EUPAVE workshop « Surface finishing techniques & decorative concrete » - 20/5/2026, Brussels

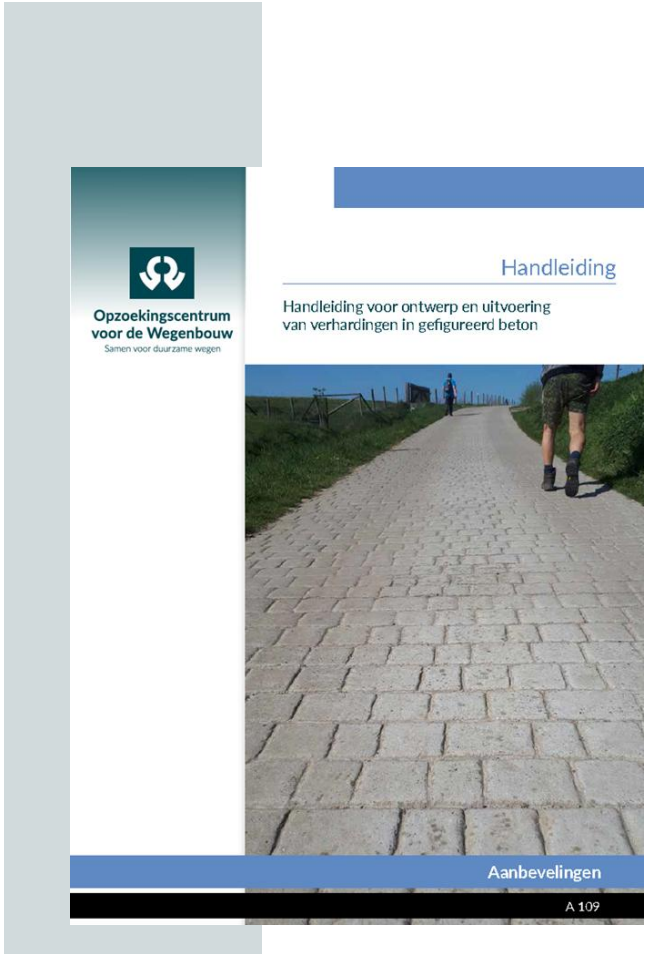
Belgian Road Research Centre
Together for sustainable roads

EUPAVE
EUROPEAN CONCRETE PAVING ASSOCIATION

Pattern imprinted concrete: new Belgian guidelines

Contents

- Introduction & context
- New Belgian guidelines for pattern imprinted concrete (PICP):
  - Classification system & design;
  - Construction aspects;
  - Surface characteristics.
- Conclusions



https://brrc.be/fr/articles/code-de-bonne-pratique-beton-imprime-2025

Intro – Pattern imprinted concrete (PICP)

- Decorative type of concrete pavement:
  - Private and public spaces;
  - Traffic islands, roundabouts;
  - Roads, buslanes, tramways.

Context for PICP in Belgium

- Specifications existed in Belgian standard documents for road construction, BUT:
  - **Not always coherent**
- HENCE: **New WG at Belgian Road Research Centre (BRRC) in 2022**
  - Improve and update the guidelines;
  - Subdivision in categories depending on way of **constructing, coloring and imprinting;**
  - For each category = updated tech specs for:

    Materials - Concrete mix – Requirements on fresh and hardened concrete – Construction practices – Surface characteristics - Inspections

New guidelines (2025)

- **Classification system for PICP**:
  - Based on 3 parameters:

1) The way of **coloring;**
   - Using a color-hardener at the surface
   - Full-depth colored concrete (or not colored at all but simply using gray concrete)

2) The way of **constructing;**
   - Manually between fixed formworks (mostly the case for PICP)
   - Mechanically using a slipform paver (rather exceptional but some experience in Belgium)

3) The way of **imprinting.**
   - Using (plastic) moulds
   - Using a texture roller

Classification system for PICP

- 6 categories (or systems)
  - 1A: color-hardener + manual construction + imprinting with moulds
  - 1B: color-hardener + manual construction + imprinting with a texture roller
  - 2A: full-depth colored + manual construction + imprinting with moulds
  - 2B: full-depth colored + manual construction + imprinting with a texture roller
  - 3A: full-depth colored + mechanical construction + imprinting with moulds
  - 3B: full-depth colored + mechanical construction + imprinting with a texture roller

