CITY OF GREATER GEELONG – CHANGING CONSTRUCTION – USING RECYCLED MATERIALS IN INFRASTRUCTURE

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Abstract

The City of Greater Geelong has been proactive in trialing changing construction methods that we are incorporating into our day to day civil works and infrastructure maintenance activities. The trial projects shall be expanded upon in this paper.

To ensure the outcomes are consistent they should meet the relevant Infrastructure design standards, a tool used by Councils to communicate design and construction expectations of civil infrastructure.

The City has adopted a common set of infrastructure standards known as the Infrastructure Design Manual (IDM). The IDM does not currently capture opportunities to deliver more sustainable infrastructure. A case study to develop a green civil infrastructure section for the IDM that provides alternative design and construction to achieve greater sustainability outcomes was completed in June 2014.

The Sustainable Infrastructure Guidelines (Draft), aims to provide advice on alternative design considerations and materials that would deliver more sustainable infrastructure through:

- Using recycled materials
- Reducing the carbon footprint of infrastructure projects
- Reducing maintenance and operating costs
- Utilising water in more efficient ways
- Utilising materials from sustainable sources

Key Words

Recycled, infrastructure, sustainable, guidelines, construction, green, carbon

Introduction

This paper references the changing construction methods that the City of Greater Geelong is trialing and incorporating into its day to day civil works and infrastructure maintenance activities.

The paper shall briefly touch on the history of Geelong and the enormous amount of infrastructure works that have been built in the past and what the City is faced with in the future.

The paper shall then outline the current Sustainable Communities Infrastructure – Development Guidelines that inform new development and then discuss the Infrastructure Design Manual and the new chapter - Sustainable Infrastructure Guidelines that has been prepared and was based on trial projects using alternative construction methods and materials.

The projects that made up the trial were; Steampacket Place, Geelong – Laneway; Grant St, Forrest – Concrete Footpath and Car Park; Grange Park Drive, Waurn Ponds and Townsend Road, Whittington – recycled foam bitumen.

City of Greater Geelong

Located 75km south west of Melbourne, Geelong is Victoria's largest provincial centre and its fastest growing region.

Geelong is among the largest of 80 Councils which collectively represent approximately 5 million Victorians. While each Council is independent there are common rules, mainly in the form of State Legislation, which provide the framework in which Councils operate

With over 240,000 residents, Geelong provides the perfect environment to balance work and home-life.

The area is known for Urban Geelong – residential, commercial and industrial areas; Bellarine Peninsula - rolling hills, rural and coastal lifestyle, with many attractions both natural i.e. the beaches and hinterland and man made i.e. wineries, tourist parks; and Residential communities in small townships.

What we did then

The original Geelong Town Council (GTC) was incorporated on 12 October 1849. The first rates levied were used for salaries and urgent street repairs. The surrounding areas quickly grew and the GTC borrowed funds to carry out public works. As it grew so did the need for modern infrastructure, electricity, trams, water supply, sewerage, port, harbour and rail services all provided between 1880 and 1920.

It wasn't until after WWI & II that the Civic Precinct and community infrastructure started to be delivered that provided services that benefited the whole community. The scope widened to include personal health and welfare, development planning, environmental protection and community amenities.

The 1950's saw traffic management become an important issue with the tram system dismantled and the first parking meters installed.

The outer suburbs expanded in the 1970's leading to a decline in the central city and its central infrastructure and facilities.

1993 saw the amalgamation of 6 councils into the now City of Greater Geelong with a focus on regional and economic planning and the ability to lobby with a strong voice to state and federal levels.

The 1990's heralded the era of Urban Renewal and regeneration. The traditional methods of construction were employed and the result is the current civil assets we have today.

What we do now

The City of Greater Geelong (the City) has over $1.5b worth of civil assets that we manage and maintain. Approximately $25M of new civil assets are added to our portfolio each year.

If we can reduce the use of new material and recycle existing material on some of our projects we are on the way to providing a more sustainable future.

Supply of road making materials came from onsite or local quarries such as Fyansford and Drysdale, both of which are now closed.

