Concrete pavement maintenance

Session 2 - Repair materials, repair good practice and asphalt overlays

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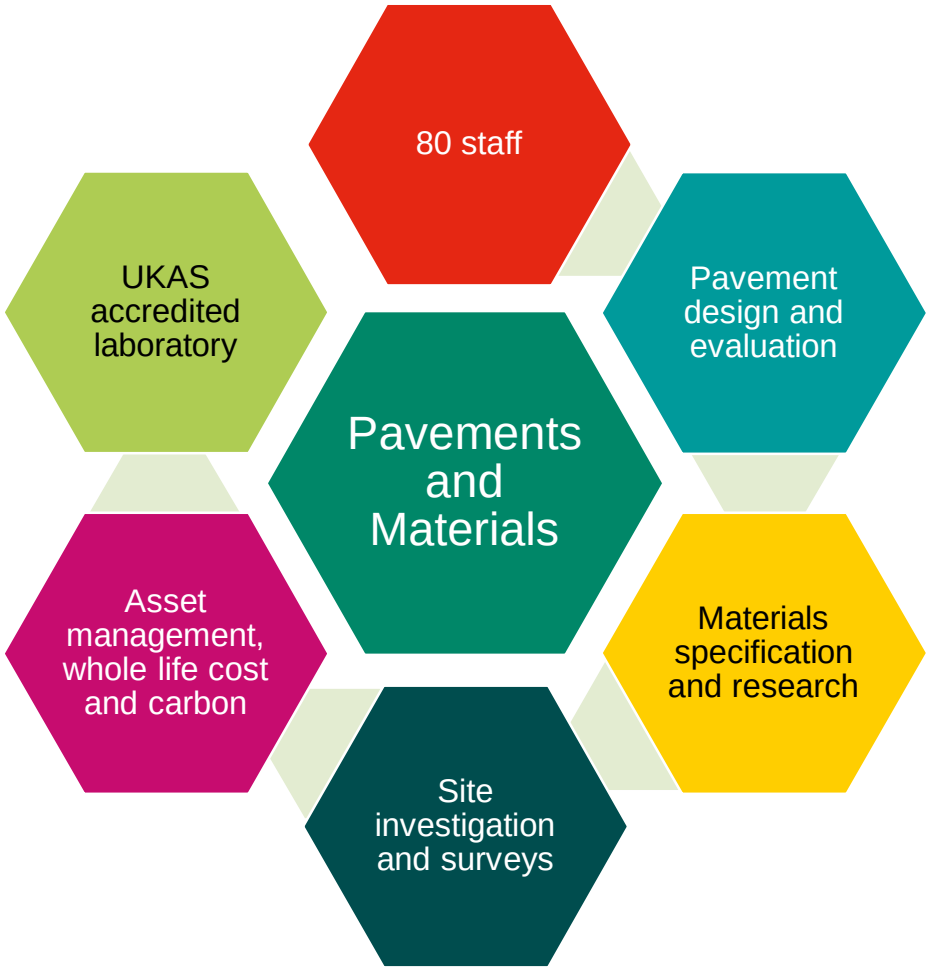
AECOM Pavement Design, Asset Management and Operations



We are a one stop shop!

AECOM

Recent and ongoing projects

National Highways

- Concrete roads design framework
- Concrete roads D&B (with Morgan Sindall)
- Concrete Pavement Maintenance Manual
- Legacy concrete pavement whole life cost and asset management
- RIS3 legacy concrete pavement planning and prioritisation

Transport for London

- Research on reflective cracking of asphalt over concrete

Defence Infrastructure Organisation (DIO)

- Updating DIO TS06 pavement maintenance manual
- High Temperature Resistant Concrete for F35 fighter jet vertical landing pads at RAF Marham

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Content

- Concrete pavement repair materials

- Concrete pavement repair good practice
- Inlaid crack repairs
- Thin bonded repairs and shallow repairs
- Full depth repairs

- Asphalt overlays

Concrete Pavement Maintenance Manual (CPMM)

- Published in 2021

- Developed by AECOM in collaboration with Britpave

- National Highways Publication, funded by Concrete Centre of Excellence (CoE) under the Legacy Concrete Roads Programme

- Incorporates input from many other stakeholders via innovation projects, network trials and UKPLG Working Group 8

Available via National Highways Concrete CoE and at https://aecom.com/uk/pavement-design-publications/

Recap - Treatment options

See CPMM Section 4 and Appendix B.

