SOUTH AFRICA ROAD FEDERATION

Non-Motorised Transport Practitioner's Course

Session 14: NMT Pavement Design and Maintenance Procedures

Part 1: Pavement design for NMT users

Pavement design for NMT users

- Documents to be consulted when designing and constructing paved surfacing:
  - South African Pavement Engineering Manual (SAPEM)
  - COLTO standard specifications
  - SANS 10400 Part S
  - Manufacturers guidelines.
  - NMT Facility Guidelines
- Objective of presentation - to provide brief introduction to pavement engineering design considerations regarding NMT pavement surfaces.

Pavement design for NMT users

Function of Cycleway Surfaces

- The ***wearing surface*** is the uppermost layer of a pavement structure over which the users of a cycleway are required to travel. Its overall function is to provide a safe, economical and durable all-weather surfacing that is:
  - Smooth
  - Skid resistant
  - Dust-free
  - Waterproof
  - Durable and protective of the underlying pavement.
- In addition, cycleway surfacing are often required to perform aesthetic or social functions that include the following:
  - Visually enhance the cycle lane environment for users and adjacent residents
  - Assist in separating user groups.

Types of NMT Surfacing

Unsealed Surface

- Granular materials of up to about 20 mm in stone size are typically used as the principal load bearing layer and can also provide the riding surface.
- The mechanical interlock developed between the larger stones provides the shear strength while the plastic fines in the material bind the surface of the layer.

Sprayed Treatment

- Sprayed seals consist of a layer of stone chips spread and rolled onto a thin film of bitumen to form a water-resistant surfacing over granular layer(s).

Types of NMT Surfacing

Bituminous Slurry and Microsurfacings

- Slurry surfacing is a mixture of sand, crushed rock, filler, cement, and bituminous emulsion applied to form a thin surfacing layer.
- Slurry surfacing tend to be very thin (<12 mm), have a fine surface texture, and are relatively brittle when compared to asphalt. Can also be used to correct minor surface irregularities.
- Microsurfacings are a form of slurry surfacing in which the conventional emulsion is replaced by a polymer-modified emulsion to provide faster setting times and improved flexibility.

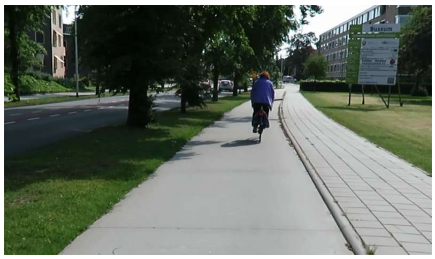
Types of NMT Surfacing

Asphalt Surface

- Asphalt (or Hot Mix) consists of a mixture of well-graded, clean, non-plastic granular material and 4.5% to 7% bitumen by mass, which is produced in a purpose built mixing plant.
- When compacted and cooled it forms a smooth, stable and durable riding surface.

Concrete

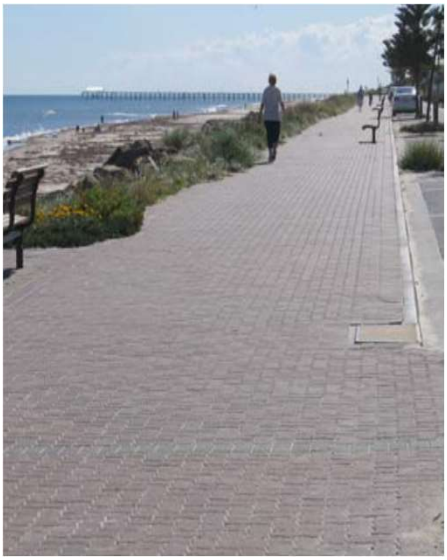
- Concrete surfacing is the finished top of the structural base layer rather than a separately placed surfacing treatment.



Types of NMT Surfacing

Concrete Block Pavers

- Concrete paving units about the same size as clay house bricks are placed over a thin sand bedding layer and granular material.



Cycle lane surface	Expected service life of surface (years)
Sprayed seal, 5mm / 7mm	5 -10
Double application seals	8 - 15
Dense graded asphalt	10 - 20
Fine gap graded asphalt	15 - 20
Slurry & Microsurfacings	8 - 15
Concrete	20 - 40
Concrete Block pavers	15 - 25