Classification system for PICP

- **Some remarks**
  - 1A: color-hardener + manual construction + imprinting with moulds
    - Has the highest aesthetical potential;
    - Mostly used for private applications.
  - Combination of color-hardener + mechanical construction is not considered
    - Difficult to follow the speed of the slipform paver;
    - The mix may be too dry.
  - 3A: full-depth colored + mechanical construction + imprinting with moulds
    - Only for shallow surfaces or linear elements

Case 1 – Landen (1/2)

- Landen, “Stationsstraat”
  - 1996, JPCP, system 1A: color-hardener + manual construction+ moulds with fan pattern

Case 1 – Landen (2/2)

- Landen, Station Street
  - 1996, JPCP, color-hardener + moulds;
  - Pictures anno 2024 (28 years old);
  - **Very good condition, some wearing of the trafficked surfaces.**

Case 2 - Brussels

- Brussels, Luxemburg street – Bus lane with intense traffic
  - 2000, JPCP, color-hardener + manual construction + moulds;
  - Pictures of June 2024: **wearing of the surface of the driving lanes, still perfect on the parking places.**

Design - Specific materials for PICP

- Color-hardener – Release Agent – Surface Sealer
  - Commercial products coming from EU, UK, US
  - Possible compliance with EU standards and CE-marking

- COLOR-HARDENER
  - Well-composed mixture of dyes, cement, silica and admixtures;
  - Powder or liquid form;
  - Liquid form only for private works; possibly for public works after approval only;
  - Possibility to incorporate Al_2O_3 to increase the wearing resistance.

Specific materials for PICP

- RELEASE AGENT
  - To prevent the moulds from sticking to the concrete;
  - Add secondary colouring effect, giving it a more “antique” look;
  - Powder or liquid form.

Specific materials for PICP

- SURFACE SEALER/PROTECTION
  - Systems 1A & 1B
    - solvent-based acrylic sealer;
    - Beautifies, protects and seals the surface.
  - Other systems
    - Hydrophobic impregnation;
    - Increases surface resistance to de-icing salts;
    - Silanes/Siloxanes;
    - EN 1504-2;
    - In Belgium mandatory on all manually built concrete surfaces.

© IN2-CONCRETE

Design - Specs for the concrete mix and its constituents

- **Need for extra water**
  - Color-hardener and dying pigments are fine powders with high water demand;
  - Additional amount of water to moisten and/or hydrate these powders;
  - **Higher water content – higher cement content to limit the water-cement ratio**;
  - Possible concession in terms of durability – **priority to decorative aspect.**

Microcracking in PICP surface, possibly due to a too dry concrete mixture

Specs for the concrete mix and its constituents

- **Manual construction:**
  - Minimum cement content = 400 kg/m³ ; (blast-furnace slag cement CEM III/A 42,5 N LA = "low carbon" cement);
  - Maximum water-cement ratio = 0.50;
  - 180 liter ≤ water content ≤ 200 liter/m³.

- **Slipform paving:**
  - Minimum cement content = 400 kg/m³;
  - Maximum water-cement ratio = 0.45

Specs for the concrete mix and its constituents (3)

- **Coarse aggregates**
  - In general, no need for polishing-resistant aggregates - Limestone is mostly possible:
    - PTV 411: LA_{25} – MDE_{20} - PSV_{NR}
  - Except for trafficked roadways (skid resistance):
    - PSV_{50}
  - Dmax= 20 mm or even 14 mm
    - For ease of construction;
    - To increase the mortar content and improve 'imprintability'.

- **Sand**
  - Higher mortar content ⟹ High sand content;
  - Round sand 0/2 or 0/4 ≥ 40% of total aggregate fraction.

