Pyrite

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Pyrite and pyrite related heave

- What it is (and isn't)
- Why we should care
- What we should do about it

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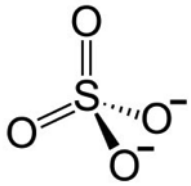
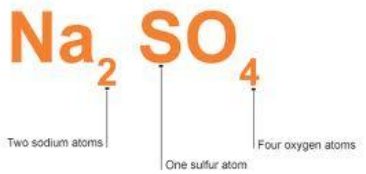
Common Terms

Sulphur, sulphates, sulphides, oxidation, **framboidal pyrite**, euhedral crystals, iron sulphate, cubic, equivalent pyrite, SR21, argillaceous rocks, mud rocks, hardcore, acid soluble sulphate, water soluble sulphate, total sulphur, oxidisable sulphide, **sulphate attack**, calcareous mudstone, **shale**, calcite, 10% fines, LA Abrasion, magnesium sulphate soundness, **gypsum**, x-ray diffraction, scanning electron microscopy, petrographic examination, total potential sulphates, the high court…

Key Terms



SO_4



H_2S

FeS_2

Mudstones / shales, Argillaceous rocks, Limestones & clacareous shales	Sulfates & sulphates	Sodium sulfate	sulphides

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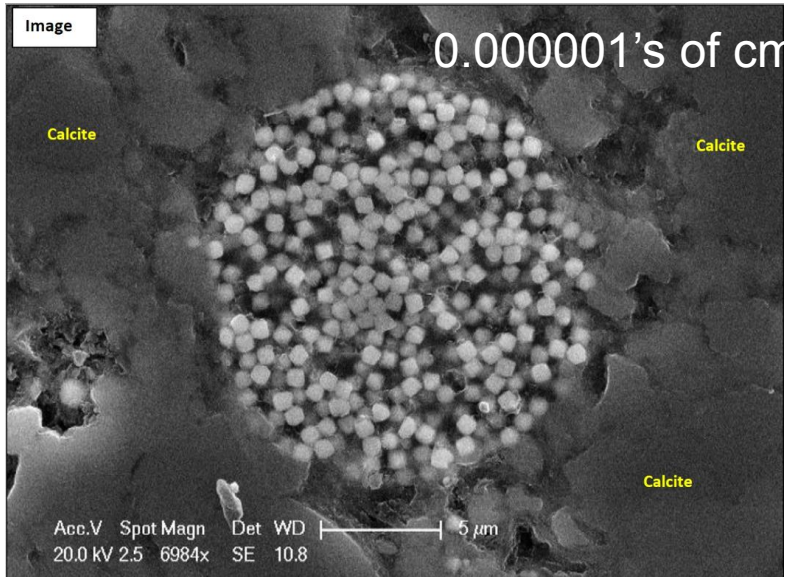
Key Terms

- Reactive pyrite and non-reactive pyrite (framboidal and cubic)



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Key Terms

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- Water absorption
- 10% Fines (TFV) & LA abrasion
- Magnesium sulphate soundness

