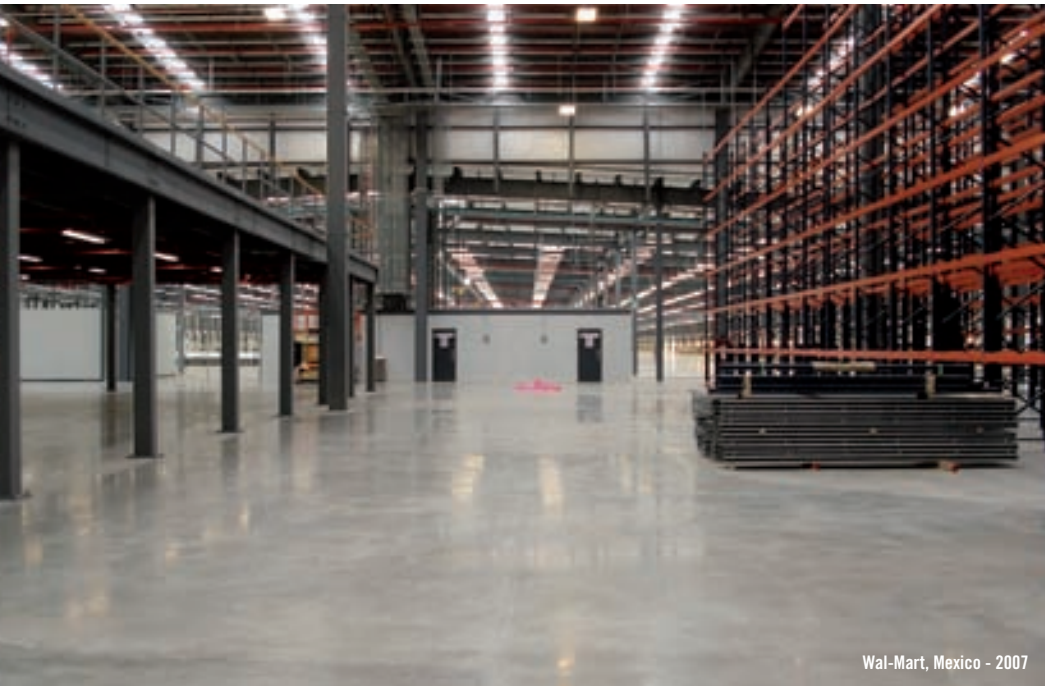


# V S L S L A B O N G R A D E



PROJECT ANALYSIS  
DESIGN  
POST-TENSIONING  
CONSTRUCTION  
FINISHING

# THE VSL EXPERTISE AND SPECIALIST CONSTRUCTION SERVICES



Wal-Mart, Mexico - 2007

## The Company

VSL's special construction systems have been used throughout the world since 1956. The company operates on five continents as a multinational group of companies through 35 subsidiaries. This worldwide network ensures that clients benefit from the technical

experience and knowledge developed and shared between all of the subsidiaries. Clients operating anywhere in the world can rely on the leverage of VSL's commercial networking. VSL's strength is its people, with more than 900 engineers worldwide focusing their efforts on providing state-of-the-art and cost-effective construction technologies.

## Tailor-made solutions

VSL's approach is to provide a solution tailored to the particular needs of each project. The VSL Slab on grade system provides a high-quality solution for concrete slabs that are placed directly on the ground and offers great value for money.



## VSL – guided by a strong QSE culture

VSL's leading position is based on a rigorous and committed quality culture. The QSE (quality, safety, environment) policy represents a major focus for every service provided. Local teams ensure co-ordination of actions, encourage sharing of experience and promote best practice, with the aim of continuously improving performance. In VSL's culture, employees are vitally important to the competitiveness and prosperity of the company. VSL is committed to maintaining the highest levels of client satisfaction and personnel safety.



Tenax project, Italy - 2006



Nestlé Distribution Plant, Chile - 2002

VSL is committed to being a valuable, reliable and trusted construction partner, delivering high-quality performance and efficiency for its customers.