Defects

- Surface defects
  - Up to 1/3rd slab depth
    - Shallow spalls
    - Pop outs
    - Scaling
    - Crazing
- Structural defects
  - > 1/3rd slab depth
    - Cracks
      - Narrow
      - Wide
    - Deep spalls
    - Stepping
    - Settlement
    - Blow ups

Thin bonded and shallow repair

Inlaid crack repair

Full depth repair + drainage!

Repair materials

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Repair materials – rigid materials

Concrete		Proprietary cement mortars		Resin mortars	
Suitable for: Shallow repairs > 40 mm Full depth repairs		Suitable for: Thin bonded repairs – 10 – 40 mm Shallow repairs – 50 – 100 mm		Suitable for: Thin bonded repairs – 5 – 40 mm Shallow repairs – 40 – 50 mm	
Advantages: Lower cost Workability	Limitations: Seasonal Curing time?	Advantages: Curing time?	Limitations: Expensive Workability	Advantages: Thickness range Bond strength	Limitations: Seasonal Curing time

Long-term repairs (>10 years) when used correctly!

Repair materials – flexible materials

Holding repairs only (3 to 7 years).

May accelerate the occurrence of other defects.

Polymeric materials		Asphalt	
Suitable for: Inlaid crack repairs Shallow repairs		Suitable for: Temporary repairs	
Advantages: Flexible Short trafficking time Not seasonal	Limitations: Low stiffness Small areas only	Advantages: Low cost Not seasonal	Limitations: Durability

Repair good practice

Inlaid crack repairs

Thin bonded repairs and shallow repairs

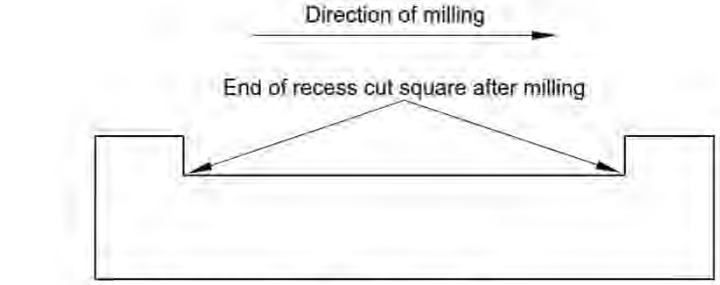
Full depth repairs

Inlaid crack repairs

Undertaken using hot-applied or cold-applied polymeric materials.

Key points:

- Wider crack = poorer performance
- 40 mm depth better than 20 mm depth
- 200 mm wide better than 100 mm wide
- Uniform depth recess, including at edges
- Make sure the recess is thoroughly cleaned and dry



(b) Recommended recess preparation.

What about overbanding instead?

- Trials indicate poor performance

Thin bonded repairs and shallow repairs - terminology

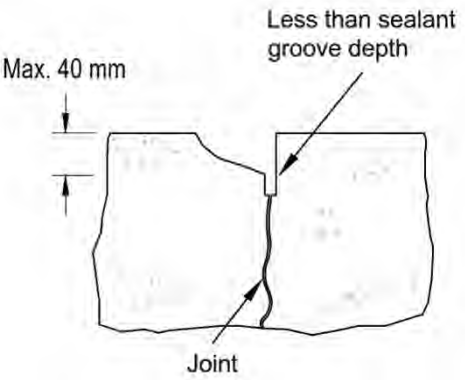
Both are ‘partial depth repairs’, but:

- Thin bonded repairs are up to 40 mm thick
- Shallow repairs are from 40 mm up to 1/3rd thickness

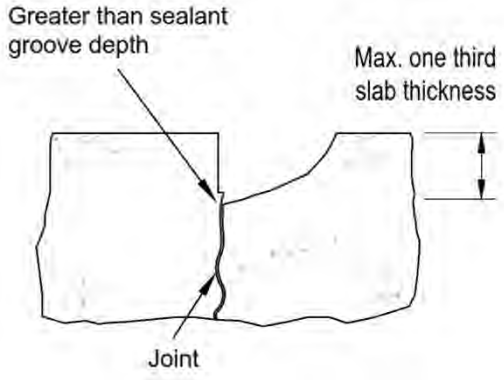
Thin bonded repairs are undertaken with rigid materials, shallow repairs can be done with rigid materials (long term repairs) or flexible materials (holding repairs).