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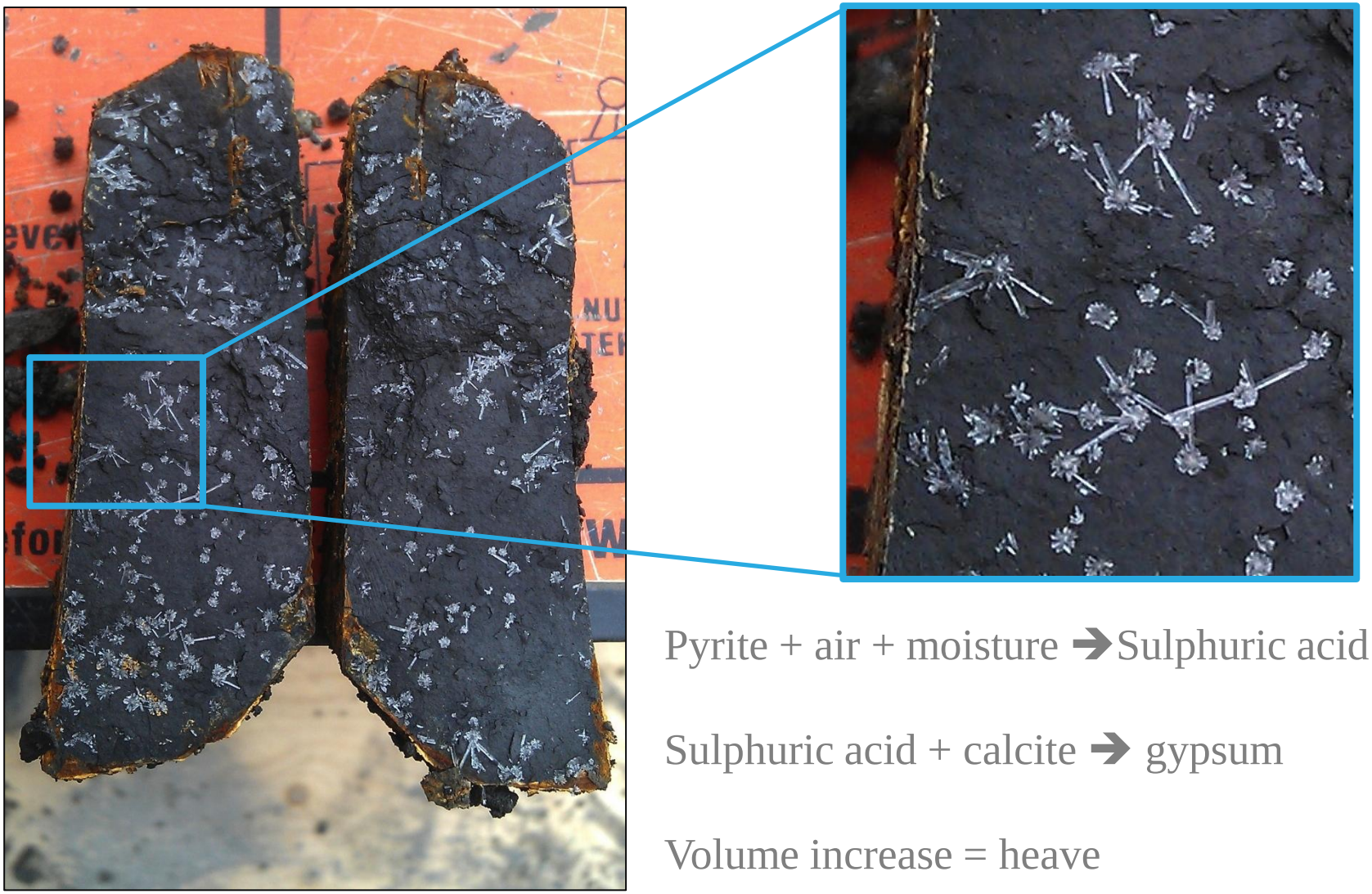
‘Pyrite related’ or ‘gypsum’ heave?