# PREVENTING COSTLY REPAIRS



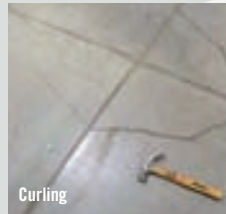
Delamination and spalling



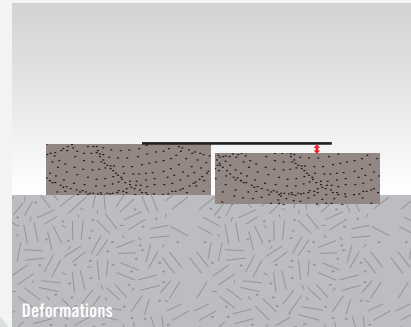
Cracking



Abrasion



Curling



Deformations

## Expensive consequences of failures

- Greater requirement for maintenance of the joints
- Slabs requiring repair
- More frequent repair to rolling equipment such as trucks and forklifts
- Loss of productivity

Consequences of these failures can be expensive to the owner. Large areas may become unusable, which restricts operations and in some extreme cases leads to closure of the facility.

## The right solution

The VSL post-tensioned Slab on grade greatly diminishes the risk of failures and is therefore widely used in the construction of such structures.

The system uses post-tensioning technology in the design and construction of slab-on-grade flooring and pavements. Compared with conventional reinforcement, post-tensioning provides a long service life and high loading capacity, requires almost no maintenance and retains a high resale value. The VSL Slab on grade system has been used successfully worldwide in various types of logistics and manufacturing facilities, workshops and other structures.

Post-tensioned slabs on grade are used in industrial structures where the main objective is to eliminate most of the joints that are the major weakness in concrete structures. The VSL Post-Tensioning System allows a reduction in the number of joints while keeping the structure within allowable tensile stresses, which leads to lower maintenance costs over the design life of the slab.

## Factors affecting industrial facilities

- Differential temperature variations
- Heavy traffic, such as trucks, forklifts...
- High abrasion from vehicle movements
- Heavy loads from stocks

## Risks of failure with conventional solutions

The images above show failures in conventionally reinforced concrete slabs on grade or slabs with steel fibre reinforcement.

## Requirements for an industrial slab on grade

An industrial floor slab on grade should be durable, free of excessive cracking, suitably flat and able to withstand traffic loads.

Achieving these aims requires consultation between the slab designer, owner, geotechnical specialist and builder.

VSL deems it important to consider factors including:

- Environmental conditions
- Site conditions
- Traffic requirements
- Loads on the slab
- Slab thickness and reinforcement requirements
- Joint location and spacing
- Method of slab construction.

Each of these considerations affects one or more of the others.

# THE LIGHT SOLUTION FOR ANY CONDITIO

Providing customers with the optimum efficient structure is at the heart of the VSL  
The VSL Slab on grade system is economic to construct and maintain.

## Supporting any load

The VSL Slab on grade can be designed to accommodate any loading requirement.

## Control of cracks

Post-tensioned slabs reduce the risk of cracking more effectively than other reinforced slabs because of the compressive forces that are applied by the post-tensioning cables.

## Fast-track construction

Post-tensioned slabs can be constructed much faster than conventional reinforced slabs. Time is also saved by using fewer joints and narrower footings with less digging and less concrete. Large pours of more than 2,500m<sup>2</sup> are a common feature of post-tensioned slabs on grade.

