

## Briefing Note

Road Construction Princes Street- BSC/SDS proposals 22 May 2009 (11:30)

Attendance:-

BSC :- Colin Brady, Jim Donaldson (part time)

SDS :- Alan Dolan, Orlando Walters

tie :- Colin Neil (chair), Michael Paterson, Duncan Fraser

### 1. Background

1.1 SDS set out the original design, for approval at a full depth of 610mm based on an assumed CBR of 3.

1.2 tie instructed BSC to carry out further site investigations to determine a more comprehensive understanding of site conditions with the objective that a palette of a simple set of options for reconstruction could be set out.

1.3 BSC through SDS and their consultant Halcrow's have now re-designed the roads and set this out in Appendix 7/1 (V3). This has set out three forms of construction ranging in depth from 0.350m to 1.290m

1.4 Intuition suggest that as the road is carrying high bus loads at the moment, albeit with some surface rutting, that full reconstruction including capping requires further justification and explanation by BSC/SDS.

1.5 Princes Street has the highest traffic loading and poorest ground conditions according to SDS. They advise that elsewhere the loading is lighter and the formation provides significantly better ground bearing support for the carriageway, such as in Leith Walk.

### 2. Introduction

2.1 Princes Street has the highest traffic loading, along the on-street section of the tram route, because of the high volume of buses, and according to the SDS the lowest CBR values (the formation bearing capacity expressed as the California Bearing Ratio). Consequently, SDS

DMF draft report V2 25 May 2009

advises that for most of the length of Princes Street the proposed reconstruction is 1.29m deep including 0.5m of capping (H2), because the assumed bearing capacity is less than 2.5 (CBR) (refer to their drawings and coloured legend for reconstruction).

2.2 SDS advises that they have determined the reconstruction depths on the basis of the CBR results. These results have not been provided to tie/CEC, however, SDS indicated that because of the wide scatter of results they have adopted the lower values, typically less than 2.5. tie/CEC has asked again for this data and analysis to justify this approach.

2.3 The other forms of construction include for 0.89m (H3) where a top formation layer of on average 100mm is less than 2.5 (CBR) but the layer below greater than 2.5 and for areas where the FWD show the lean mix is fit for purpose the construction depth is 350mm (H5). It is not clear why these soft layers or spots are not just removed and replaced by capping, as this could be determined on exposure of the formation, rather than use these values to determine all the road reconstruction. ***Part of the answer to this is the division of responsibility between SDS and BSC and SDS's approach to their PI (Professional Indemnity).***

2.4 The other form of reconstruction includes for a 0.350m (H5), where the existing lean mix proves robust support, thus only requiring the replacement of the surface courses and the base.

2.5 The SI results are the primary driver of the decision-making. The Light Weight Deflectometer (LWD) established the base and sub-base conditions while the formation is determined by the CBR results.

2.6 To date these results and analysis, including the justification for using retracted design, has not been provided to tie/CEC, to explain and justify the BSC/SDS proposals.

2.7 The implications of deep digging includes impact on the footways and pedestrian access, encountering more services (footways and carriageways), exposure of cellars, reconstruction methods around services and the potential risk of damage to services. The combined impact of these factors will affect both time and costs. To date these have not been justified by BSC/SDS.

### 3. Issues

3.1 The LWD and cores results and analysis require to be provided to show where the lean mix or the sub-base material is not fit for purpose.

DMF draft report V2 25 May 2009

3.2 The CBR values and their analysis requires to be provided to show how these have been used to inform and justify the design process. SDS stated that the design of the road is not actually based on results but rather an interpretation that as the results are so variable and that the lowest value should be adopted. The example given was where there are two values on a section (east and west bound) and that the lowest value is adopted. This also applies along the chainage. ***This cautious approach to variable CBR results has major construction impacts. Thus it does seem appropriate to take further CBR results to verify the ground conditions and only provide capping where the design requires it. It is possible that the variable result reflect soft spots. If this were the case then the additional results would avoid the worst case ground conditions approach to the design and adopt a fit for purpose approach, thus minimising the dig to that which is essential, while at the same time assuring that SDS's PI cover is still provided.***

3.3 Another factor in seeking to minimise the dig is the likely exposure of services especially below 610mm. This in turn would impact upon the method of compacting the sub-base and capping. SDS has stated that their approach is to save time yet they appear not to have considered the impact of services and advise tie that this is a matter for BSC. BSC confirm that the depth of the layers would require to be thinner if the compaction on or adjacent to services restricts the compaction plant both in terms of size and weight- this would have an impact on cost.