Pyrite + air + moisture ➔Sulphuric acid

Sulphuric acid + calcite ➔ gypsum

Volume increase = heave

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Geological definitions

- Calcareous shale
- Argillaceous Limestone
- Mudstones

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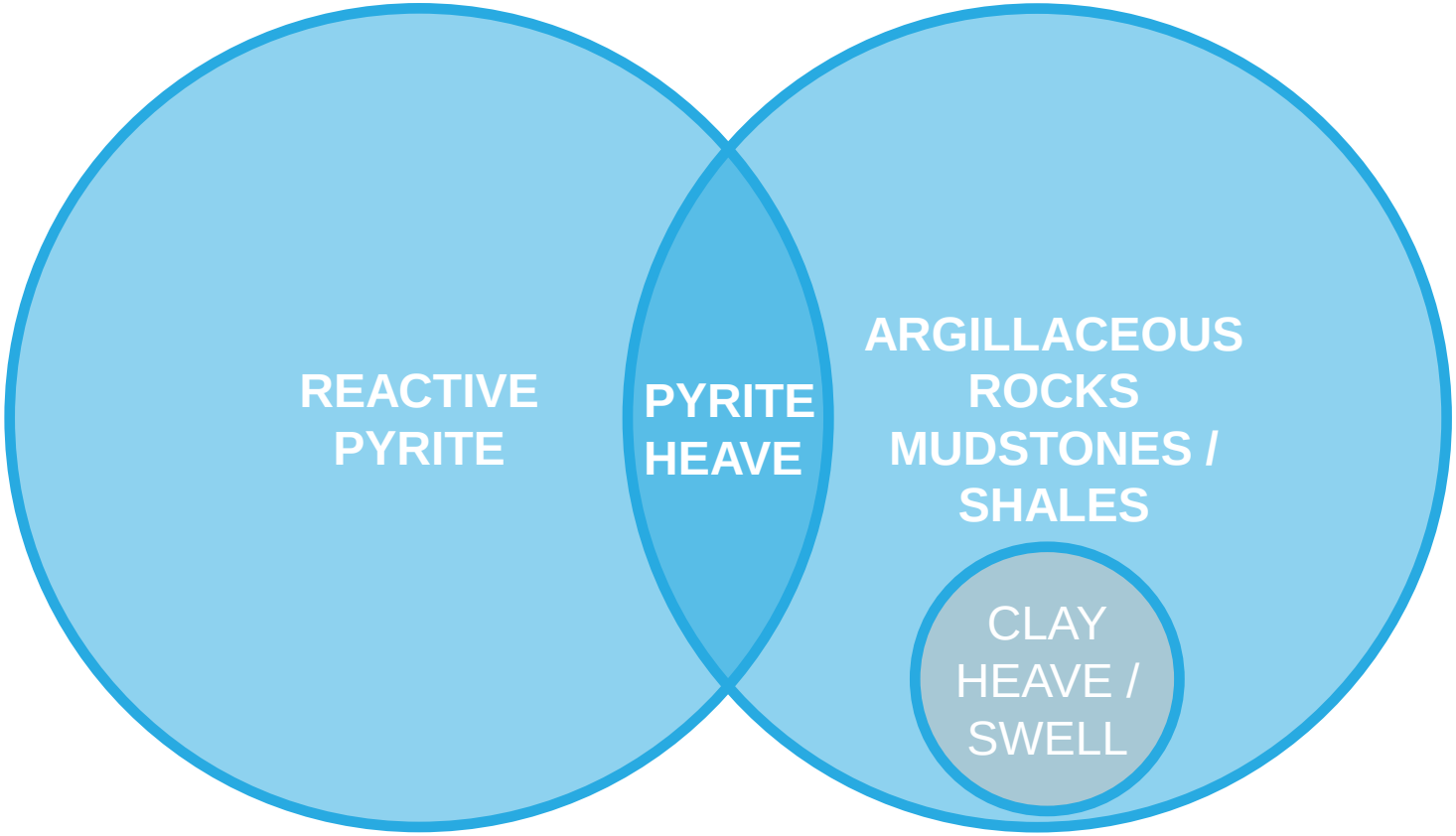

