MAVERICK
INDUSTRIES

CONCRETE CONSTRUCTION STATEMENT
MAVERICK INDUSTRIES LTD

PART 1: CONCRETE SPECIFICATION

Compliance Notes

Cement specification
Cement used will be ordinary and rapid hardening Portland cement compliant with EN197 or alternatively with the national standard on regulations valid in the place of use of the sprayed concrete.

Aggregates
Aggregate to comply with BS882 and shall be appropriate to the requirements of the application. For dry mixes the natural moisture content in the aggregate

Sand
Sands sourced will be cleaned and washed and compliant with the requirements of BS882

Water
Mixing water shall comply with the requirements of EN1008

Admixture
Admixtures for concrete and sprayed concrete shall comply with the requirements of EN934-2 and EN934-5 respectively and sprayed concrete admixtures with appendix 1. Other admixtures shall be permitted provided that they comply with the general requirements of industry standards Full account should be taken of their effect on the finished sprayed concrete and there should be sufficient data about their suitability, including previous experience with such materials.

Steel Reinforcement
Reinforcements specified shall comply with the requirements of EN206–1 and EN10080

Concrete
This shall comply to the requirements of EN206 – Concrete strength Specification shall conform to the following criteria as a minimum

Foundations:	C16 / C20
Riding Surfaces:	28 day strength 40.2 N/mm² (mean average)

Additions (if we chose to specify them)
The most commonly used additions in sprayed concrete are fly ash, ground granulated blast furnace slag and silica fume. These additions shall comply with the relevant European standards or regulations in place in the use of sprayed concrete such as EN450.

Curing agents (if we chose to specify them)
The curing agents shall be in accordance with the relevant European Standards or the National standards valid of the use of sprayed concrete

General Requirements

Consistency
The consistency required for wet spraying depends on the type of conveyance and the application procedure. For a given cement content & w/c ratio the consistency can be adjusted by admixtures added at the mixing plant or on site. Typically speaking we will be specifying a P450 mix with a 70 slump.

Working Temperature
The temperature of the mix before placing shall not be below 2°C and shall not exceed 35°C unless special provisions are in place. Spraying shall not be undertaken when ambient temperature is below 2°C or 2°C and falling.

Requirements of Durability – General
Maverick will produce a durable concrete which protects the reinforcing steel against corrosion, and withstands satisfactorily the working and environmental conditions to which it is exposed during its lifetime. The following factors shall be taken into consideration:
- Choice of suitable constituents, containing no harmful components, or those which may interact unfavourably.
- Choose a concrete composition that will satisfy all specified performance criteria.
- Chloride contents in in-situ sprayed concrete shall not exceed the values that are specified in ENV206 section 5.5
- Alkali content shall comply to the requirements of current National Standards to prevent Alkali – Silica reaction.

Method of Construction Preparatory work
Before spraying of the concrete can start the following preparatory work must be done:
- Poor and loose rocks or stones shall be removed from the surface
- Water ingress shall be engineered out by drainage solutions in line with our engineering drawing specification for the site.
- Loose soil shall be compacted and stabilised.
- Levels shall be set, coping bars placed in their final position and appropriate drainage systems constructed and tested.
- Appropriate rebar networks shall be installed on transitional elements and metal rib systems set utilising screed rails or similar.

Execution of Spraying

For spraying, the following shall be undertaken

- Preparatory wetting shall be carried out unless otherwise specified
- Larger cavities shall be carefully built up before the main application.
- Spraying shall start from the bottom and continue upwards (this is to avoid spraying in rebound losses).
- The nozzle direction shall generally be maintained at 90°to the surface
- Velocity and spraying distance shall be the optimum for maximum concrete adherence and compaction.

Curing

Sprayed concrete shall be cured in accordance with the recommendations set out in EN206 or any other method which has been shown to allow continuous hydration of cement over the curing period.

Curing agents which may impair bonding shall not be used where a further layer of sprayed concrete is to be applied.

