Benefits of Subgrade Stabilisation on Major Projects

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What is Stabilisation?

- Using additive(s) to strengthen the in-situ subgrade.
- Generally lime, cement or a combination of the two is used.
- A rotary hoe blends this mixture in with the existing subgrade, along with water.
- Stabilisation can significantly increase the subgrade strength - between 2-10 times the in-situ CBR.
Subgrade Stabilisation on Hobsonville Deviation
What are the Benefits of Subgrade Stabilisation?

I plan to outline the three major benefits that subgrade stabilisation can have on major projects and these include:

- Construction benefits
- Programme Benefits
- Cost Benefits
Major Projects with Subgrade Stabilisation

The presentation will focus on two recent projects with large amounts of subgrade stabilisation:

- Northern Gateway Toll Road (pictured)
- Hobsonville Deviation
Construction Benefits

- Stabilisation provides an ‘anvil’ that the rest of the pavement can be constructed upon
- Multi-layer stabilisation can be used to create a stronger, deeper foundation
- Once subgrade has been stabilised it is strong enough to run construction traffic, such as graders, trucks etc. across it - allowing easier construction
- The subgrade strength can continue to increase over time, although the initial strength gain is achieved after 4 days
- In some areas tested after a few months of stabilising the strength had continued to increase (up to 1.5-2 times) after the initial post-stabilisation testing
- In a study conducted on Paremoremo Rd, Auckland, the subgrade strength had increased by over 300% from the original design and the subgrade had lasted over 31 years (Browne & Hallett, 2009)
Multi-layer Subgrade Stabilisation Taking Place
Benefits to Programme

If soft subgrade is found on a roading site then this will need to be addressed and there are generally three options;

1. Cut and replace with on-site material
2. Cut and replace with ex-situ material
3. Stabilise

All of these options take a different amount of time to complete and will affect the overall construction programme
Option 1 & 2: Remove and Replace

- Involves using plant to undercut, cart away poor material, replace with good material, compact and trim material.

- Additionally the area will need to be drained at a deeper depth - often causing extra work involved with finding a stormwater outlet at the correct depth.

- If black sand is used to increase the strength of the undercut then the subbase needs to placed on top of the sand to protect it.

- Both of these operations are very slow processes and involve a lot of plant use - black sand plus subbase can only progress at approximately 25m per day (assuming a 25m carriageway).
Black Sand and Subbase being placed (2 days = 40m at 12m width)
Option 3: Stabilise

- Depending on material types, up to 8-10 times more area can be stabilised, compacted and trimmed in one day.

- The reason that it depends upon material type is that this will determine how many times the material needs to be hoed to achieve the correct particle sizing.

- The turnaround time to complete testing and allow subbase to be placed is between 2-4 days in summer – longer in winter due to curing time.

- The result is an overall productivity gain of 2-4 times greater than using black sand to improve the subgrade.
Benefits to Cost

The main reason to use stabilised subgrades is to reduce the overall cost of the project.

Having a strong subgrade to construct the rest of the pavement upon can reduce the thickness of the subsequent layers – which are generally the most expensive.

The cost savings on the two projects, Northern Gateway and Hobsonville Deviation, were analysed to discover the overall effect on project savings.
Northern Gateway Toll Road

- Approximately 200,000m² of subgrade was stabilised on the project.

- Design of CBR 7 for subgrade was being consistently over-achieved during testing for the initial 2km of subgrade.

- Design CBR was increased to 15 and this allowed a reduction in subbase thickness from 200mm of GAP65 to 100mm of GAP40.

- This meant that 6500m³ less material was required – achieving an acceleration to program.

- This resulted in an overall cost saving on the subbase budget of approximately 25%.

- With 150mm of deeplift and 25mm OGPA surfacing, the final pavement was very strong on the final beam and FWD testing.
Deeplift layers being placed on GAP40 subbase
Hobsonville Deviation

- Original concept had no stabilised subgrades and a maximum subgrade CBR of 5, and less than CBR 5, black sand was to be used.

- A cost analysis based on the overall pavement design found that a reduction in deeplift thickness could be achieved by applying subgrade stabilisation.

- By achieving a CBR 10, asphalt thickness could be reduced by up to 30mm from the original CBR 5 design.

- In some areas - double layer stabilising can take place and reduce the asphalt thickness by up to 40mm.

- By trying to achieve the highest subgrade CBR possible the overall cost savings on the deeplift budget should be approximately 7%.
<table>
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<th>SUBGRADE CBR</th>
<th>SIL DEPTH (mm)</th>
<th>TNZ AC14HF THICKNESS (mm)</th>
<th>AC20 THICKNESS (mm)</th>
<th>BEAM DEFLECTION TARGET PRIOR TO 1ST AC LAYER** (mm)</th>
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**REFER TO NOTE 1

Pavement Design Table from Hobsonville Deviation
Section of Stabilised Subgrade on Hobsonville Deviation
Conclusions

- Subgrade stabilisation allows faster construction resulting in a shorter construction programme.
- A stronger subgrade will allow a reduction in overall pavement thickness, which will generate a cost saving.
- An early finish is advantageous for the client and also saves on overhead and plant costs for the contractor.
- As an example, Northern Gateway Toll Road was completed 6 months ahead of schedule.
- If the in-situ material is suitable for stabilising then it would be recommended that the subgrade should be stabilised to achieve significant benefits for the project and the client.
Northern Gateway Toll Road – 1 Week Prior to Opening
Acknowledgements

- Mike Nelson - Hiway Stabilizers
- Greg Seed & Ross Peploe - Bartley Consultants
- Paul Herbison

References