Thin bonded repairs have a track record of performance. Shallow repairs with rigid materials are more likely to fail due to debonding.

Thin bonded repair



Shallow repair



Key rules – shallow repairs with rigid repair materials

Rule 1 – Rigid materials are not flexible

Maintain the joints!

Do not try to span cracks

Rule 2 – Cementitious and epoxy materials shrink as they cure

Shrinkage cracking can occur in repairs with a high aspect ratio, so make repairs square or use a low shrinkage materials.

Rule 3 – Bonding is important

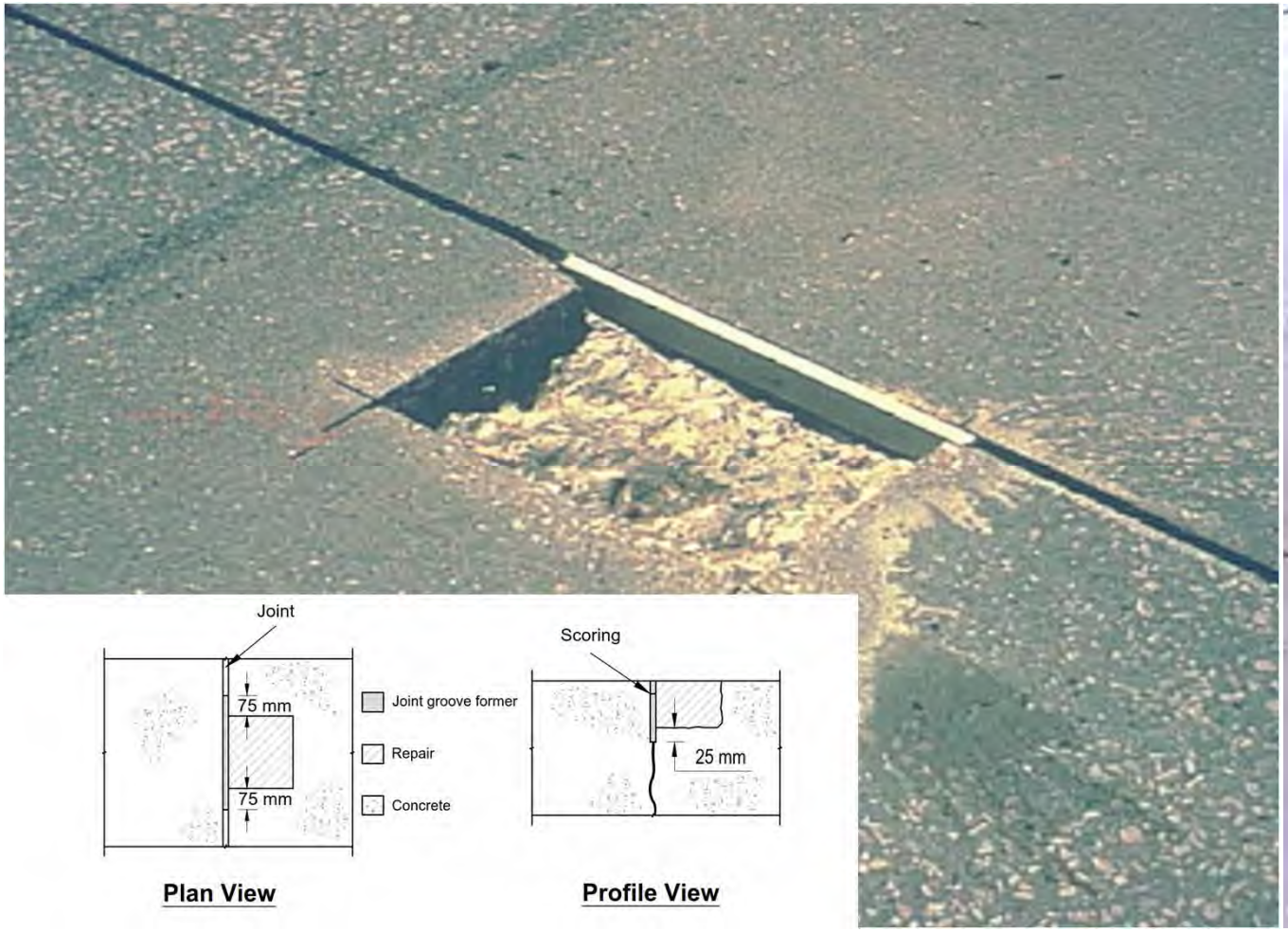
Surfaces should be irregular and rough, but clean!