Protection against frost is needed until the sprayed concrete has cured to the satisfaction of the Maverick site supervisor.

Our preferred method of curing however is to allow the concrete to cure naturally over time in controlled conditions without recourse to acceleration or retarding agents. It is anticipated that this time will be in the region of 4 to 6 hours after pouring

The Installation Process

Excavation

Check levels and validate throughout process

- Partially excavate 6m section of the site to the required depth (as per design)
- Using an excavator, excavate/grade ground in line with the profile of the previously installed rib sections
- Set in a new section of floor runner/shuttering, pin into ground and set in starter bars as specified
- Fill 6m section of excavated ground with 70mm of lean mix allowing for the removal of the shuttering and cross bracing
- Lay reinforcement mesh onto 75mm hy-chairs

Shotcrete application on Transitions and Flatbank sections

Final shotcrete layer of concrete applied during a dry spell of weather and should be applied to large sections of the skatepark

- Attach pre-rolled sections of coping to inset rib structures
- Spray one 70mm layer of shotcrete, to agreed specification. The layer of shotcrete is designed to encase the reinforcement mesh and provide approximately 40mm to top surface.
- Experienced trowellers will finished the shotcrete surface to an agreed transition surface tolerance of approx 3-4mm.
- Shotcrete layer will also be designed to meet with the coping (Galvanised steel tube 60.3mm OD). Beading will be formed around the top and bottom of the coping to prevent cracking of the concrete. (see Page 8 for details and pictures)

Flat Base/floors

After all transitional and banked sections of the park are completed the flat base will be constructed

- The base will be connected to the transition sections through the starter bars.
- Reinforcement mesh will be laid in the base using the conventional method and will be suspended using plastic or wire Hy-Chairs. The base will be filled with 70mm of lean mix 70mm of shotcrete. The reinforcement mesh will be designed to sit in the shotcrete mix at the same depth, as specified above.

Quality Control

The production of sprayed concrete shall be subject to control procedures. Quality Control is defined as a combination of actions and decisions taken in compliance with specifications and checks to ensure that the specified requirements are satisfied. However since any "P mix" concrete will not be guaranteed by any batching plant it is our experience that dictates conformity. If we decide its wrong, it is simply rejected.

Alignment control

Alignment control is necessary to establish line and grade in sprayed concrete construction and to ensure that proper and uniform material thickness and cover are maintained. Maverick will employ a mixture of depth gauges guide wires and cut ribs to create the formwork needed to ensure the correct angles are maintained especially in the transitional elements of the bowls we are creating.

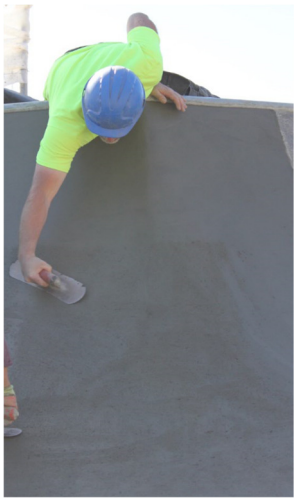
Surface finishes

The specific finish requirements shall be defined as follows:
"As Shot" The sprayed concrete as left from the nozzle. The sprayed concrete shall be trimmed to true lines using a trammel between two temporary radius shutters (if no fixed radius points exist) and shaped to a uniform finish and left to part cure. When the site foreman decides the concrete is ready, the trowel finishing shall take place.

Trowelled finishes

Following the treatments as detailed in the "As shot" method the material shall be trowelled smooth in one or more "wipes" depending on the specified levels of polish with one or more of the following:

- Steel Float
- Wooden Float
- Brush
- Sponge



Build up sections

On occasion and where conditions dictate, it may be necessary to build a up a skatepark as a whole, or sections thereof by building up from the ground rather than digging into it or utilising the natural topography of the site. Where this is the case the following methodology will apply.