## Providing the ultimate choice in surface coatings

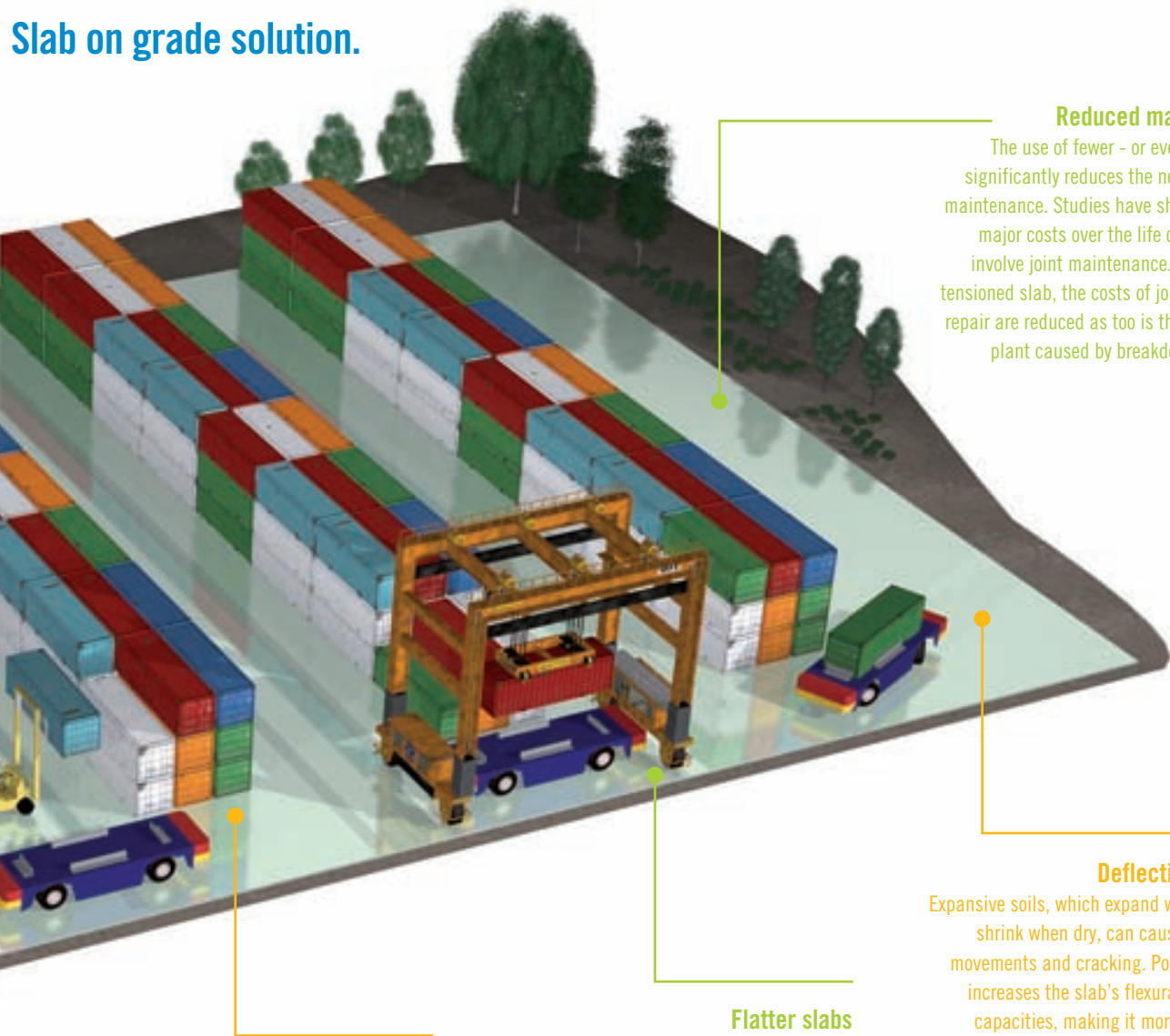
VSL Slab on grade produces the best possible base for surface finish and gives the customer the ultimate freedom of choice in coatings. The eventual finish of the slab can be selected for appropriate texture, hardness and colouring, making it not only serviceable but also attractive.

## Up to 30,000m<sup>2</sup> without joints

Large concrete areas can have their joint spacing increased to minimise the costs of the joints as well as the long-term maintenance and operational costs. Use of the Slab on grade solution also reduces the wear and tear caused by moving equipment, extending the life of the joints.

# N

## Slab on grade solution.



### Reduced maintenance

The use of fewer - or even no - joints significantly reduces the need for future maintenance. Studies have shown that the major costs over the life of a structure involve joint maintenance. With a post-tensioned slab, the costs of joint and crack repair are reduced as too is the damage to plant caused by breakdown of joints.

### Deflection control

Expansive soils, which expand when wet and shrink when dry, can cause foundation movements and cracking. Post-tensioning increases the slab's flexural and tensile capacities, making it more resistant to problematic soils.

### Flatter slabs

The risk of slab curling is greatly reduced with fewer joints and greater joint spacing. This produces a smoother ride and less maintenance for forklifts.

### More flexible slabs

A thinner slab is more flexible. In the event of a large overload that may induce cracking, the prestressing ensures that the slab returns to its previous state when the load is removed. In comparison, a weak point is more likely to remain in the substructure with a conventional reinforced slab, leading inevitably to deterioration.



