Natural Stone Pavements:
The Tangible Benefits

An architect's viewpoint on the benefits of using natural stone when designing pavements.




Federation Stone
Great Britain

Natural stone pavements – The Tangible Benefits

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About the Author - Rosey Paul, BSc MA, CMLI

Rosey Paul has been a Chartered Member of the Landscape Institute since 1982. She has spent over 30 years working as a public sector client most recently overseeing the regeneration of the public realm in Liverpool City Centre. In particular she led on the public realm works at the Pier Head and Liverpool Canal Link which secured 14 national design and construction awards. She has written articles for the technical press and presented at regional and national conferences on public realm works in Liverpool and shared space issues. She has acted as a landscape awards judge and has recently qualified as a CEEQUAL assessor.

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1. Introduction

The purpose of this paper is to examine the tangible benefits to clients of selecting natural stone as a material for improvements to the public realm. Its reasoning is based on extensive research, design and product evaluation undertaken for and during the delivery of the comprehensive regeneration of streets and squares in Liverpool.
This paper will address the creation of distinctive high-quality environments with natural stone; life cycle costs, the economic benefit to towns and cities of creating high quality public realm and sustainability issues. It concludes with a case study of improvements delivered in Liverpool as part of the City Centre Movement Strategy between 2004 – 2011.

2. The creation of distinctive high-quality environments

The treatment of the surface of streets and squares makes a huge impact on the identity of any town or city. Since Georgian times natural stone has been a favoured material in successful cities of the UK including the magnificent streets of London, The Crescent in Bath and elegant cities of Edinburgh and Liverpool. It was chosen to express prosperity and create places of worth.

Today natural stone is still chosen by designers and clients for its aesthetic properties, its inherent good looks and natural beauty and its ability to retain these looks in the long term. Some stone appearance actually improves with age. By comparison man made alternatives can start to lose their visual appearance and be in need of renewal much sooner often long before they have lost their structural integrity.

The wide variety of natural colours and the natural variations within any stone allow the creation of unique solutions which enhance local distinctiveness. Stone can be successfully used as a simple monocolour or by mixing a rich pattern with different hues either bright or muted. The permanence of colour and its ability to resist fading in sunlight is a great asset.

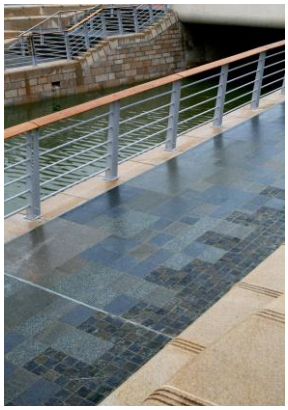

Fig 1. Rich mixes created with a variety of granites at Pier Head & Cavern quarter, Liverpool.

Natural stone resists the absorption of moisture despite its exposure to wind, rain and frost. It is not normally stained by atmospheric grime which helps in busy areas where conditions pose an extreme test to any material where dirt, chewing gum and liquid spillages, often with fats and oils, are continual pressures.

Designing with natural stone allows flexibility with an ability to create an infinite number of sizes and shapes from the product. It is therefore easy to design a pavement compatible with standard street furniture, kerbs and drainage.
The stone can be cut to exacting tolerances allowing the creation of intricate designs. A good example of this is the creation of the complex granite seating walls at Pier Head Liverpool. The design of the individual units was computer modeled and their cutting schedules prepared in the UK. They were cut and dry assembled like a giant jigsaw puzzle before transporting to check on accurate build ability. On site the construction went smoothly with only minor on site cutting required.