Retaining walls

Depending on the height of any retaining wall required, Maverick will either seek professional advice from accredited structural engineers and their recommendations will be followed over the composition, width and structural integrity. Or we will adhere to industry standards of low height retaining walls. BS 8006: 1995 governs the specification. Typically speaking we anticipated to utilise one of the following (or similar) to create any wall required.

- Aircrete Blocks 620mm x 215mm x 100mm
- Dense concrete Blocks 3.5n 440mm x 215mm x 100mm
- Hollow Dense Concrete Block 3.5n 440mm x 215mm x 140mm

The finish will conform to any specification laid down by tender documentation, expert advice or Maverick requirements and will be adhered to. Rendering or Spray concrete application will follow in the manner previously described, or alternatively the backfilling of and compacting of soil as required.

Block work

Street sections in Skatepark provision will require blocks or pads to be created with no set dimensional parameters. In addition to:

- Aircrete Blocks 620mm x 215mm x 100mm
- Dense concrete Blocks 3.5n 440mm x 215mm x 100mm
- Hollow Dense Concrete Block 3.5n 440mm x 215mm x 140mm

We can also utilise Polystyrene blocks or simply use wooden box formers. The choice will ultimately be Mavericks and will reflect the needs and strengths of the unit specified. Rendering or Spray concrete application will then follow to create the finished article.

It is possible that natural topography or compacted subsoil can be used as the base of any works. Spray concrete application in this manner was covered in preceding chapters.

Environment, Health and Safety

A reduction of the environmental impact and improved occupational health and safety has been among the priority objectives in the further development of sprayed concrete technology. Sprayed concrete with alkali-free accelerating admixtures can offer considerable advantages in terms of both environmental protection and occupational health and safety.

The application of sprayed concrete should meet all health, safety and environment regulations valid at the place of use. Prior to commencement of any contract a full risk assessment and safety plan should be established and approved.

Safety of Personnel - Dust concentration

During spraying, the building-site crew is at risk due to dust formation and the pollution of the air. The aerosols formed during the sprayed concrete application may constitute a health hazard and therefore have to be minimised. Dust is classified as an aerosol, as are smoke and mist.

Depending on the location and the point in time, the concentration of dust during spraying is subject to major fluctuations, which have to be considered in the interpretation of the results obtained. The fine dust concentration is assessed on the basis of the maximum permissible concentration of contaminants at the work place measured according to the Austrian Guidelines for Sprayed Concrete, Section 12.5.3. Fine dust is defined as dust likely to penetrate into the alveoli of the lungs.

The maximum permissible contaminant concentration at the work place is equal to the maximum permissible concentration of dust which, in general, does not adversely affect the health of workers in the case of repeated and long-term exposure, usually for eight hours, but for no more than 40 hours a week, without use of personal protective equipment (fine-dust masks).

Permissible dust concentration based on maximum permissible contaminant concentration at the work place:

Quartz content MAC value Type of dust Nature of dust% by weight c[mg/m3]
Q < 1 6 fine dust inert
1 < Q < 3.75 4 fine dust siliceous
Q > 3.75 0.15 fine quartz dust siliceous
(Ref: Austrian Guidelines for Sprayed Concrete, Section 12.5.3)

Given the fact that a range of activities are performed during tunnelling which produce varying amounts of dust, the assessment should be based on the entire working cycle. During spraying, a fine dust concentration of less than twice the relevant maximum permissible contaminant concentration at the work place should be aimed at as an hourly average. If personal protective equipment is used, higher limits are permissible, depending on the protective effect of the equipment. To diminish the dust load over the entire working cycle, the following measures are recommended:

- Dry spraying: use of moist aggregates, machine enclosure, favourable nozzle design, nozzle distance, water content
- Wet spraying with alkali-free accelerators
- Mechanical spraying arms

- Sufficient ventilation

Health hazards for building-site personnel, above all the risk of skin and eye lesions, can be prevented through the elimination of highly alkaline and strongly irritating admixtures, such as aluminate based products or waterglass.