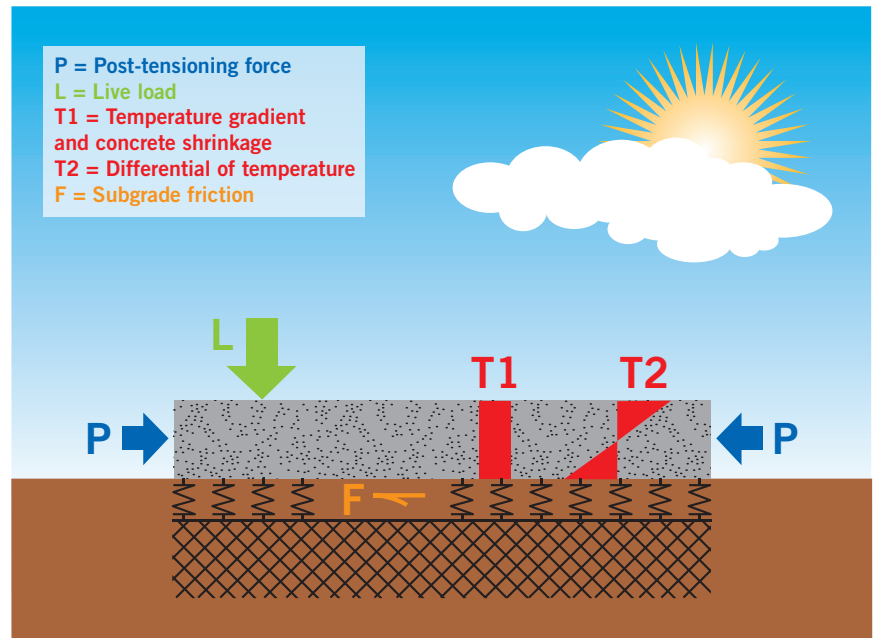
# OPTIMISED COSTS WITH POST-TENSIONING

## Post-tensioning achieves the highest efficiency, based on:

- the external effects that apply to the structure (including temperature, temperature differential and loadings);
- the internal effects such as concrete shrinkage;
- the size of the structure;
- the quality of the supporting ground, which may require additional preparation to reach a given standard.

The design of the VSL Slab on grade optimises the overall cost to the client of the entire structure, including cost of ground preparation and the cost for the slab itself. The cost optimisation is enhanced by the application and effects of the post-tensioning that compensate for any excess of tensile stresses in the structure.

The system uses an optimum combination of post-tensioning, slab thickness and concrete tensile strength to produce a cost-effective slab on grade solution. Moreover, the design provides a wider joint-free and crack-free area with improved durability.



Internal and external force that may affect a slab on grade.



## VSL Slab on grade: Resisting tensile stresses

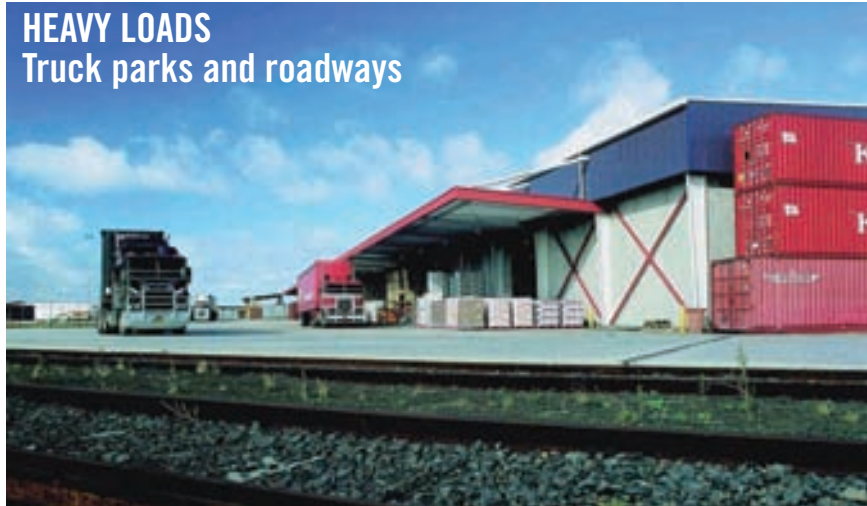
Concrete has limited capacity to resist tensile stresses. For conventional reinforced concrete slabs or slabs with steel fibre reinforcement, the thickness and primary reinforcement are increased so that the stresses do not exceed the concrete tensile strength and satisfy the design code requirements. Post-tensioning allows balancing of the tensile stresses in the concrete, leading to thinner slab and a great reduction of conventional reinforcement.