Source: Dept. of Planning, Transport and Infrastructure, South Australia

Bicycle pavement types

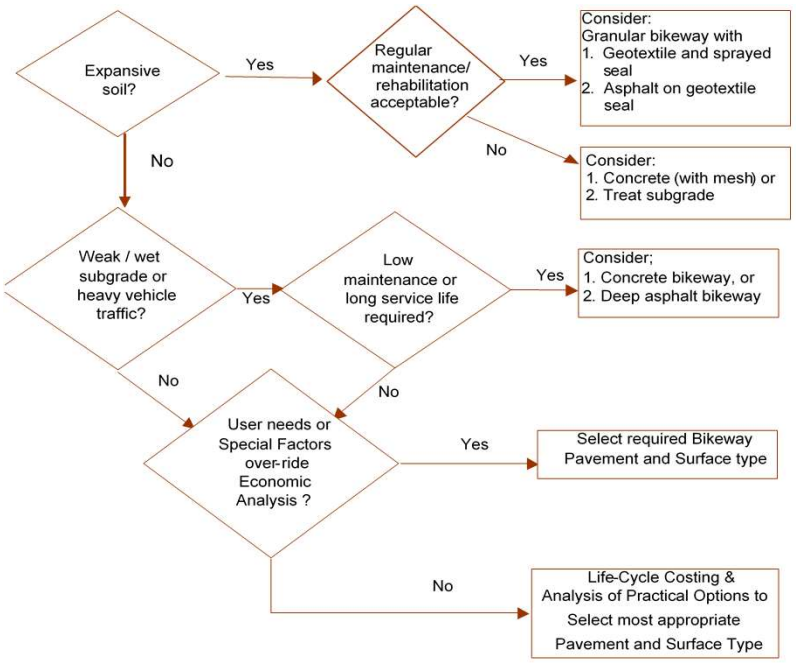
Fall into two broad categories, flexible and rigid.

- **Flexible pavements**
  - Have a structure that deflects or flexes under load. Include sprayed sealed pavements, asphalt pavements, and unsealed pavements.
  - Concrete block pavers and pavements incorporating cement stabilised materials are also classified as flexible and use a similar design methodology.
- **Rigid pavements**
  - Have a rigidity associated with their slab action and comprise cement bound concrete pavements.
  - The structural design procedure differs fundamentally from that used for flexible pavements.

Key factors in the pavement and surfacing selection

- Presence of expansive soils
- Expected condition monitoring and future maintenance effort
- Drainage and moisture environment
- User needs and traffic type
- Community expectations
- Material availability, preferences, costs
- Available construction expertise, equipment, access, supervision, timing
- Level of performance and service life required
- Initial and ongoing funding.

Key considerations in selecting pavement type



Cycleway Selection Based on Functional Criteria (1)

Delineation:

- Surface type (and hence colour) to define a shared-use path or define the bikeway crossing another paved area?
- High use at night; thus a surfacing of a lighter colour?

Aesthetics:

- Visual impact on adjoining residences/businesses?
- Compatibility with natural surroundings?
- Heritage issues for surface type?

Ride Quality:

- No joints at all?
- A quiet surface required? (e.g. roller-blades and skateboards).

Cycleway Selection Based on Functional Criteria (2)

Construction:

- Access for mechanical pavers or large equipment?
- If hand-laid or small plant used, will surface finish quality be acceptable?
- Does industry have the equipment, materials, and skills available locally?
- Are there numerous vertical level constraints to be accommodated along --the bikeway?
- Does the time of year (climate or industry supply) have an effect on the pavement type?
- Gradient and change of grade

Cycleway Selection Based on Functional Criteria (3)

Design:

- Are bikeway pavement edge restraints to be avoided?

Trees:

- Will roots grow beneath and distort the pavement?

Flooding:

- Is inundation of pavement a concern? May also lead to loss of structural integrity.

Maintenance:

- Access for works, condition monitoring, timeliness, funding, work quality.

Widening:

- Possibility of future improvements?

Part 2: Maintenance of NMT facilities

Maintenance of NMT facilities

- Asset Management Systems
- NMT Facility Inventory
- NMT Condition monitoring
- NMT Facility usage counts
- Stakeholder requirements
- Situational analysis

Asset Management Systems

- Asset management systems (AMS) represent a range of technical tools used to meet the strategic, tactical and maintenance scheduling needs of the road authority. AMS take on a variety of forms, with varying complexity and described in TMH22.
- The asset definition dataset sets out how the assets are identified and laid out. It forms the basis for storing all other data associated with individual assets.
- Management of road pavements and related maintenance practices well established, the maintenance of NMT facilities less attention.
- Most NMT facilities are viewed as components of road assets and separate condition monitoring and prioritisation seldom carried out.

NMT Facility Inventory

- The NMT Inventory and Asset Register will include the many details for each NMT asset or component in the system.

- All inventories have a hierarchy and in the context of NMT assets as shown below:
  - Facility: Complete bicycle lanes, walkways, bus stops, bicycle sheds, etc.
  - Asset: Individual links or separately identified assets that make up the above facility such as shelters, etc.
  - Components: Individual elements of the asset such as sidewalks, walkways, pedestrian crossings, roofs, area lights, benches, etc.

