Mitigating Shape Loss on Roads Prone to Deformation Using Geosynthetic Reinforced Pavements

Rod Fyfe

Geofabrics

GEOFABRICS®

Smarter Infrastructure

Introduction

- 20% of Australia is covered with expansive and swelling soils/clays
- Known as Black soil and Red-Brown clays
- Early CSIRO Waite Campus work on building foundation stability over expansive clays
- Typical basal reinf. increases pavement life/ reduce wheel load rutting
- Basal reinf. to mitigate longitudinal cracking research since early 2000's
- Early research by Gupta, Zornberg, Al-Qadi, Berg, Fanin, Perkins and Ismeik
  - Texas USA based

GEOFABRICS®
Smarter Infrastructure

Introduction

- East/North East suburbs of Adelaide - areas of black and red/brown clays
- Full depth pavement deformation and longitudinal cracking
- Old local street pavements with 150mm depth FCR
- Local Govt utilised geosynthetic solutions since mid 1990's
- Full depth pavement solutions trialled over last 10 years

GEOFABRICS®
Smarter Infrastructure

History

- Paving fabric surface treatments for spray seals and asphalt used since late 70’s
- Waterproofing and reinforcement function
- Asphalt reinforcement geogrids used around Adelaide since early 2000’s
- Subgrade reinforcement over soft subgrades used extensively since 2010
- Pavement stab. over expansive clay subgrades increased over last 10 years
- Installations in the Ingle Farm, Regent Gardens, Campbelltown/Newton areas.

GEOFABRICS®
Smarter Infrastructure

Application

- W'proofing existing cracked asphalt seals
- Replacement of old thin pavements
- Substitution of rock sub-base layer
- Reconstruction to full depth needed
- Shape correction/ride quality issue
- Mitigation of expansive clay effects
- Improve pavement life span

GEOFABRICS®
Smarter Infrastructure

Products

- Paving Fabric 140 gsm for waterproofing of asphalt overlays
- Replacement of 150mm rock layer up to 400mm deep with;
  - Geotextile 200 gsm for clay separation
  - Triaxial geogrids for subgrade reinforcement

GEOFABRICS®
Smarter Infrastructure

Theory

- **“Roads wear out from the top down, but they fall apart from the bottom up’’**
- Cracking caused by inability of pavement to withstand shear and tensile force
- Clay expansion and contraction seasonal.
- Water ingress from cracking exacerbates clay reactivity
- Influence from water ingress in shoulder/parkland/wetland areas
- Geogrids provide a mechanically stabilised pavement interlayer
- Geogrids intercept vertical forces, enacts tensile properties to disperse forces along horizontal plane.
- Visual proof of mitigation and pavement stability upon site inspections

GEOFABRICS®
Smarter Infrastructure

Design

- Reactive subgrade failure - longitudinal crack defined as >3mm wide
- Geogrids increase pavement subgrade CBR - measurable only on upper pavement levels
- Texas studies show success through trial section monitoring
- Quantifiable stress inducement not yet released
- Empirical methods using Traffic Benefit Ratio [TBR] not applicable
- Activated tensile properties = stresses dispersed along horizontal plane.
- Measurable stresses possible through new age conductive geosynthetics
- Development of factor to input to existing design method in near future

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Vasey St. Greenacres

- City of Port Adelaide Enfield
- Reconstructed 1994
- 30mm asphalt overlay with Sealmac 140gsm PET paving fabric
- 40 FCR base course 200mm deep
- Area ~ 4000 sqm
- Reflective cracking as a result of shallow depth pavement over expansive clay subgrade
- 15+ year performance success

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Vasey St. Greenacres
1994

Vasey St. Greenacres
2009

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Deans Road, Campbelltown

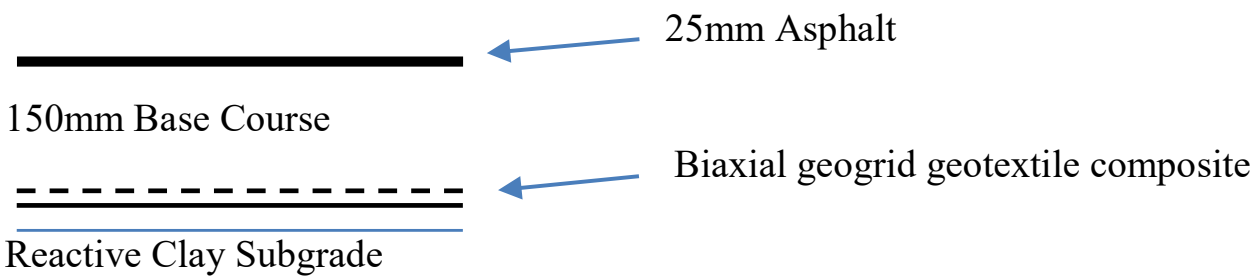
- City of Campbelltown
- Reconstructed 2000
- 30mm asphalt overlay
- Reconstructed 40 FCR base course 150mm deep
- Tensar SS20 + bidim A24 subgrade stabilisation
- Area ~ 7500 sqm
- Reflective cracking as a result of shallow depth pavement over expansive clay subgrade – very poor original condition.