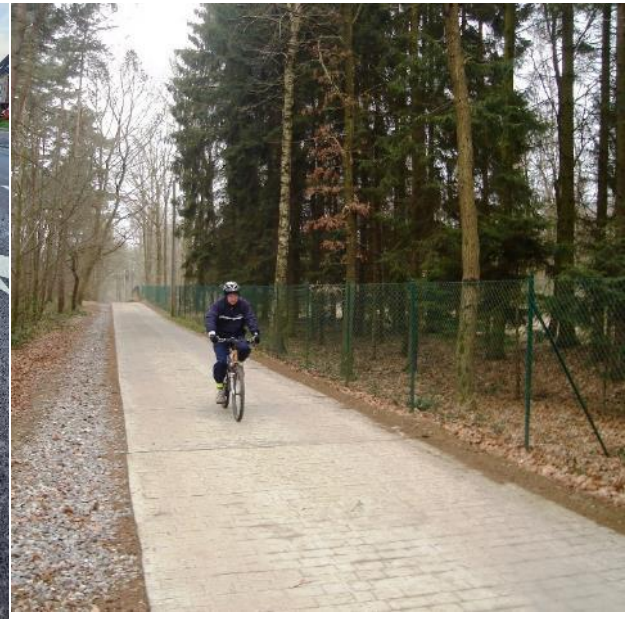
Specs for the concrete mix and its constituents (4)

- **Consistency**
  - Manual placement: S2/S3 – slump between 80 and 150 mm;
  - Slipform paved: S1/S2 – slump between 20 and 60 mm.
- **Air entrainer (AEA)**
  - Not mandatory;
  - Not recommended for manually placed and thus more fluid concrete due to possible interference with the superplasticiser;
  - For systems 2 and systems 3 without AEA: hydrophobic impregnation takes care of resistance to frost-thaw and de-icing salts;
  - For systems 1: effect of color-hardener + acrylic resin?

Specs for the concrete mix and its constituents (5)

- Strength requirements
  - Non-trafficked areas: **50 MPa** ~ C30/37;
  - Trafficked roadways: **60 MPa** ~ C35/45.

  (average values at an age of 90 days, measured on cores drilled from the pavement, h=10 cm, S= 100 cm²)

Construction of PICP

- Processing and compaction of concrete:
  - Spreading – compacting – levelling

Construction – surface finishing

- Systems 1A-1B
  - Uniform spreading of the color-hardener;
  - see producer's instructions – possibly in two stages;
  - 3 to 5 kg/m² for powders;
  - 100-200 g/m² for liquids.
- Level again the concrete surface with a bull float

Surface finishing

- Systems 2A-2B-3A-3B
  - No color-hardener;
  - Either grey or mass colored concrete, using mineral pigments (EN 12878), mostly 3 to 4% in mass of the cement content.

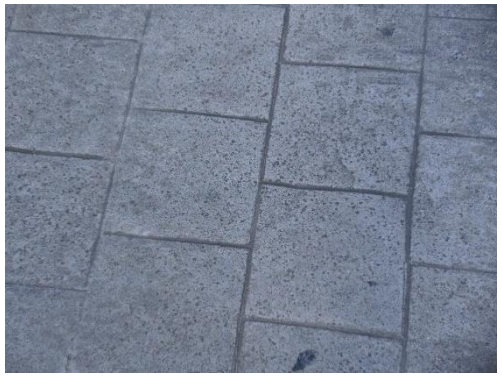
Surface finishing (3)

- Application of the release agent
  - Powder or liquid;
  - **BUT keep the same form as the color-hardener!** (powder + powder – liquid + liquid)
  - Or a thin plastic film (10µm) for system 2.

Surface finishing (4)

- Printing the pattern
  - **Moulds**
    - Placed carefully side by side;
    - Pressed by the weight of the applicator or a specific tool.
  - **Texture roller**
    - In general, a shallower pattern is obtained.