# ADAPTABLE AND VERSATILE

VSL Slab on grade can be applied to many commercial and industrial situations, including but not limited to:

- Cool rooms and freezer storage facilities
- Taxiways
- Aircraft hangars
- Heavy vehicle workshops
- Manufacturing facilities
- Lorry parks and roads
- Warehouses and distribution centres
- Rail and seaport container terminals
- Water tanks

## HEAVY LOADS Truck parks and roadways

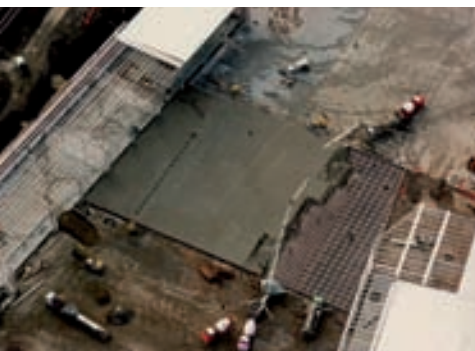


## HEAVY LOADS Manufacturing facilities



## HEAVY LOADS Warehouse and distribution centres

## AGGRESSIVE ENVIRONMENTS Seaport container terminals



## WIDE TEMPERATURE RANGE Cool rooms and freezer storage facilities



## JOINT FREE Aircraft hangars



## WATER TIGHTNESS Water tanks



# VSL – YOUR PARTNER FOR A TURN KEY

## VSL's scope of work

VSL offers complete design, supply, installation and stressing services to produce the finished product:

1. Ground analysis
2. Preliminary design and quotations
3. Final design
4. Subgrade preparation
5. Supply and placing of the sand base and plastic layer
6. Supply and installation of the normal reinforcement associated with the post-tensioned slab
7. Supply and placement of the post-tensioning components and carrying out the post-tensioning works
8. Supply, placing, finishing and curing of concrete
9. Final coating if required



## Key aspects considered by VSL include:

- use of few or no joints depending on the dimensions of the slab;
- sub-base design to optimise slab and sub-base costs for individual site conditions;
- concrete properties to maximise durability and strength while minimising the combined cost of the concrete and post-tensioning;
- pour size to provide a slab that has buildability characteristics that match local capabilities;

- design detailing to match project-specific requirements such as a range of jointing treatments depending on usage and tendon positioning to suit fixed racking layouts.



1, 2, 3



4



5



9



# SOLUTION



## COATINGS AND FINISHING



### The ultimate freedom of choice

The VSL Slab on grade with fewer joints and crack control does not only produce a smoother ride for forklifts, but is also the best possible base for eventual coatings.

Finishing is the operation of creating a concrete surface of a desired texture, smoothness and durability. The finishing can be strictly functional or decorative.

Warehouses and industrial floors usually have greater durability requirements and need to be flat and level, while other interior floors that are covered with floor coverings such as epoxy finishing have to be smooth and durable.

A slab on grade that shows defects such as curling, cracks, delaminations and spallings will have severe consequences on the coating.

**Different finishings and coatings are possible** depending on the appearance and material characteristics (polished mirror finishing, half polished finishing, quartz finishing...). The slab's mechanical properties also allow the best base for particular coatings as the ones that belong to the three overall coating families: synthetics (polyurethane or epoxy), bitumen and cement.





# SUSTAINABILITY

VSL has shown that sustainable practices and economic success can go hand-in-hand. The VSL Slab on grade system offers a number of advantages over traditional reinforced concrete slabs:

- Reduced concrete volumes
- Reduced energy demand
- Reduced emissions of greenhouse gases (CO<sub>2</sub>).

In addition to providing all the benefits that customers are looking for and at a lower cost, the VSL Slab on grade system offers further advantages with regards to sustainable development:

- lower maintenance and repair costs through the life of the slab due to the inherent crack-inhibition properties of using prestressing.
- lower whole-life costs due to the extended longevity of the VSL Slab on grade system compared with plain reinforced concrete slabs.
- reduced volume of end-of-life demolition and waste disposal with corresponding reductions in costs.

**The VSL Slab on grade uses up to 30% less concrete, resulting in 30% less CO<sub>2</sub> emission, compared to conventional reinforced structures.**

## Changing the way we do business

For VSL, sustainable development means striking a balance in its development model between the economic profitability of its businesses and their social and environmental impacts. This commitment has been formalised into the VSL Sustainability Development programme.

The quality of the VSL Slab on grade system has been recognized through a number of Awards:

**2000**

IVOR certificate stating that the VSL Slab on grade System is a recognised technique with regards to its durability.