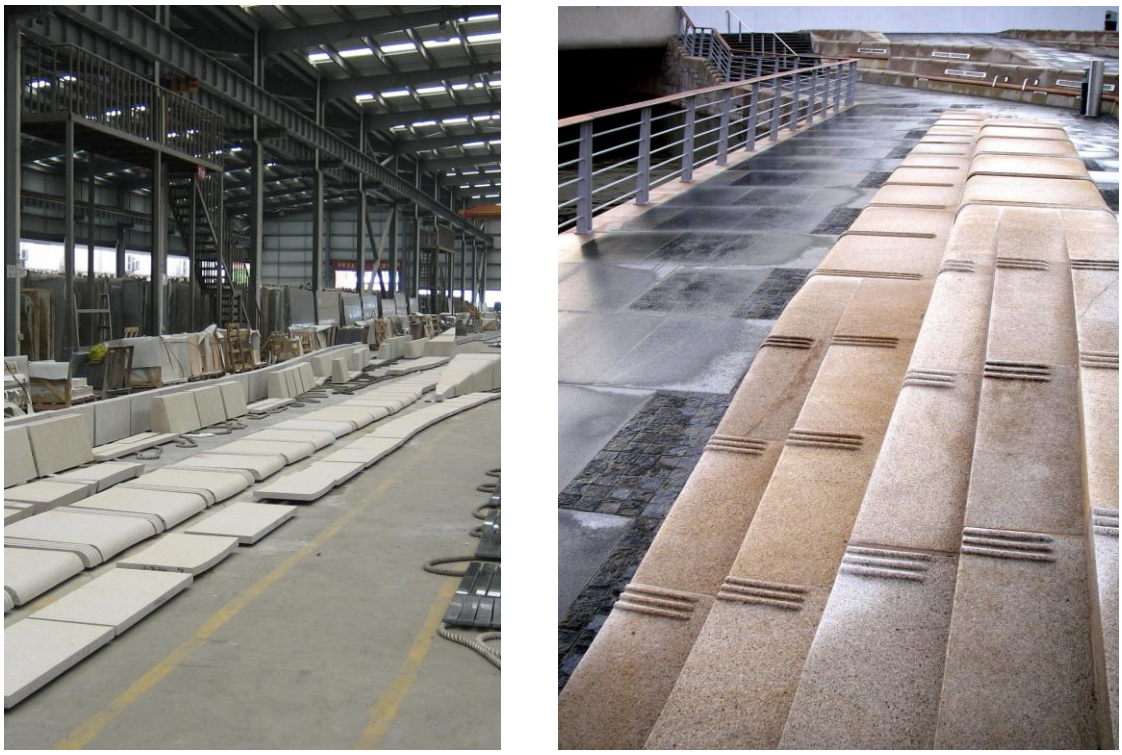

Fig 2. Photo stone seat walls being laid out in china & completed seat walling.

The versatility of stone is favoured by craftsmen and stone masons. For generations natural stone has been used for masonry, traditional carving and etching. Now with modern developments in both CAD design and cutting techniques, designers are able to embrace other aspects of art in the landscape, including text and illustration as well as inlay with other materials like stainless steel. It also allows achievement of a high-quality finish to contrasting step nosings and the creation of coordinating tactile pavings needed to help with DDA compliance. On steps and walls ribbing can be cut into the natural stone to

provide a subtle but effective deterrent to skateboarders avoiding the need for metal studs which detract from its looks.

The natural durability and inherent strength of good quality natural stone make it ideal for townscape work where long scheme life is important. It is important to select good quality stone. CE marking should be applied to all natural stone products which provides assurance of both quality and performance. With appropriate construction techniques stone can withstand vehicular traffic as well as heavy pedestrian usage. It has inherently good skid and slip resistance.
These many considerations all favour the use of natural stone for works in the public realm.

Fig 3. Use of natural stone in Williamson Square, Liverpool

3. Life cycle costs

There have been times when clients have sought to deliver everything for the cheapest cost, however, over time, an appreciation of quality has led to a more balanced approach. The last decade has seen a dramatic increase in the use of natural stone in UK cities partly due to the availability of competitively priced stone imported from China and India but also the need to achieve best value. Natural stone is in the main still more expensive than man-made alternatives if only supply costs are compared, however this saving is only a short-term advantage when life time costs are considered.