Personal protection

Personal protection equipment should be always used:
- Helmet
- Goggles, visor
- Dust mask (respirator type - when required, depending on application method and conditions)
- Overalls
- Gloves
- Ear protectors
- Reinforced toe-caps

When applying sprayed concrete overhead, it is not allowed to walk below freshly placed concrete until sufficient strength has been reached. The required time span has to be based on early strength measurements and local conditions (temperature, cement type, dosage/type of sprayed concrete accelerator).

Precautions in the event of blockages of material lines and nozzle

- Whenever a blockage occurs, the operation of the following equipment has to be interrupted:
- Main air supply: to be turned off
- Spraying machine: to be exhausted and/or shut off
- Accelerator pump: to be shut off
- Air supply to nozzle: to be shut off
- Wet spraying machine: take off concrete pressure by reversing the pump.
- Before demounting the line: secure the material lines/nozzle from uncontrolled recoil.
- No personnel in front of the hose under demounting or until the pressure in the material line is relieved.

Safety of hoses and couplings

- Only special reinforced and approved concrete hoses and couplings should be used. In general they should be approved to a bursting pressure equal to twice the actual working pressure.
- All connections/couplings (of concrete, water, accelerator and air hoses) should be equipped with secondary safety fittings.
- All couplings/hoses should be regularly checked and tested.

Environmental issues

Local regulations and standards for environmental issues shall be implemented and followed. The following environmental impacts should be considered:

Impact on soil

In the course of spraying, some of the concrete mix drops to the ground as rebound and is removed together with the excavated material.
Given the fact that the rebound mixes with the excavated material and an environmental impact cannot be altogether excluded, a reduction of the rebound ratio is desirable.

Impact on Water

When used in tunnelling, sprayed concrete may be in contact with rock and ground water. Increased leachability of sprayed concrete may therefore lead to segregation and long-term impact on draining water. Since the leachability of normal concrete is very low even after a short period of hardening, an adverse impact on water quality has not been observed. Thus, concrete qualifies as an environmentally safe construction material. The same applies to sprayed concrete with alkali free accelerators. The use of accelerators based on alkali aluminate and/or silicates increases the portion of leachable materials in sprayed concrete. The leachability of the rebound is also adversely affected.

Although the likelihood of Maverick getting involved with any form of tunnelling work is remote the section above has been included purely as a precautionary measure.

PART 2: STEEL SPECIFICATION

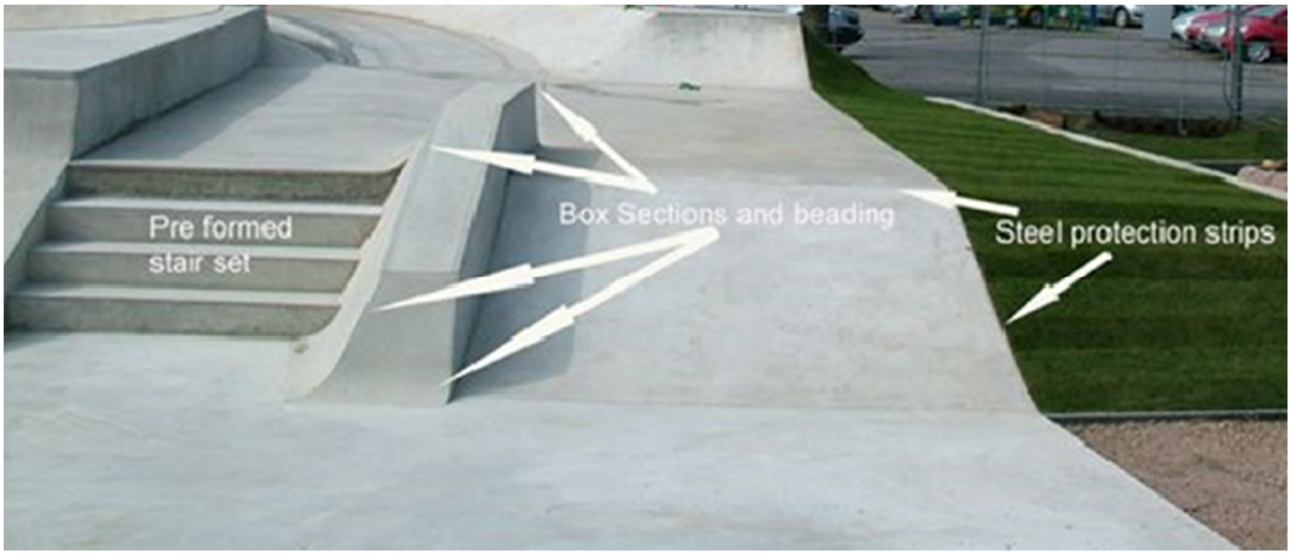
Maverick Industries Ltd were instrumental in creating a sustainable method of construction that will enhance build accuracy and design out the potential for cracking and chipping of concrete elements during the skate park's life time – Please refer to our 'Steel Construction DWGs for detailed specification.