**2002**

Award of the Concrete Institute and Association of US engineers for the world's flattest pavement.

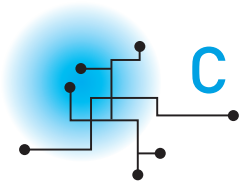
**2003**

Award by Lockwood Greene Engineers J.A. Jones Co. for the largest and flattest post-tensioned pavement system in the world.

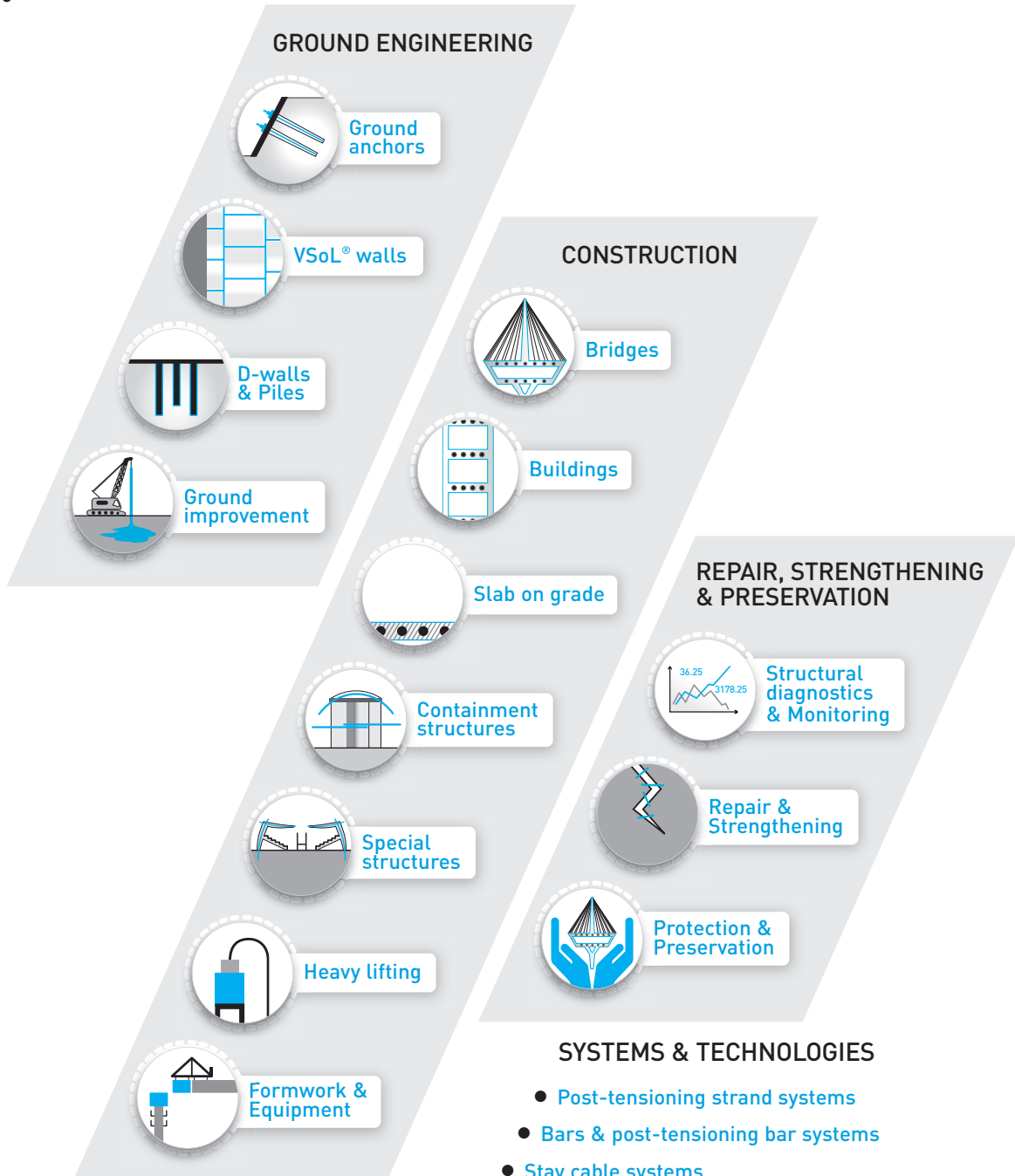
**2007**

Golden Trowel Award issued by Face® for the flattest and most level of the year.





# CREATING SOLUTIONS TOGETHER



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