Quarry material is sourced from Mountain View Quarries at Point Wilson and Holcim near Werribee. Material is now sought from further afield thus increasing the construction miles required to deliver necessary infrastructure.

Along with our own construction works we received over $23M of new assets per year from private development which could be more sustainable. We expect Development that meets the economic, social and environmental needs of current generations without compromising the needs of future generations.

Sustainable Communities – Infrastructure Development Guidelines

Sustainable infrastructure is based on more efficient site layouts that are more compact, provide increased transport choices, reduce water consumption and protect natural streams and watercourses.

Five key Council departments came together to prepare the Sustainable Communities – Infrastructure Development Guidelines which set out the philosophy, principles and expectations of the standard of development for future growth areas of Greater Geelong.

The guidelines require best practice and careful consideration so that good quality outcomes are achieved without being too prescriptive. Council is keen to encourage innovation and creativity in the design of new communities.

In promoting innovation however comes the reality of asset management and ongoing operational responsibilities, so it is important that communities are developed and improved with sustainable outcomes in mind.

These key points have been emphasised throughout the guidelines because achieving this balance can be the biggest challenge.

The guidelines are used as an important tool by the Statutory planning department to guide their process

The Principles within the guidelines focus on Sustainable Communities. They focus on livability and quality of life and acknowledge the importance of residents feeling connected to their communities.

The guidelines pick up these principles and apply them to the design and development of infrastructure. We are trying to avoid the mistakes often made where infrastructure can be an impediment to safe and welcoming communities.

Infrastructure Design Manual - Sustainable Infrastructure Guidelines

The City has adopted the Infrastructure Design Manual (IDM) as its' standard for the design and construction of infrastructure within the City and in particular, the standard for civil works in subdivisions. There is a current provision in the IDM for Council's to consider innovation and advances in technology as alternative treatments provided they meet the objectives of the IDM. This is at the discretion of each Council.

The provision does not give information on the standards to apply to development. Therefore in order to meet Sustainable objectives a new chapter Sustainable Infrastructure Guidelines (SIG) has been prepared for the IDM.

The Aims of the SIG are to encourage;
- Using recycled materials,
- Reducing the carbon footprint of infrastructure projects,
- Reducing maintenance and operating costs,
- Utilising water in more efficient ways,
- Utilising materials from sustainable sources.

Funding was obtained from the Victorian Local Sustainability Accord to develop Green Infrastructure Standards or the Sustainable Infrastructure guidelines as an appendix to the IDM.

The project involved;
- Identifying sustainable and greener design and materials and undertaking market assessment of the availability of sustainable products;
- Construction of 4 demonstration projects;
- Preparing a final report and case study for each project including;
    - how the guidelines impacted the project
    - determining the carbon footprint for each project and comparing this to the carbon footprint without applying the guidelines and
    - determining the cost comparisons for construction, operation and maintenance.

The three projects were split between Greater Geelong City Council and Colac Otway Shire. They include a trafficked laneway redevelopment, Steampacket Place; the construction of a footpath and car park Grant St, Forrest; and pavement rehabilitations using foamed bitumen asphalt Grange Park Drive and Townsend Road Recycled.

The key performance indicators assessed for each project were;
- Carbon Footprint
- Cost

- Constructability
- Availability of materials
- Design Initiatives
- Net Flora Increase
- Use of sustainable / alternative materials
- Drainage
- Maintenance
- Appearance/Aesthetics

Steampacket Place, Geelong

The City of Greater Geelong carried out the Reconstruction of Steampacket Place in Geelong in 2014.

The site is a laneway off Eastern Beach Road near the waterfront of Geelong. Steampacket Place is a well used laneway with 2 way traffic. The main door to the Novotel and Edgewater apartments is off the laneway as well as car parks for adjoining apartments. The laneway also services delivery and rubbish vehicles for waterfront businesses. The lane is a main pedestrian route into the abutting businesses and connects through to Brougham street and the main City Centre.

The works included:

- The removal of asphalt pavement, precast pavement and bluestone pavement.
- Construction of new pavement, drainage infrastructure, furniture, lighting and landscaping.
- Inclusion of Stormwater quality treatment.

