Steam Curing System

ZÜBLIN Precast Industries uses a state-of-the-art fully automated steam curing system which ensures a practical, efficient, environmentally responsible and cost-effective production of precast concrete elements.

The process of steam curing is carried out until the pre-determined maximum temperature under the steam covers is reached. The temperature rise in any one 15-minute period is programmed not to exceed 6 °C. The steam supply will then be reduced so that the maximum temperature is not exceeded. Steaming will continue until the required concrete strength has been achieved. The maximum temperature for steam curing shall not exceed 70°C.

Benefits of Steam Curing

- Less permeable concrete
- Displays great surface hardness
- Increased overall durability
- Improves protection of the concrete during removal of formwork

Quality Control

All production processes of the concrete precast elements are subject to a stringent Quality Control Management System. This system puts an especially high emphasis on the concrete curing procedures. At the beginning of the production and at defined intervals, the effectiveness of the employed curing method is tested using concrete specimens that are produced under conditions equivalent to the precast segments. The testing of those specimens is performed in our accredited laboratory.



STRABAG Laboratory

The Laboratory is located within our factory premises is accredited to certify to international norms and standards.

The laboratory equipment is periodically calibrated and certified by a third party.

Standard Tests

- Compressive Strength
- Sieve Analysis of Fine Aggregates
- Sieve Analysis of Coarse Aggregates
- Slump Test
- Pipe Crushing Test
- Water Tightness Test
- Air Content Test
- Flexural Strength Test
- Splitting Test
- Water Penetration Test
- Testing of Cement
- Organic Impurities
- Outer Seal Test (ingress of water)



NDT – Non-Destructive Testing Equipment

Ferro Scan

Using the Ferroskan system we can carry out a non-destructive means of locating and measuring reinforcing bars and concrete cover. This system employs the induction principle, with the scanner locating rebar's accurately and reliably within concrete.

Ultrasonic Pulse Velocity (UPV) Scan

A UPV test is an in-situ, non-destructive test to check the quality of concrete. In this test, the strength and quality of concrete is assessed by measuring the velocity of an ultrasonic pulse passing through a concrete structure. This test is conducted by passing a pulse of ultrasonic wave through concrete to be tested and measuring the time taken by pulse to get through the structure. Higher velocities indicate good quality and continuity of the material, while slower velocities may indicate concrete with many cracks or voids.

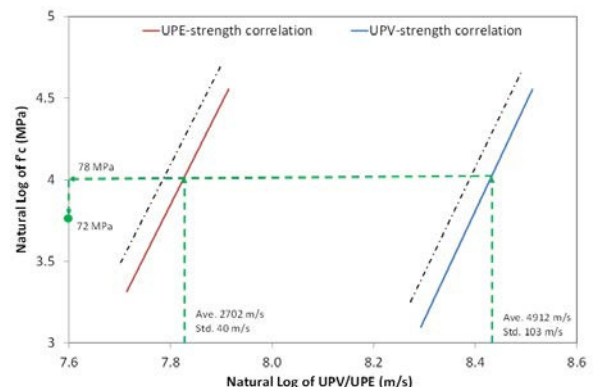


Ultrasonic Pulse Echo (UPE) Scan

The UPE technology extends ultrasonic pulse velocity (UPV) applications to objects where access is restricted to a single side.

UPE & UPV test scan can detect and map the following in concrete:

- Voids and honeycombing
- Steel reinforcement (Rebar)
- Concrete thickness
- Evaluating of concrete strength
- Stevedoring and packaging





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