Argillaceous rocks / Mudstone ≠ Pyrite and Heave

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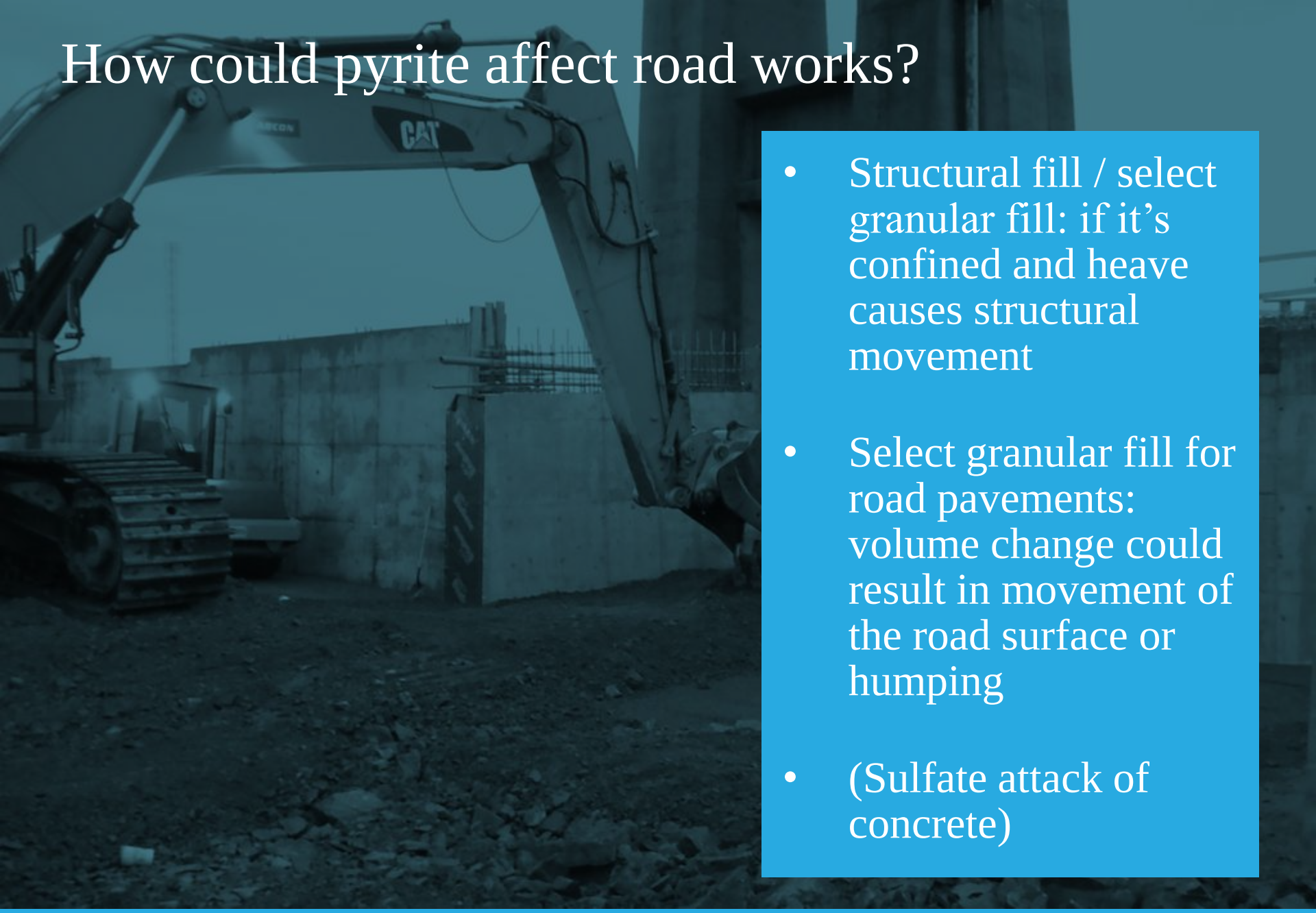
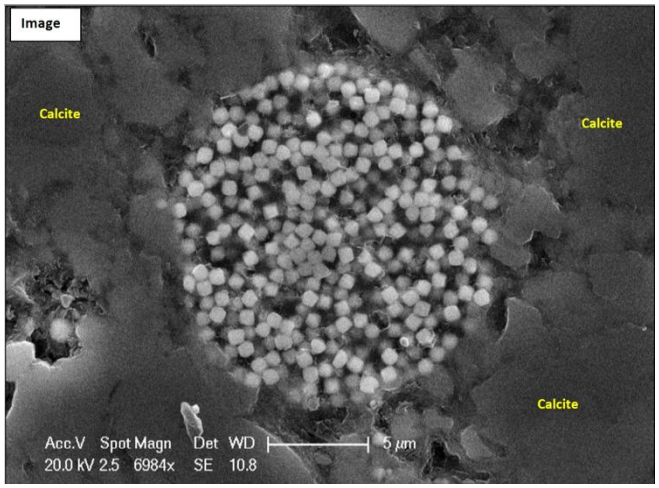
How could pyrite affect road works?



- Structural fill / select granular fill: if it's confined and heave causes structural movement
- Select granular fill for road pavements: volume change could result in movement of the road surface or humping
- (Sulfate attack of concrete)

Does the presence of pyrite always result in a problem?



- General fill?
- Mechanically strong fill?
- Which species is present?