3.4 The depth of construction will also affect the side excavation into the footways and in turn affect the passage of pedestrians and expose services and cellars. The as built drawing should help assess the impact of services on both sides of Princes Street.

3.5 SDS have advised, after some reluctance, that should further CBR results show that the CBRs are different from their current design assumption then they would agree that their analysis using the Schedule 3H would apply and be supported by their PI. Further that the H4 form of construction could be adopted to base, road base or capping depending on the SI results, thus providing a uniform depth of construction and with sub-base where the LWD shows the lean mix has failed and capping where the CBR is less than 2.5 including for localised soft spots.

3.6 SDS has further argued that their approach, restricted design, provides a consistency of construction rather than a ***patch work***. Tie would dispute this an indeed BSC (Jim Donaldson) agree that the adoption of H4 construction would provide uniform depths of construction, from top of base, to sub-base and capping, where these are required (refer to Appendix 2)

3.7 On the primary drivers for SDS's cautionary approach there are two key issues:-

- The use of restricted design rather than performance based design
- The least value approach to CBR variable values

Restricted design is within the DMRB design methods and is appropriate “ for smaller schemes where limited options are available and performance testing may not be appropriate” (extract from Interim Advice Notes 73/060 Section 1). Alternatively Performance based design “allows a wider use of materials together with measures and testing to ensure design requirements are met”. In an urban situation it can be argued that the least amount of dig because of services and other related issues must be the best value option and least engineering difficulty.

The CBR results apparent show a degree of variability, consequently, it is even more surprising that the most recent CBR information from the OLE investigations have not been used nor questions raised as the need for further CBRs at the current stage where the formation is accessible for further testing.

It is now anticipated that all the available information supported by additional CBR results will now be employed to reappraise the design criteria of the existing formation and also explore the impact of performance based design on determining the impact on the depth, accepting that subject to uniform depths of layers for construction that the depths can change to reflect changing local conditions

#### 4 Conclusions

4.1 The impact of deep digging over extensive lengths of Princes Street will adversely affect pedestrian access increase time and costs, and potentially risk damage to services. BSC/SDS have not justified nor demonstrated the requirements for this changed position (from 0.610m to 1.29m) and now require to do so.

4.2 Works can start on Princes Street at the junction with South Charlotte Street and proceed eastwards towards Castle Street because this is the H5 options for construction- this work is programmed to commence within 2 weeks and would give time for further CBR values to be provided and re-designed by BSC/SDS and potentially a independent auditor appointed to review the justification for their designs.

4.3 BSC/SDS requires to be instructed to provide the LWD and core results and their analysis to justify their design proposals on Princes Street.

4.4 BSC/SDS requires to be instructed to carry out further CBR tests on the formation and review their current design assumption.

4.5 MUDFA require to provide the as built drawings to demonstrate what services would be effected by the different construction depth options

4.6 It is unusual that tie are considering these issues as under the contract it would seem more appropriate for BSC to be raising these buildability and fit for purpose issues with SDS?

## 5. Recommendations

- 5.1 Seek the current LWD and core data and analysis showing where the lean mix has failed
- 5.2 Seek the current CBR data from BSC/SDS to determine the basis of their analysis for the need for capping
- 5.3 Instruct further CBRs to be undertaken by BSC/SDS on the formation to determine comprehensively the range of results on both carriageways
- 5.4 Seek and if necessary challenge BSC/SDS to justify their re-construction proposals in the light of updated results, replacing lean mix and providing capping only where required by the site investigation results, including the use of performance based design.
- 5.5 BSC/SDS to provide revised design proposals based on the outcome of the more comprehensive SI information.
- 5.6 Seek an independent view of the SDS designs to ensure that the outcomes are reasonable, justifiable and provide best value.
- 5.7 Agree the final construction details with tie/CEC (SfC)
- 5.8 Seek clarification from BSC that collectively they are endeavouring to provide the best value road construction solutions consistent with their contractual obligations (it is not transparent meantime that BSC are robustly challenging SDS's design assumptions, analysis and buildability. Depending on the outcome of their response seeking an independent view to their design proposals for reconstruction, should be considered.

Appendix 1:- Schedule 3H Permitted Construction Materials

Appendix 2 :- Sketch of Road Construction Options