A key element of riding a skate park is the act of 'Grinding'. This is where the rider slides along an edge of a block, side of an element or a line of coping. Conventionally built concrete parks were prone to chipping where the concrete was not protected

During the engineering design phase the scheme is scrutinised to identify sections of the park where skaters will attempt to 'grind'. These areas will then have a variety of galvanised steel edgings specified, ranging from 50mm Box Section or Equal Angle – typically used on Grind Boxes through to rounded beading or strip that will form the convergence line of a pyramid or rollout from a hubba.

By specifying a steel set into a concrete feature, we also need to be mindful of the two differing coefficient rates of linear expansion and thinning of concrete as the two elements join. To combat these facts and remove the chance of any cracking caused by this arrangement we utilise an edging tool that creates a small "V" shape between the steel and the concrete. This can be seen in the two pictures below:

Further examples of steel use can be seen in this picture of our skate park in Dorchester whilst clearly still in the build process. By no means exhaustive in terms of all the steels that could have been notated in just this picture, it does however give an indication as to why our parks hold up so well and are recognised as being technically perfect by the riders themselves



References

The following list notates the Codes and standards that were referenced partially or wholly in the above. The list is by no means exhaustive but covers every aspect of provision Maverick consider to be important.

EN 196-3 Methods of testing cement - Part 3: Determination of setting time and soundness EN 196-6 Methods of testing cement - Part 6: Determination of fineness
EN 197-1 Cement - Composition, specifications and conformity criteria - Part 1: definitions and compositions
EN 206 Concrete - Performance, production, placing and compliance criteria EN 480-1 Admixtures for Concrete, Mortar and Grout; Test Methods - Part 1: Reference concrete and reference mortar for testing
EN 480-2 Admixtures for Concrete, Mortar and Grout; Test Methods - Part 2: Determination of the setting time EN 480-6 Admixtures for Concrete, Mortar and Grout; Test Methods - Part 6: Infrared analysis
EN 480-8 Admixtures for Concrete, Mortar and Grout; Test Methods - Part 8: Determination of the conventional dry material content
EN 480-10 Admixtures for Concrete, Mortar and Grout; Test Methods - Part 10: Determination of water soluble chloride content
EN 934-2 Admixtures for Concrete, Mortar and Grout - Part 2: Concrete Admixtures - Definitions, Specifications and Conformity Criteria
EN 934-6 Admixtures for Concrete, Mortar and Grout - Part: Sampling, quality control and evaluation of conformity
EN 1008 Mixing Water for Concrete - Specification and Tests
EN 1542 Products and Systems for the Protection and Repair of Concrete Structures; Test Methods - Pull off test
EN 4012 Testing concrete - Determination of compressive strength of test specimens EN 4109 Testing concrete
- Determination of consistency - Slump test
EN 7034 Testing concrete - Cored specimens - Taking, examining and testing in compression

Acknowledgements
In the production of this method statement some factual and technical information was drawn from many sources and due deference specifically to the BSI and EFNARC authorities and their websites has been paid and is acknowledged.

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Mark Clogg
Maverick Industries Ltd