There are natural stone pavements in the historic areas of our towns and cities that have endured 80 – 100 years of use and retained a good appearance. Today stone pavements are structurally designed to achieve a design life of 40 -50 years and will perform well for this

duration. After this time, it will be possible to reconstruct the pavement using the same stone, reclaimed from the street, saving costly import of new materials. By comparison a man-made product is more likely to lose its aesthetic appeal after 10 -20 years. Selection of an initially cheaper product will therefore lead to repeated construction work requiring client and designer costs as well as contracting costs and disruption to local businesses. The decision to select natural stone may save the upheaval and cost of three to four scheme restorations. A costed example is included as appendix (i)

Townscape fashions come and go and improvements in technology and innovation bring a need for change. The adoption of a simple natural stone palette with a minimum of pattern is timeless and will not date. Whilst the design life of the pavements may be 40 -50 years, there is inevitability that lighting, planters, public art and street furniture may change several times during this duration to update the street scene.

A simple and well-designed natural stone palette makes for ease of maintenance. Planned maintenance will include re-grouting during the design life of the pavement and regular cleansing in prestigious and heavily used areas. This is likely to include both street sweeping and washing, and the removal of chewing gum. Sawn and flamed natural stone is capable of being cleaned of grime and gum more cost effectively than heavily textured man-made alternatives.

4.The Economic Benefit of high-quality public realm works

Although it is pleasing to improve the visual environment for aesthetic reasons, the principal driver which will attract financial support to any project is to improve the functionality of a place and to bring economic benefit. All towns and cities now compete with each other, be it for regional and national tourists or as a shopping destination. The number of visitors and how long they choose to spend at the chosen destination both affect local spend and therefore impact on the local economy. In addition, a positive experience and enjoyment will ensure repeat visits. There are many factors which come together to make successful places and an increasing amount of work has been undertaken to show that good urban design and streetscape improvements can make a significant impact. There are several papers which give wider support for the economic benefit of public realm works and give credit to the use of natural stone materials. (all referenced in appendix ii)

'Paved with Gold' (Cabe Space 2007) examined the extra financial value that good street design contributed over average/poor design. It concluded that better streets result in higher market prices. In London an achievable improvement can add an average of 5.2% to residential prices and 4.9% to retails rents. Good design was defined using the PERS system of assessment of the pedestrian environment which identifies high quality materials as a significant element in high quality streets.

‘Better Streets’, the Mayor of London’s street manifesto in 2009, included several guiding principles including ‘Go for Quality’, a plea to adopt materials of the highest quality and durability that could be afforded. The manifesto also urges designers to avoid over elaboration in a similar way that Liverpool’s framework sought to deliver a simple floor plane.

Places Matter!, the North West’s regional Architecture and Built Environment Centre commissioned research on the ‘Economic value of urban design’ in 2007 updating it in 2009 to address the issue in light of the economic downturn.

Their findings state that there is strong evidence that economic, social and environmental returns increase with better design finding an increase of up to 20% in rental and capital value. They state that high quality design generally reduces the whole life costings of a space and helps to stimulate the wider regeneration of an area and improve its image. They conclude that a high quality, well managed public realm is crucial and can contribute significantly to economic returns. Their update study in 2009 particularly identified a role for the public sector in keeping high standards and their case study analysis suggested that good design could help schemes to weather the effects of the recession.

The Landscape Institute’s document ‘Invest in Landscape’, extols the benefits of landscape improvement to the economies of towns and cities. It cites improvements to The Square at Barnstable as a good example. Here granite was chosen as a durable material in the creation of a new square. Increased footfall in the area saw visitor numbers at the adjacent museum grow from 50,000 to 80,000.

Transport for London have been developing work in this area over recent years and have recently published on line a toolkit for valuing public realm. www.tfl/urbandesign . This easily available resource allows any design and client team to input their data and see the anticipated benefits of improvements.

Fig 4. Lord Street, Liverpool busy with shoppers investing in the city’s economy.

5. The Sustainability of using natural stone

Clients wish to deliver projects which are sustainable from all view points. Government funding bodies have made sustainability a requirement of grant schemes for over a decade to ensure delivery of UK sustainable development policies and targets. Their methods of scheme assessment and scrutiny of scheme impact on sustainability have become more sophisticated with sustainability checklists and toolkits becoming the norm. It has become imperative to reduce carbon and waste and to provide on the job training places as just a few examples.