The whole supply chain was reviewed during the construction of the job.

In the tender documents extra detail was added around waste disposal and new material use. The documents specifically required that demolition and disposal of asphalt should go to the City's Belmont Works Depot for recycling and already crushed asphalt should come back to the site for sub-base bedding. Demolition and disposal of concrete went to Local Mix Concreting for recycling.

The tender documents specified that the concrete mix was to be sourced from Local Mix or a similar approved product if this was not available.

Most of the new job was concrete pavement, replacing asphalt road and concrete paver footpaths. The City prepared some test panels at the Belmont Works Depot with various concrete mixes that included different quantities of manufactured sand, recycled crushed concrete aggregate and low carbon cement with different percentages of fly ash, and slag.

The new low carbon Concrete mix was made up of manufactured sand, (from recycled crushed concrete), aggregate (from recycled crushed concrete and bricks) and cement (eco-blend made up of fly ash, slag and GP). In addition to the mix, 100% Recycled water was used which is collected in the plant from its wash down processes.

The Reo used was Onesteel Ecoreo, (from recycled steel and energy reducing polymer injection technology).

The asphalt pavement was demolished and any reusable excavated materials were taken to a recycling plant for reuse. After excavation works, a doweled reinforced concrete pavement was constructed.

The 100 mm deep sub-base was replaced with Recycled Crushed Concrete, further reducing the need for virgin quarried material.

A bio filter was constructed in place of the concrete kerb. The bio filter at Steampacket place is multilayered and consists of a vegetated layer, overlying a filter media, transition layer and drainage layer with a perforated collection pipe.

The runoff is firstly filtered through the surface vegetation which settles coarse to medium sized sediments, then percolates through the well-graded sand filter media which filters fine sediment and finally into the perforated collection pipe for discharge into existing stormwater infrastructure. A central rain garden pit was also constructed. Similar to the bio retention system, the rain garden is positioned to collect storm water runoff and filter through a multilayered soil system, eventually discharging excess water to existing drainage infrastructure

Eight large trees were planted providing shade in warmer months and allowing sunlight to penetrate during cooler months.

The sustainable outcomes achieved on this project were:

- Net flora increase was achieved
- Improved the general appearance of the laneway by providing lighter neutral tones accompanied by green natural elements and creative lighting.
- Reduced carbon footprint of 4,900 KgCO2
- Cost difference of $27,700
- Alternative materials were readily available. Sand filter media had strict grading requirements and had to be batched specifically for this job.
- Stormwater outflow is reduced, water quality is improved
- Generally low maintenance. Bio retention system will need to be monitored for silt build up and maintenance of plants.

Grant Street, Forrest

Colac Otway Shire carried out construction works at Grant Street, Forrest. A new 334 metre footpath has been constructed which runs along the Eastern side of Grant St connecting Blundy St and Henry St. There is a crossing point approximately midway along the footpath which crosses both Grant St and the adjacent access road.

The works include:

- Construction of new concrete footpath
- Reconstruction of car park

Sustainable Initiatives included the use of a low carbon concrete footpath and the reuse of excavated material and stripped topsoil.

The Cementitious component of the Green Star Concrete comprised of 40% slag which is quite high. The low carbon concrete required longer curing times due to the high proportion of SCMs. Therefore the contractor needed to investigate curing options for the concrete slab.

There were some potential design initiatives in the IDM that could have been implemented but weren't. For example, the materials in the asphalt car park and the surrounding drainage had some opportunities to implement sustainable elements.

Sustainable opportunities missed included the use of Warm Mix Asphalt, Alternative/recycled granular materials, Water Sensitive Urban Design and Landscaping.

The contractor was only able to reuse a small amount of existing pavement material and topsoil due to poor quality and contamination issues. Careful curing of concrete was required to prevent dusting and cracking.

The sustainable outcomes achieved on this project were:

- Reduced carbon footprint of 7,800 kgCO2
- Cost difference of $3,006
- Alternative materials were readily available.

Foam Bitumen Asphalt

City of Greater Geelong initiated two pavement rehabilitation projects one in Grange Park Drive, Waurn Ponds and the other in Townsend Rd, Whittington.