Cobblestone pattern – using moulds



Cobblestone pattern – using a texture roller

Surface finishing (5)

- Some popular patterns:





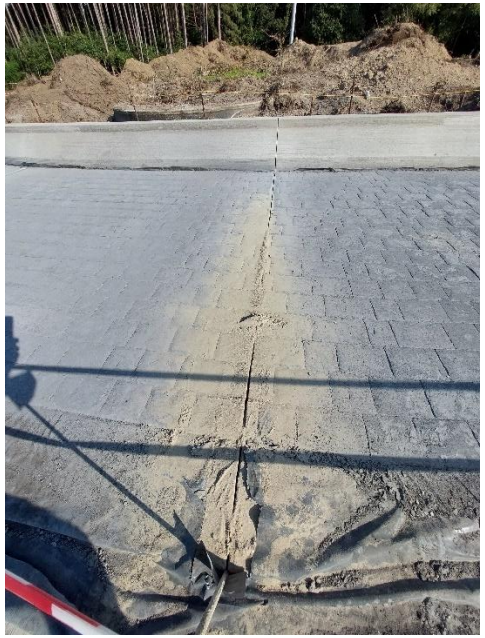

Construction of PICP - Curing

- Plastic sheet for 72 hours
- Curing compound
- Extra amount of release agent
  - Powder or liquid form
  - Extra 20 %, e.g. 100 g/m² + 20 g/m²
- Interim curing compound between pouring the concrete and imprinting

- Cleaning (after 72h) + protection against scaling!

Construction - Shrinkage Joints

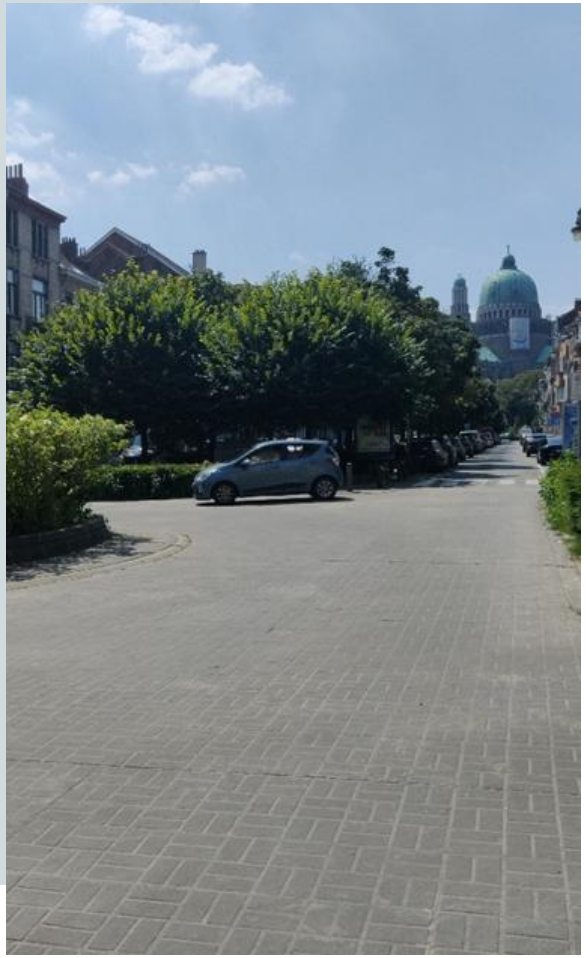
- If possible, take into account the printing pattern!
- Sealed or unsealed (depending on application)
  - Mostly sealed to prevent weed growth.



Surface characteristics

- **Skid or slip resistance**
  - Not always relevant;
  - Measured with SRT (Skid Resistance Tester) or Pendulum Test;
  - Requirement for roadways:
    PTV_i ≥50 (Pendulum Test Value)
  - In general, not a problem, except maybe just after application of the acrylic resin.
- **Rolling noise**
  - PICP are NOT low-noise pavements;
  - Shallower patterns will yield less rolling noise;
  - In some cases, the rolling noise is desired.

Conclusions Pattern imprinted concrete



- PICP = well-known & widely applied all over the world;
- Applications on both private and public domain;
- In Belgium, regulations were already available for public roads but not fully adapted to current practice;
- With a recent BRRC working group, new recommendations and guidelines were drawn up in consultation between road authorities, contractors, material suppliers and research institutes;
- **This should allow PICP to be built in a better and more sustainable manner.**

Elia BOONEN
R&D Manager
e.boonen@brrc.be - +32 477 94 38 21
https://www.linkedin.com/in/elia-boonen-6881066 /