CEEQUAL is the Civil Engineering Environmental Quality Assessment and Awards scheme that is improving sustainability in civil engineering and public realm projects across the UK and is likely to be a future requirement of grant schemes in the same way that BREAM has for buildings. It is administered by CIRIA. The scheme is based on a self assessment carried out by a trained CEEQUAL assessor, usually part of the delivery team and is then externally and independently verified by a CEEQUAL appointed verifier.

The scheme recognises the attainment of Good, Very Good and Excellent environment and social practice in civil engineering and public realm projects. CEEQUAL complements a client's economic benefit analysis/business plan to give a full picture of the three-legged model of sustainable development which seeks to achieve economic, social and environmental success at the same time.

The assessment process is undertaken by completing and providing evidence against a wide range of questions which are tailored by an initial scoping exercise to meet the needs of an individual project. The categories covered include project management, land use, landscape, ecology and biodiversity, historic environment, water, energy and carbon, materials use, waste, transport and effects on local communities. The assessors score the project using the CEEQUAL manual and are verified by the verifier before ratification by CEEQUAL.

The choice of natural stone helps promote a high score in several CEEQUAL assessment questions:

- The modular nature of paving and setts, combined with good design, reduces waste of resources.
- The ability to re-use natural stone in the future is a benefit.
- The durability of stone and its ability to extend the life of pavements and other structures scores highly as it avoids the environmental impacts associated with later refurbishment.
- The consideration of long-term issues and future maintenance of the paving enables demonstration of a whole life approach to the schemes project management.

- Stone enhances the historic environment.

There are other areas in the assessment where natural stone may fail to score highly. For example, in areas of carbon reduction when transported long distances. The benefits of transport by sea, using significantly less energy than road and rail, may provide some mitigation.

The evidence gathered on a public realm scheme is varied and often complex and there are many schemes utilizing natural stone that have been able to achieve a high CEEQUAL score. A review of recent public realm awards gaining both Excellent and Very Good includes several using natural stone demonstrating its contribution to delivering high quality sustainable environments.

These include –

- Princess Royal Square, Weston Super Mare – CEEQUAL Very Good. 'Granite chosen for longevity'.

- Sunniside Public Realm, Sunderland – CEEQUAL Very Good. 'Natural stone chosen to maintain the character and conservation status of the area'.

- Swindon Canal Walk and Regent Street Enhancement – CEEQUAL Excellent. 'High quality locally sourced natural stone paving from Forest of Dean. 'use of good design, detailing and high-quality materials which will stand the test of time and people will value and want to use and care for'.

- Derry Centre Public Realm – CEEQUAL Excellent. 'High quality paving in granite and Caithness stone were used to reflect patterns from Derry's 19th century textile industry.'

- Belfast City Centre Streets Ahead 2010 CEEQUAL Excellent. 'All paving replaced with natural stone selected for durability and long design life.'

When China and India first became popular as a source of competitively priced natural stone, concern was expressed about responsible procurement. This was both in relation to transport and its carbon footprint and moral issues for examples working conditions in stone quarries, the use of bonded and child labour and exploitation by poor wages. Reputable companies like Marshalls PLC have been at the forefront embracing ethical procurement and human rights and signing up to initiatives like the United National Global Compact and Ethical Trading Initiative. Marshalls have been a Full Member of the ETI since 2006 showing a continued dedication and commitment to its ethos. They have worked with their local suppliers to ensure appropriate environmental management systems are in place and have developed best practice standards for health and safety as well as paying a fair

wage. The export opportunities for natural stone must be recognised as a benefit to the development of these countries and their economies to the benefit of all.

6. Conclusion

A current tour of successful UK cities would provide a wealth of examples of the use of natural stone to achieve high quality improvements to streets and squares. It has been used across the land from Trafalgar Square to the Market Square in Nottingham to Sheffield's Gold Route, from improvements in Whitehall to Newcastle's Grainger town and Liverpool City Centre amongst many, many others. Clients and designers alike have made the wise decision to invest in natural stone to achieve a high-quality look which is functional and has a long design life with low maintenance liability. National design and construction awards for streetscape applaud these achievements and should give confidence to any client to follow the same path and achieve the best for their own public realm and the people of their community.