Use a bonding agent or primer unless manufacturer says otherwise.

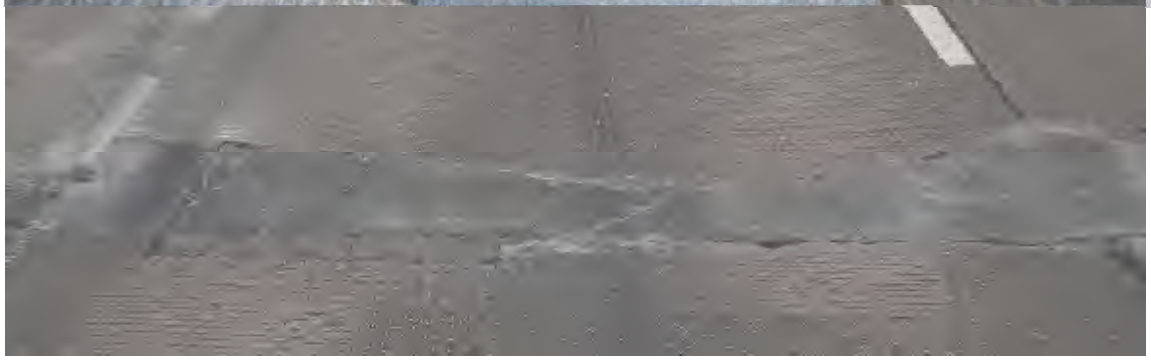
Repairs should be less than $1m^2$.

The importance of maintaining joints…

What to do, and what not to do…



More what not to do…



Main issues:

- Too large (>1m^2)
- Irregular shape (not square or rectangular)
- Joints not maintained

Full depth repair required

Full depth repairs

Key rules:

- Make sure you are prepared:
  - Is the concrete going to cure in time?
  - Can you protect the concrete from the weather?
  - Have you rectified drainage issues in advance?
- Bay replacements are better, fewer joints
- Reinstate your joints in the same location
- Install dowel bars and tie bars at joints and make sure they’re aligned
- Protect the concrete during curing and check it’s strong enough before re-opening to traffic

Continuously reinforced concrete full depth repair

Like a full depth repair, but:

- Typically larger area removed due to the regular transverse cracks
- Reinforcement continuity needs to be maintained

Other repair options

See CPMM Section 5.

Joint resealing

Applicable for:
- Failed joint seals
- (potentially) shallow spalls

Slab lifting and under slab grouting

Applicable for:
- Slab voiding/rocking
- Settlement
- Stepping

But fix the drainage!