Both pavements were in need of rehabilitation due to visible pavement defects caused by a weak sub-grade and high volumes of heavy vehicles. The sustainable treatment that was proposed for these two roads was pavement reconstruction using Recycled Foamed Bitumen Asphalt as a stabilised base layer followed by an asphalt wearing course.

The conventional treatment normally proposed by the City is to increase the pavement thickness above the sub-grade by reconstruction. This option involves 300 mm of imported gravel rather than 200 mm of stabilised. The gravel base course is a virgin quarried material and transported from elsewhere to the site. The excavated pavement is not reused and treated as a waste material and carted offsite.

Emphasis was placed on reusing existing materials through the addition of Foamed Bitumen Asphalt. The insitu pavement material was improved through stabilisation and was then reused in the new construction. The reuse of these materials meant that spoil was reduced and the need for virgin materials

was also reduced. There were some constructability issues with soft sub-grade which required unplanned sub-grade stabilisation with lime.

The benefits of the alternative construction method were

- 200 mm foamed bitumen layer equivalent to 300 mm unbound layer
- Reduces demand for quarried virgin pavement materials and disposal of excavated pavement material when granular replacement is utilised
- Both increase stiffness above weak sub-grade
- Foamed Bitumen acts as a bound layer and achieves equivalent strength of a thicker unbound granular layer
- Batching plant is mobile and can be positioned near the site where suitable space is available
- Ready to begin manufacturing Foam Mix within two hours
- All other plant to remove and relay the pavement is the same as traditional techniques.

The sustainable outcomes achieved on this project were:

- Reuse existing gravel as base course
- Foamed cold mix bitumen utilises bitumen at much lower temperatures with environmental and safety benefits
- Reduced carbon footprint of 22,130 KgCO2
- Cost difference of $120/sqm (foamed) vs $172/sqm (conventional)
- Alternative materials were readily available.

The trial projects met the following aims of the IDM - Sustainable Infrastructure Guidelines.

- Using recycled materials,
- Reducing the carbon footprint of infrastructure projects,
- Reducing maintenance and operating costs,
- Utilising water in more efficient ways,
- Utilising materials from sustainable sources.

The main focus was on material substitution. A positive outcome was the reduction in carbon footprint achieved for all projects.

Fitting with existing infrastructure did limit sustainability initiatives. This was indentified in the Grant St project where surplus material was not suitable for reuse and in Steampacket Place where recycled concrete sub-grade was used in preference to the asphalt won from the site.

Pre planning is necessary to identify opportunities for use of existing and recycled materials from a site. Inclusion of sustainable initiatives such as Water Sensitive Urban Design and landscaping to enhance the aesthetics and liveability of a new asset is encouraged and supported.

Overall the City of Greater Geelong is keen to try new methods of construction that are sustainable and will stretch our dollar further but at the same time providing long lasting infrastructure into the future.

Conclusion

The information gathered from these four projects has now been included in a draft chapter for the IDM. Access to the Sustainable Infrastructure Guidelines will become available via the IDM website at www.designmanual.com.au when it is released in September 2015 following consultation with stakeholders.

The Objectives of the Sustainable Infrastructure Guidelines are:

- To provide a range of alternative sustainable design options and materials that reduce the carbon footprint of infrastructure projects recognising that some options can be adopted immediately, some may be more suitable in urban environments than rural and others may be more aspirational and may require regulatory or policy change or innovation in order to be delivered;
- To provide infrastructure in a way that preserves the natural environment, protects habitat and maintains or increases biodiversity;
- To provide infrastructure that uses stormwater more efficiently by reducing peak volumes and increasing the volume that is retained in the water sensitive design elements prior to discharge to watercourses;

- To better integrate design elements such as road, landscape and stormwater conveyance to increase sustainability and meet amenity, accessibility and level of service provisions whilst delivering greater aesthetics;
- To introduce processes such as the use of rating tools whereby projects can be evaluated on sustainability criteria, compared with other projects and improved;
- To increase confidence levels in the use of alternative designs and materials;
- To encourage broader thinking around sustainability initiatives at the design stage.

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