A case study of the implementation of Liverpool's City Centre Movement Strategy and detailed case studies for three Liverpool projects utilizing natural stone follows.

Liverpool City Centre Movement Strategy Case Study

Between 2004 and 2011 Liverpool City Council implemented a 73 million programme of street and public realm works as part of its City Centre Movement Strategy (CCMS). This strategy aimed to aid the City's economic regeneration and to improve access for all users whilst also supporting the improvement of city centre architecture and townscape. The strategy supported a 'golden triangle' approach whereby improvements to movement, public realm and development were all closely integrated. In parallel significant new areas of public realm were created by the private sector, including the development of Grosvenor's Liverpool One mixed use development. The city centre as experienced today is dramatically different. It is a city which now attracts international visitors and has moved up the UK's retail destination chart from fifteenth to fifth place. (ref CACI; 2010)

Design Philosophy

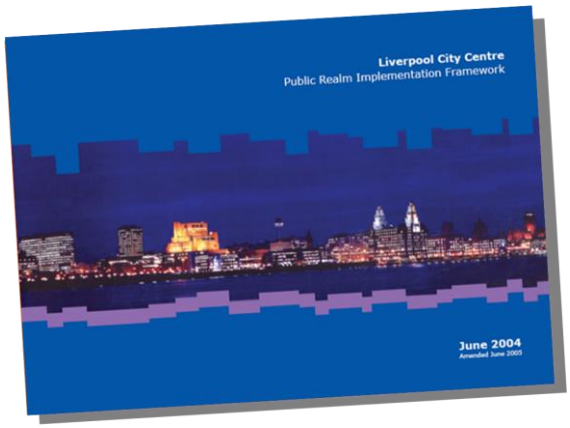

Fig.i. Liverpool Public Realm Implementation Framework document

At the outset of the programme the Liverpool City Centre Public Realm Implementation Framework (PRIF) was developed by Liverpool as a guide to ensure a coordinated, high quality approach to streetscape design and materials selection. Its use both for public projects and private developments ensured a joined-up methodology ensuring that separate developments all join together in a gigantic jigsaw puzzle to create a coherent whole with a well-defined local character. The PRIF document has been recognised as best practice receiving both national and regional awards.

The first part of the PRIF document laid out a vision for the creation of dynamic streets and spaces that were fit for purpose, adaptable and which create visual delight. The vision for the floor of the city was for a simple carpet which sets off the rich and diverse architecture both modern and historic. The vision strived to avoid complex pattern making and deliver a simple and timeless elegance. The strategy developed a hierarchy of streets in the city centre which then influenced the scale of paving materials adopted. Individual policies for subject areas like art, street furniture, lighting and greening were well developed and sought to keep street clutter to an absolute minimum.

The second part of the document detailed a performance specification for the floor of the city and contained material palettes for paving and other streetscape elements. Whilst the choice of paving stone colour and sizes was strictly controlled for streets, designers were however allowed flexibility to choose other materials in city squares. This approach encouraged innovation and the creation of distinctive spaces like Williamson Square. This has huge monolithic granite blocks and a dynamic fountain surrounded by a poem in stainless steel lettering laid into granite. The scheme provides an excellent example of designers, contractors and suppliers working together to achieve excellent results with natural stone.

Fig ii Photo – Williamson Square fountain text detail

In selecting materials and construction techniques Liverpool were determined to adopt a paving palette which was robust. It needed the ability to be easily cleaned and retain good appearance with low future maintenance costs. The team looked to other UK cities, Europe and beyond for examples of best practice. Natural stone was selected as a preferred material for its durability and good looks and to complement its historic use in the city with a preference for granite to reflect the historic granites used around the docks and sandstone around the cultural quarter. A secondary and tertiary palette of coordinating, cheaper, paving materials were also chosen to keep a similar look away from the prestigious city core. The materials choice for road kerbs remained as granite as this was considered part of the street's structural integrity.