NMT Facility Condition Monitoring

- Condition monitoring of the NMT elements should be carried out. Should be done yearly as part of road inspections.
- TMH9 Pavement Visual Inspection Manual provides guidelines of detailed inspections of roads, but these not carried out routinely on NMT facilities. Distress of these facilities not traffic-related but more a function of isolated incidents and occurrences that require occasional rather than routine cyclical maintenance.
- TMH22 generic indicators of condition and functional rating for each NMT element should be used. Ambiance rating is included to assess the attractiveness of the NMT facility.

NMT Facility Usage Counts

- The usage of NMT facilities typically measured using 15-minute counts in the peak hour - expanding this to full day count using a peak hour factor (persons in the peak hour/ persons per day).
- These counts include the following parameters:
  - Physical count
  - Duration of count
  - ADP: Average daily persons that use the facility measured in both directions over 24 hours,
  - Mode (%): Walk, Cycle, Animal, Wheelchair mobility,
  - Type of usage: Commuter, School, Recreation
  - Peak Hour Factor: Ratio of peak hour volumes as a percentage of daily volume. Typical default values for this are: Commuter - 15%, School - 20%,Recreational - 20%, General - 12%

NMT Facility Stakeholder Requirements

- Stakeholder Requirements
  - Involves formal statistical surveys of stakeholders that could include a number of questions to determine the safety, comfort and convenience of the NMT facility.
- Situational Analysis
  - Situational analysis can be carried out from the information gathered on the enumerated list above.

Maintenance of NMT facilities

Regular maintenance activities of cycle ways should include *(Austroads 1999):*

- Filling of cracks
- Patching of potholes
- Trimming or removal of grass so that it does not intrude into the path
- Sweeping of paths to remove debris such as broken glass and fine gravel (including that arising from construction and maintenance activities such as crack sealing)
- Repainting of pavement markings
- Cleaning of signs
- Trimming of trees and shrubs to maintain safe clearances and sight distances.

Maintenance of NMT facilities

Safety and Service Division: **Guide to Bikeway Pavement Design Construction & Maintenance for South Australia**, January 2015

Maintenance of NMT facilities – Practical guide to treat defects on:

- Gravel paths
- Asphalt paths
- Concreate pavers
- Concrete paths

Government of South Australia
Department of Planning, Transport and Infrastructure

Maintenance of NMT facilities Intervention Treatment
1. Gravel paths

Defect	Treatment
Erosion of the path	Redirect the water flow where possible. There is a requirement to fill any areas of erosion with additional gravel. Stabilising the gravel with lime may also be required.
Loose surface	This may require the gravel to be stabilised with lime at 2% by volume.
Water ponding	Place additional gravel to ensure water runs off the path.
Grass on the path	Spray the path with weed killer and chip weeds where required.

Maintenance of NMT facilities Intervention Treatment
2. Asphalt Paths

Defect	Treatment
Substantial cracking, shoving and surface breaking up	Remove surface, recompact base material and replace asphalt, sprayed seal or slurry surfacing.
Cracks wider than 10 mm	Can cause pedestrians to trip, and cycles, wheelchairs and strollers to be thrown off course. Cracks must be filled to remove hazard.
Sharp subsidence/ uplift and dangerous bumps	Remove surfacing in the affected area and replace, removing the subsidence/uplift.
Potholes	Fill pothole with cold mix.
Water ponding	Drain the bikeway where possible by removing soil from the side of the path to allow water to escape.
Deterioration of surface with age	Replace the surface or overlay the bikeway with asphalt, slurry or sprayed reseal.

Maintenance of NMT facilities Intervention Treatment
3. Concrete Paver Paths

Defect	Treatment
Subsidence/uplift of individual pavers greater than 8 mm	Remove pavers, fix base and relay the paver.
Cracked pavers	Where the paver is cracked and not moving - no action.
Missing pavers	As a temporary repair fill with sand or gravel, install a new paver.
Gaps between pavers	Narrow gaps between pavers may be filled with sand. Larger gaps may require additional sections of pavers to be placed in the gaps.
Slippery surface of pavers	Slippery paver surfaces may be ground to remove the slippery surface.

Maintenance of NMT facilities Intervention Treatment
4. Concrete Paths

Defect	Treatment
Vertical displacement greater than 25 mm	Localised displacements on sections in good condition should have a Coldmix asphalt ramp installed
Joint/crack widths between 8 and 20 mm	Individual cracks can be filled with grout. Extensive cracking of the bikeway requires replacement.
Joint/crack widths greater than 20 mm	Fill cracks with Coldmix if the path is still serviceable.
Skid resistance problem	Replacement of the section of path or overlay with bituminous wearing course if reflection of joints and cracks is acceptable.
Ponding of water	This may be in association with subsidence. Altering the landscaping or replacement of the section of path may be required.