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Deans Rd Campbelltown
2018

Pavement detail - Deans Road Campbelltown 2010



GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Duthie Street, Regent Gdns

» City of Port Adelaide Enfield

» Reconstructed 2015

» 30mm asphalt overlay

» Reconstructed 40 FCR base course 400mm deep

» TX160/A24 geo-composite subgrade stabilisation

» Area ~ 3000 sqm

» Reflective cracking as a result of shallow depth pavement over expansive clay subgrade

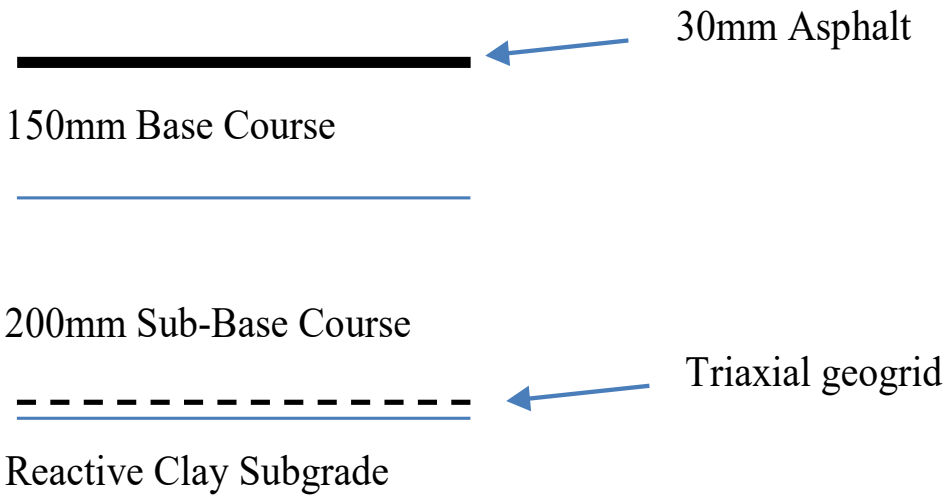
» Located adjacent park with water retention pond.

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Duthie St, Regent Gardens
2015

Pavement detail - Duthie Street Regent Gardens 2015



GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Voss Street, Regent Gdns – Control [adjacent Street]

- City of Port Adelaide Enfield
- Reconstructed 2015
- 30mm asphalt overlay
- Reconstructed 40 FCR base course 400mm deep
- Area ~ 3000 sqm
- Reflective cracking as a result of shallow depth pavement over expansive clay subgrade
- Located adjacent park with water retention pond.

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Voss St Regent Gardens - Control
2015

Pavement detail - Voss Street Regent Gardens 2015

30mm Asphalt

150mm Base Course

200mm Sub-Base Course

Reactive Clay Subgrade

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Doncaster Ave, Newton

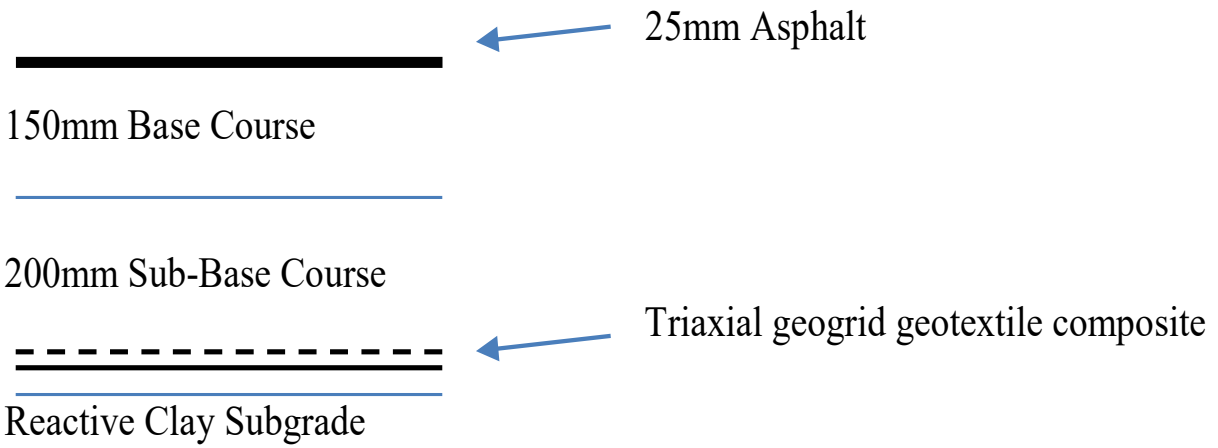
- City of Campbelltown
- Reconstructed 2016
- 30mm asphalt overlay
- Reconstructed 40 FCR base course 400mm deep
- TX160/A24 geo-composite subgrade stabilisation
- Area ~ 2200 sqm
- Reflective cracking as a result of shallow depth pavement and environmental factors over expansive clay subgrade
- Located with large gums in close proximity

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Doncaster Ave, Newton
2016

Pavement detail - Doncaster Ave Newton 2016



GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Chatswood Grove, Newton

- City of Campbelltown
- Reconstructed 2016
- 30mm asphalt overlay
- Reconstructed 40 FCR base course 300 - 400mm deep
- TX160/A24 geo-composite subgrade stabilisation
- Area ~ 2200 sqm
- Reflective cracking as a result of shallow depth pavement over expansive clay subgrade

GEOFABRICS®
Smarter Infrastructure

Field Evaluation

Chatswood Grove, Newton
2016

Chatswood Grove, Newton
2018

GEOFABRICS®
Smarter Infrastructure

Conclusions

» Geofabric seals show evidence of surface stability over 15+ years
» Geosynthetic geogrids can provide effective crack mitigation
» Geosynthetic geogrids can provide extended life and ride quality
» Texas site trials and papers provide ample evidence of reinforcement benefits
» Local Adelaide trials showing control of reflective cracking
» Continued monitoring of East Adelaide sites required for conclusive results enhanced by collection of data on; clay type, pavement type, local climate …….
» Development of design method factor for input into pavement design
» Future construction and monitoring with new age geosynthetics to gather stress information

GEOFABRICS®
Smarter Infrastructure

Mitigating Shape Loss on Roads Prone to Deformation Using Geosynthetic Reinforced Pavements

Thankyou

GEOFABRICS®
Smarter Infrastructure