Liverpool set up a multidisciplinary project team to deliver the programme with both engineers and landscape architects working together to form an educated and critical client ensuring good design and detail at the heart of all projects. All projects commenced with the production of an effective project design brief which advocated that landscape architects should lead the master planning stage of any scheme with engineers leading once an outline design had been agreed. This ensured that the place making principles were well developed and that the build ability and construction issues were rigorously addressed. Public realm designs were developed through a series of design workshops with involvement from a wide range of professionals as well as Council members. All designs took cognisence of the Public Realm Implementation Framework.

Delivery

With such a large programme it was economic for Liverpool to set up a framework of three contractors to implement the works which also allowed for very valuable early contractor involvement during the design stage to help with material sourcing and build ability issues.

Working in a city centre was not easy and regular and lengthy liaison was undertaken with local business in addition to other public consultation to ease disruption. The feedback from the public and businesses at consultation events and from general emails and correspondence was favorable in relation to the use of natural stone. It was felt important by the client to avoid cost cutting and adoption of a cheaper palette in the city centre core to retain a consistent high standard. The private mixed used scheme at Liverpool One used consistently natural stone making it imperative to surface the adjacent main public high street in similar to avoid creation of a second-class ambience which could have affected trade in a negative way.

Before embarking on the CCMS programme a workshop was held, inviting a range of officers including engineers, landscape architects and maintenance engineers and the city centre manager, to identify lessons which could be learnt from recent street works in other areas of the city. Several important outcomes influenced future design standards and project management approaches. One significant decision was the adoption of a 'rigid method of construction' for many areas of both natural stone setts and flag paving (i.e. they were laid on a concrete sub-base). This was driven by several factors.

Firstly, to create a clean city centre it is vital for regular street washing to be undertaken in areas of high night time activity and for any paving specification to be robust enough to withstand this. Previously street washing had removed all sand jointing material from areas of existing block paving creating further maintenance problems.

Secondly, it was recognised that city centre streets and spaces need to be adaptable. One day a street or square may be wholly used by pedestrians, but it may also need to house a market or a funfair or music stage for outdoor events making it highly desirable to design for vehicular use at the outset to prevent the use of a proliferation of bollards to separate vehicular servicing routes.

Fig iii. Williamson Square in use for an urban beach and for the music festival

Thirdly, vehicular over-run of kerbs was recognised as a regular problem so it was decided to lay the first metre back from kerb edge on concrete to ease future maintenance.

In 2004 British Standard BS 7533 on trafficked natural stone pavements was still under preparation so standards were adopted from the SCOTS guide after joint working with officers in Scotland and visits to Glasgow where a programme of natural stone street improvements was already well advanced.

The use of a rigid method of construction has led to an easily cleaned and robust product capable of heavy vehicular use. The disadvantage of the chosen method has been the difficulty for Statutory Undertakers to access their equipment for repairs as stone and concrete are often broken in the excavation process. To mitigate against this, Liverpool's own maintenance partner is now often used for repairs as they have the advantage of a stockpile of relevant material and can provide quicker response times achieving a repair in natural stone without lengthy ordering and delivery delays.

In 2010, Liverpool decided to embrace CEEQUAL and 17 client officers, engineers and contractors trained and qualified as CEEQUAL assessors. It was decided that all new public realm projects would be registered for the whole project award. These schemes have yet to be fully assessed and verified though an initial internal assessment suggests that the first scheme should achieve CEEQUAL Very Good.

Programme Evaluation

The CCMS public realm works used natural stone as its primary surfacing material for pavements and for shared use /pedestrianised streets. The city has a whole new ambiance as a result and the quality of its streetscapes provides a fitting setting for its wealth of fine architecture. The streets are easy to keep clear of litter and to be washed on a regular basis. The chosen rigid specification allows for a variety of uses which enliven the city centre

including Christmas markets and erection of the big wheel fairground ride as well as setting up stages to host Europe's largest annual free street music festival in August.

