

High Strength PQA

Rapid Curing, Accelerated, High Strength Repair Concrete

INTRODUCTION

High Strength PQA (RP5) is a proprietary performance concrete to provide rapid curing and early age strength development in pavement quality concrete for carriageway repair, small scale replacement or construction project justification within specific timescales and production work schedules.

The specified strength class C32/40 (40N/mm²) Clause 1001.1 is stipulated, which shall be satisfied after 24-hours and for early trafficking to clause 1048 which indicates cube strength of 20-25N/mm². Further to the above, the concrete should also allow paste generation that's enough to enable a compliant surface texture to be achieved.

STRENGTH COMPLIANCE – PERFORMANCE PEDIGREE

The historical performance provenance experienced on major contracts have determined control factors which justify the placement, curing temperature and in-situ cube strength of 25N/mm² that should be targeted at **between 4 and 5 hours** after the commencement of the curing process.

SUMMARISED KEY FACTORS

- The concrete may initially look dry and unworkable, as vibration is applied and maintained, the concrete will flow and compact efficiently.
- Ensure enough personnel are assigned and appropriate number of vibrating pokers are supplied to compact the concrete sufficiently rapidly to assist the finishing procedure, between 15 – 30 minutes.
- Rapid early age strength development is justified for all weather conditions, just requiring best site practices using efficient curing materials to retain the exothermic heat of hydration.
- Enhanced concrete durability with the potential to demonstrate both high strength and freeze thaw resistance, but also low surface absorption and water proofing attributes.

Trafficking of the finished concrete shall not be permitted until the concrete has conformed to all criteria, confirmation that the concrete has fulfilled all curing temperature and non-destructive testing requirements to have developed an in-situ compressive strength more than 25N/mm².

INSULATED CURING

To attain the full-strength potential, it is essential to install insulation curing blankets which will maintain the temperature and strength gain but can be removed quickly and easily; thus, efficiently utilising more available heat curing and strength.

The high early age strength development is characteristic to the exothermic hydration reaction which both acts as a heat curing process but also accelerated further strength development – thus it is paramount to efficiently retain this heat generation.

Monitoring the curing temperature of the fresh concrete as part of the production control process can include a testing regime using thermocouples or a probe thermometer, embedded in the core of the slab or repair panel, to ensure that the concrete reaches and is maintained at a temperature of at least 35°C for a minimum of 1 hour prior to the removal of curing apparatus and trafficking of the slab.

PLACEMENT OF FRESH CONCRETE

Mix design, pre-production checks and calibrations shall be the responsibility of Axtell Limited and are undertaken in accordance with internal operation procedures.

Each concrete pour will be backed up with documentary evidence to show that all pre-production equipment, materials checks, and calibrations have been undertaken prior to the concrete batching plant arriving on site.

Controlled designed factors employed when using the optimum setting has justified the required consistence, compaction and finishing performance properties.

The rapid curing concrete shall be laid, spread and compacted to the full depth of the pavement in one operation. Concrete shall be placed and distributed evenly. It shall be compacted with approved hand-manipulated vibrating pokers, tampers or screeds capable of achieving the specified level of compaction and finishing for the required strength performance.

The concrete may initially look dry and unworkable with low apparent slump. Placement by excavator bucket or direct from the Volumetric mixer chute is preferable.

As vibration is applied and maintained, the concrete will flow and compact extremely efficiently, as the super-plasticiser is activated. The placement and compaction process allow further mixing of the batch – an important consideration when using a volumetric mixer. As vibration is removed, the concrete will lose most of its workability, preventing further slump or loss of surface alignment.

Personnel should be assigned accordingly – but it's important to remember that a concrete such as this requires far greater effort to place than a standard concrete mix, and appropriate number of vibrating pokers are supplied to compact the concrete sufficiently rapidly to keep pace with discharge speed and the concrete's designed rate of setting.

The methods used for laying and compacting shall be as stated in the Contractor's method statements.

In view of the requirements for surface texture, it is of importance to ensure that the final graded surface is a uniform moisture and that the surface is not overworked to produce irregular patches of laitance.