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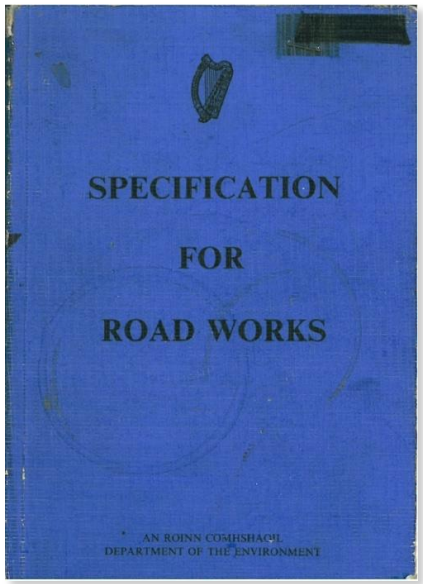
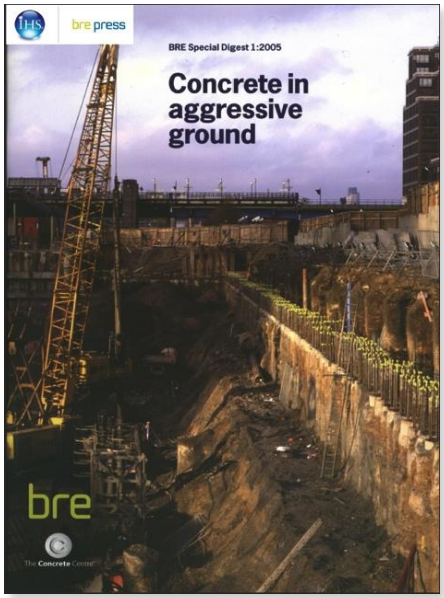
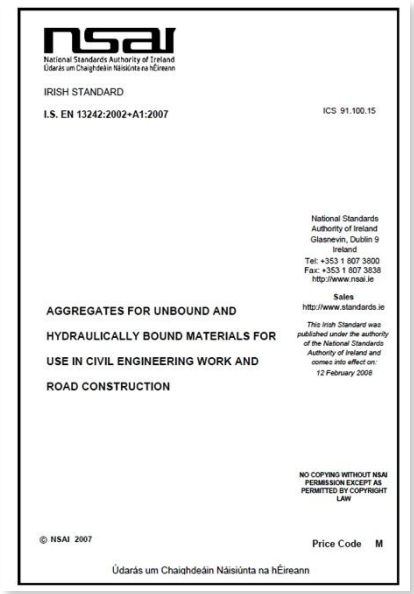
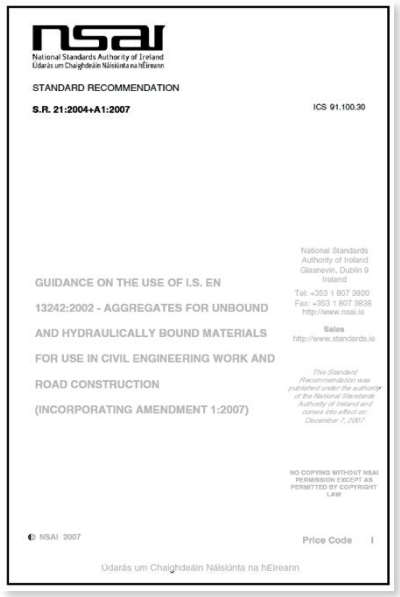
Specifications









DoE Spec. 1979
mechanical properties and risk of sulphate attack on concrete

BRE SD1 & TRL 447,
2005 risk of sulphate attack on concrete (amongst other compounds)

NSAI
IS EN 13242:2002
SR 21:2004

NRA Specifications

- 600 series / 800 series
- Limits on oxidisable sulphides
- 803 | Type A and 804 | Type B and Cl808 & Cl809
- 6N and 6P materials
- Notes for guidance

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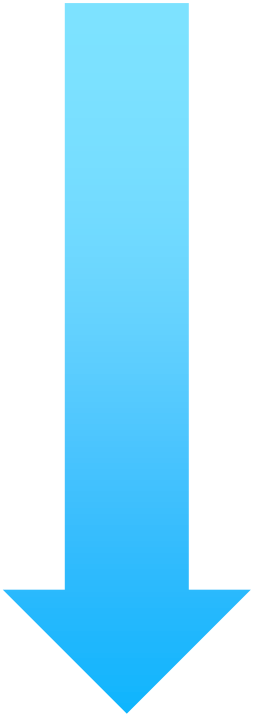
Sulfate testing on select granular fill

Assessment	Test Method
Basic	Visual*
Mechanical	PSD / LAA / FI / LL
Chemical	MSS AS / WS / OS Total Potential Sulfate
Complex	Petrographic X-Ray diffraction, SEM Combine results with detailed assessment of history of performance of material from the quarry



Speed &Volume decrease

Cost & Confidence increase*

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The most sophisticated piece of test equipment available?

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Thank you, questions...

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