Shotcrete
An overview
The Australian Shotcrete Society

• The **Australian Shotcrete Society** is a not-for-profit organization affiliated with the Australian Tunnelling Society and EA/AusIMM

• The society was formed in 1998 to promote improved awareness and understanding of shotcrete and its uses, good practice within the shotcreting industry, and the education of practitioners and the wider industry through seminars and conferences
The Australian Shotcrete Society

Objectives

✓ To promote the use & further development of shotcrete & promote better practice

✓ To provide a suitable interface with allied societies

✓ To support and become involved with research and development of Shotcrete

✓ To arrange conferences, workshops & meetings

✓ Publication and ongoing maintenance of the “Recommended Practice for Shotcreting in Australia” is regarded as one of the principal objectives of the society.
Sprayed Concrete was invented in 1907 to spray a building facade, and is today widely used for rock support world wide, both in mining and tunnelling.

Carl Ethan Akeley 1864 - 1926
Australian Shotcrete Society

A special interest group of

The 1st machine to spray concrete in USA

Gunite was used in USA to fireproof mine drifts

Coarse Aggregate was introduced into dry sprayed concrete mixes

The term Shotcrete was introduced by American Railway Eng. Association

The Wet Shotcrete process was introduced

Austrian Eng replaced heavy steel & timber support with shotcrete in squeezing ground in diversion tunnel

Rotary drum dry shotcrete machines developed

Shotcrete Evolution

Time

1907 1912 1920's 1930's 1940's 1954 1955 1957

1907

The 1st machine to spray concrete in USA

1912

The term Gunite was registered for sprayed mortar

1920's

Gnite was used in USA to fireproof mine drifts

1930's

The term Shotcrete was introduced by American Railway Eng. Association

1940's

Coarse Aggregate was introduced into dry sprayed concrete mixes

1954

The Wet Shotcrete process was introduced

1955

1957

Rotary drum dry shotcrete machines developed

1912

Austrian Eng replaced heavy steel & timber support with shotcrete in squeezing ground in diversion tunnel
Gunite was used in Swedish u/ground mines

Helca Mining Co. in USA started using s’crete routinely as u/g support

Norwegians 1st to realize benefits of silica fume

Norwegians introduce steel fibres as replacement for mesh

Robotic spraying of wet s’crete starting to emerge

w/c ratio < 0.4 using “Hyperplasticisers”

Introduction of non caustic alkali free accelerators

What Next

Shotcrete moving forward

WHAT NEXT ???

• Higher outputs

• Greater mechanisation

• Faster setting times for water problems & faster build rates

• Faster strength development for early re-entry
Features of Shotcrete

- Reduction in Formwork Requirement
- Reduction in Application Labour
- Difficult Access can be overcome
- Quick response to exposed weathering
- Automatic thickness conformance on uneven substrates
- Minimising outage times
- Rapid Safe development in underground construction
Versatility of Shotcrete

Limited only by imagination
The Shotcrete Process

DRY MIX (Shotcrete)

WET MIX (Shotcrete)
# Shotcrete methods

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Wet –Mix</th>
<th>Dry-Mix</th>
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<tbody>
<tr>
<td>Equipment</td>
<td>Lower maintenance cost</td>
<td>Higher maintenance cost</td>
</tr>
<tr>
<td></td>
<td>Higher capital Cost</td>
<td>Lower Capital Cost</td>
</tr>
<tr>
<td>Mixing</td>
<td>Accurate mixing at plant can utilise bulk premix. Wet aggregates acceptable</td>
<td>Mixing at site, plant or Premixed &amp; delivered either in large bulk bags. Performance impaired by wet aggregates. Range limited to max 6% moisture content. More labour intensive.</td>
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<tr>
<td>Output</td>
<td>Moderate to high placement</td>
<td>Low to moderate placement rate (1-1.5m3) per hour</td>
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<td>Higher than similar dry mix machines (3-10m3/hr. hand held or up to 25m3/hr. remote controlled equipment)</td>
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<tr>
<td>Rebound</td>
<td>Low rebound, typically 5-15% depending on mix design/application</td>
<td>Generally higher rebound than wet (up to 30%) depending on site conditions and applicator.</td>
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<tr>
<td>Dust</td>
<td>Low Dust</td>
<td>Notably higher dust</td>
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<tr>
<td>In place quality</td>
<td>Consistent</td>
<td>Potentially higher variability</td>
</tr>
<tr>
<td>Pumping distances</td>
<td>Lower transport distances – generally no more than 100m unless special lines &amp; mixes are used</td>
<td>Higher transport distance eg max 500m with special equipment</td>
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Modern sprayed concrete technology contributes substantially to the safety of the entire working environment.

Significant advancement in concrete technology and development in sophisticated equipment not only has improved shotcrete quality and speed of placement but has reduced accidents and health problems to a minimum.
Conclusion

Over the last 100yrs we’ve gone from...

To this

This

Testing Gunite Slabs 1920 - 1930
Thank you