In 2008, Arup undertook an evaluation of the Liverpool CCMS programme to evaluate its economic benefit. It was credited with making a significant contribution towards the regeneration of the city centre in the run up to 2008 the Capital of Culture year. The initiative had met its aims of improved accessibility and had created a people friendly place that was safe, clean and attractive, improving city centre architecture and townscape. It was credited with creating 1,000 new jobs in the retail/visitor economy and had helped the city achieve significant progress as a visitor and shopping destination. The scheme had been sustainable, improving access to jobs and services for those walking and by public transport improvements. It had created places that felt safe to use and new lighting had helped with crime reduction. It was judged to have delivered value for money to date. In particular the report highlighted areas of best practice achieved by the programme-

- It had promoted wider economic development
- It had complemented the Liverpool One project in order to avoid concentrating gains made in one area at the expense of the rest of the city centre
- it had been flexible in the programming of projects to maximize impacts
- It illustrated a successful and joined up approach working across several organsiations responsible for different areas of the city centre

The programme's achievement in terms of attracting some £80m funding and securing some twenty national and regional awards is another testimony to its success. These included recognition by the Landscape Institute for design and master planning, several LGN streetscape awards and Institute for Highways and Transportation NW best practice award. The Pier Head public realm and canal link scooped fourteen awards including a British Construction Industry award, the RIBA/CABE space award and an award from Stone Federation Great Britain.

The Liverpool City Centre Public Realm Implementation Framework has recently been updated to reflect lessons learnt during the CCMS programme.

Liverpool City Council's winning application for the Landscape Institute urban design award 2008 is available at www.liverpool.gov.uk.

Appendix (i) Paving cost comparison Jan 2012

A comparison of costs is made for a 100 metre length of street with a 3m wide pavement on either side. i.e. 600m2. The costs for using concrete; granite and sandstone are compared over a 60-year period. The following assumptions have been made -

(i)All installation is rigid on modified a mortar bed with mortar joints.
(ii)All flag sizes to be 600x900mm
(iii) All flags have a depth of 63mm
(iv) Installation is on a concrete base for a standard pavement. Costs include materials, labour and 20% preliminaries**.**

Material choice	**Cost £ per square metre**	**Cost £ for 600 square metres**
Mid grey granite flag	**150**	**90,000**
Dark grey concrete flag	**95**	**57,500**
Scoutmoor Yorkstone flag	**185**	**111,000**

It is assumed that natural stone has a design life of 60 years.

The implementation cost plus re-pointing of flags (assume 15 per m2) twice gives a total cost of £99,000 for granite; £120,000 for York stone.

By comparison it is assumed that the concrete flag design life 20 years; so, in 60 years will require implementation three times. This gives a total cost of £172,500 ignoring significant inflation costs over the period and the cost of disruption to businesses, residents and visitors.

The conclusion is that natural stone provides better value for money. Also, after 60 years the stone can still be re-used whereas the man-made material will have utilised three times the amount of material resources.

Appendix (ii) References

Economic Benefit

Paved with Gold - the real value of street design. CABE Space 2007 http://webarchive.nationalarchives.gov.uk/20110118095356/http:/www.cabe.org.uk/publications/paved-with-gold

The Economic value of urban design. www.placesmatter.co.uk

Transport for London - Valuing public realm toolkit. www.urbandesign.tfl.gov.uk/

Better Streets 2009 www. urbandesign.tfl.gov.uk/

Why Invest in Landscape? www.landscapeinstitute.org/invest

Sustainability

Marshalls – 'The truth about imported sandstone'. www.marshalls.co.uk in sustainability section

Marshalls 'in India behaving ethically' as above.

www. CEEQUAL.co.uk On line workbook and assessment tool.

Liverpool Case Study

Liverpool Public Realm Implementation Framework 2004 (PRIF) & Landscape Institute award application for CCMS can be found at www.liverpool.gov.uk/council/strategies-plans-and-policies/transport-and-streets/city-centre-movement-strategy

Evaluation of Liverpool City Centre Movement Strategy 2008. Arup