PRODUCTION CONTROL PROCESS

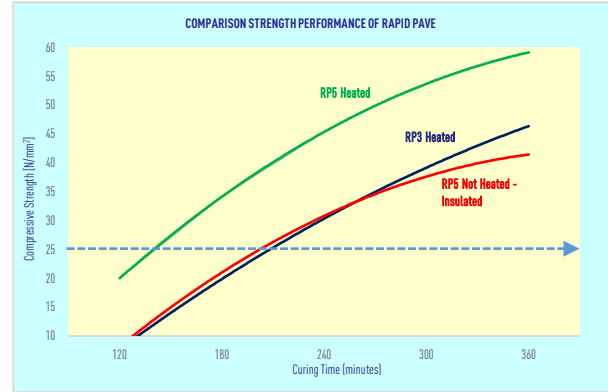
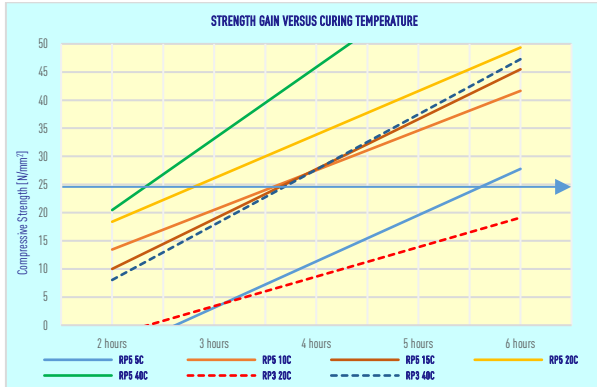
It is recommended that a rebound hammer is used to analyse the slab surface and so build up a correlation between this and the measured compressive strength. At least ten rebound hammer tests should be performed at each time interval. An average rebound hammer value should be used to correlate with the strength gained at the corresponding time.

A flat non-textured area of the concrete surface should be prepared for undertaking the rebound hammer tests, so that ridges, grooves or other discontinuities in the surface do not affect the results gained. Production trials have found that the recorded rebound hammer results are a magnitude of 10 greater than the equivalent estimated in-situ cube results gained from the cores in N/mm². If the correlation is found to be consistent, then it's possible that the re-bound hammer can be used on site to provide further confidence in early strength development.

Concrete Technology Guidance

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**Average Compressive Strength (Insulated Cured for 6-hours)
Ambient Curing Range from 5 - 20°C**

Initial Curing Time	Strength Range (N/mm²)	Final Curing Time	Strength Range (N/mm²)
1-hour	Set - 2.0 N/mm²	5-hours	16.0 - 36.0 N/mm²
2-hours	1.0 - 8.0 N/mm²	6-hours	27.0 - 42.0 N/mm²
3-hours	5.0 - 22.0 N/mm²	24-hours	70.0 - 80.0 N/mm²
4-hours	11.0 - 32.0 N/mm²	7-days	80.0 - 90.0 N/mm²

Air Temperature	Concrete Temperature	In-situ Time to Reach 35°C	Min. Production Period
5-10°C	10-14°C	3-hours	5-hours
10-15°C	14-20°C	2 ½ Hours	4-hours
15-20°C	20-23°C	2-hours	3 ½ Hours
20-25°C	23-28°C	1 ½ hours	3-hours

Concrete Technology Guidance

CONCRETE:	CONTRACTORS:	THE CLIENT:
<ul style="list-style-type: none"> Controlled Quality Production Cohesive Consistence Rapid Strength Gain Minimum 25 N/mm² in 5-hours 	<ul style="list-style-type: none"> Consistent Fresh Properties Repeatable and Reliable Performance Speed of Production / Reinstatement Enhanced Concrete Durability and High Strength Classification 	<ul style="list-style-type: none"> Reduced Penalty Clauses Offers Numerous Cost Advantages Long Term Concrete Durability for Extended Working Life of the Construction

TECHNICAL SERVICE

Our Technical Service department of Axtell Limited is available to assist and provide a technical and advisable service, which can be consulted early in the design process. This service can assist to create bespoke mixes, or if requested provide suggestions to ensure specification needs of the project.

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HEALTH AND SAFETY

Wet concrete can cause serious alkali burns, a form of skin ulceration, from contact with freshly mixed concrete. Allergic contact dermatitis may be caused by individual sensitivity to Chromium (VI) compounds in cement.

Suitable protective clothing must be worn when working with concrete (long-sleeved clothing, gloves, full length trousers, safety glasses and impervious safety boots). Keep out of reach of children.

Back injuries are a hazard when lifting, stand clear of the truck when it's manoeuvring and discharging the load.

The information given is based on extensive research and product development and is offered in good faith for the user's consideration, investigation and verification. Whilst we guarantee the consistent high quality of our products, we have no control over the circumstances in which the materials are used, site conditions or the execution of the work therefore we do not warrant the results to be obtained in the case of misuse. Our product specialists are at the disposal of the users to help them with technical advice for the performance application and any problem encountered.