Crack stitching

Applicable for:
Longitudinal cracks only

Asphalt overlays

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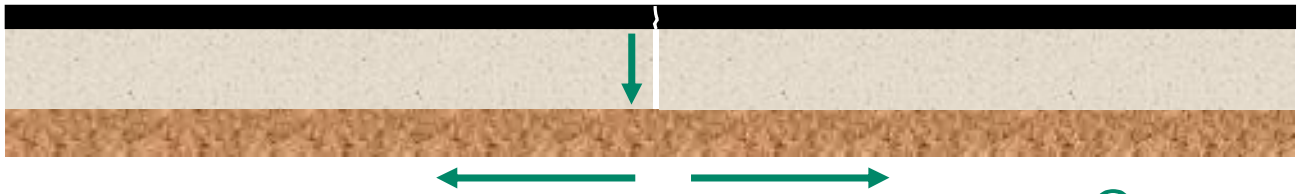
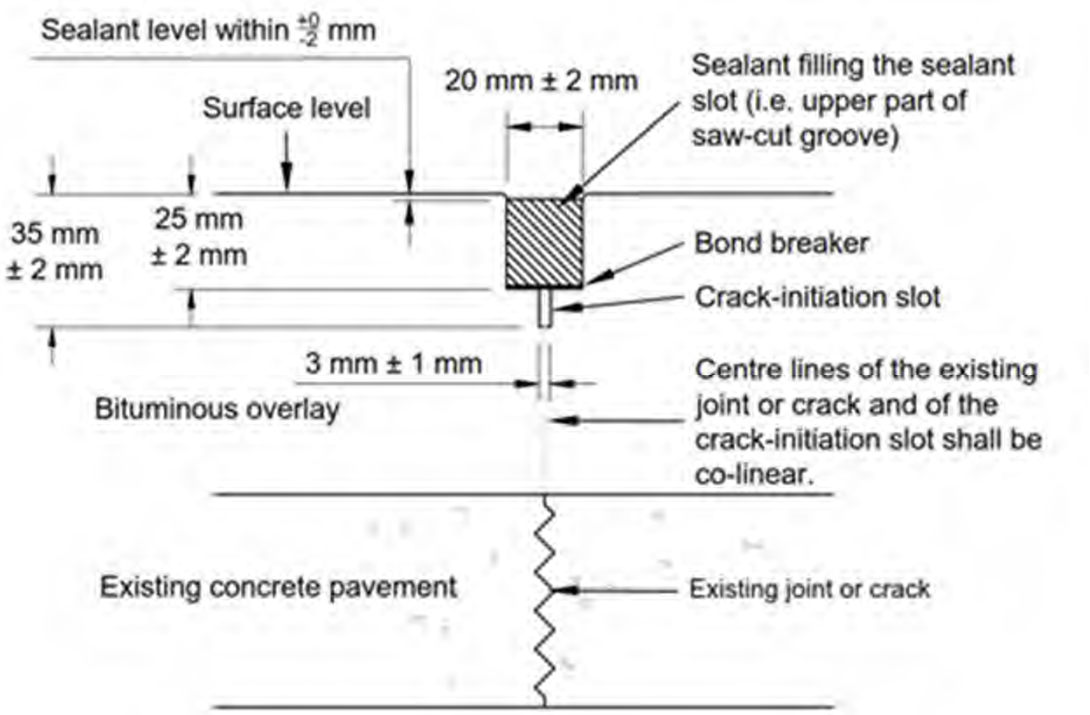
What’s the issue?

Reflective cracking due to horizontal (thermal) and vertical movements



Overlays – traditional approach – saw-cut and seal



Reflective crack mitigation systems – traditional approach – saw-cut and seal

Limitations:

- Time consuming
- Potential for workmanship issues
- Saw cut is a weakness, so additional deterioration at the saw-cut can be expected
- Design life 5 to 8 years

Alternative reflective crack mitigation systems

Theory:

Absorb and distribute strain to prevent cracking by installing a Stress Absorbing Membrane Interlayer (SAMI) at or close to the concrete interface.

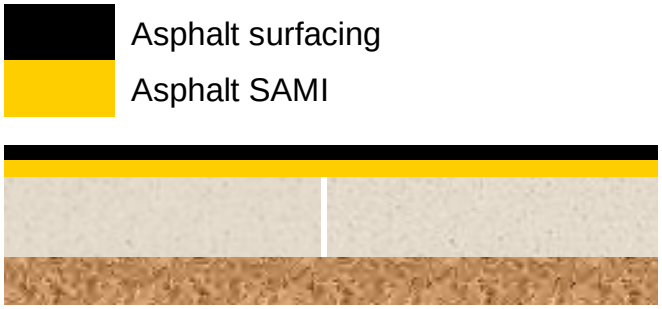
Benefits:

- Rapid construction
- Proven performance
- Design life 8 to 12+ years (trial monitoring ongoing)

Limitations:

- Proprietary materials
- Minimum thickness
- Geosynthetic recyclability

Option 1 – Asphalt SAMI – Total thickness ≥ 50 mm



Option 2 – Geosynthetic SAMI – Total thickness ≥ 90 mm

Thanks for listening.
Questions?

Next session: Next week Tuesday 30th November 2021 12:00 – 13:00

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