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ABSTRACT

Train stations are places of connection in our cities and are the gateways of urban space. They represent one of the most exciting places to experience. Some stations make great destinations offering shops, restaurants, museums and exhibition spaces to commuters. While new architecture at railway stations acknowledges heritage, the urban spaces around them provide excellent public areas and rationalise functional needs. Grand spaces with monumental structures, including constant movement of people and trains makes for an exhilarating experience. Modern or historic, great train stations add another level of excitement in the regeneration of our cities. Adding into the mix of the sustainability paradigm, place making of railway stations transforms into sustainable urban centres and signature architecture, but how does it support an environmentally sustainable future? This paper reflects the journey of exploring the challenging situations of balancing the requirements between historic, operational, functional, economic and innovative sustainable design solutions during the Flinders Street Station Design Competition in Melbourne. The author highlights how the unique spatial, social and cultural circumstance of this world-renowned city railway station possesses specific resilient and sustainable design answers to a public realm and city space that challenges established thinking.

Keywords: Railway Station Design, Sustainable Design, Regeneration, Sustainable Urban Centres, Public Spaces, and Signature Architecture.

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Introduction

"Since the world's first railway station, Darlington, opened in 1826, stations have always maintained a special place in the public's affection. The lure of the great railway terminus has always been especially strong: the breathtaking grandeur, swagger and opulence of the architecture inextricably fused with the dizzying prospects of adventure, romance, escape or challenge offered by far-flung destinations." - Steven Parissien (Parissien, 2001)

Figure 1: Flinders Street Station, Melbourne (Image source: Lauder, Matt, 2013)

Rail transport infrastructure, especially railway stations, significantly contributes to the quality of life, sustainability and economy of urban centres. Station buildings play a major role in efficient and vibrant places, and are at the forefront of innovation and modernity; after all, many great civilisations in history have used infrastructure prowess as a symbol, as well as a function (SKM, 2012).

These train stations hold high symbolic value and are central to the life of many people across all sections of society. During the planning, design and construction of railway stations and its wider related infrastructure, direct and indirect wider impacts (positive or negative) must be considered to ensure that all opportunities are exploited. Stations also support a sustainable urban form (Barret, 1996).
Benefits can be grouped in five broad categories: quality station design, quality urban design, urban integration, environmental sustainability and economy. These categories sit at the core of the design and development process for the changing of Flinders Street Station into a sustainable urban centre of Melbourne.

Quality Station Design

All over the world railway stations, transit centres and transport interchanges are evolving from functional spaces and buildings that conveyed symbolic values of their city and society, to new vibrant and active urban centres and destinations. As well as being transport hubs, these stations generate high footfall past commercial activities creating life and vitality (Roös, P. & Juvara, M, 2012)

The design of a railway station needs to be sensitive to the local surrounding urban area, incorporate practical environmental sustainable design elements to the building and the landscaping, and provide the functional services and amenities for daily commuters to enjoy their travel experience. In any community, the railway station is an important piece of public infrastructure which impacts directly on people’s decisions to use public transport.

It is, therefore, important that it provides a high quality environment which is legible, safe, sustainable and attractive. The design approach thus considers key criteria for the successful design and delivery of the railway station and need to include the following key principles:

- Efficiency - Station Functionality;
- Integration - Passenger flows;
- Safety - Passenger safety and security;
- Place Making - Station forecourt and Station design; and
- Connectivity - Accessibility and interchange

Quality Urban Design

While new architecture at railway stations should acknowledge heritage, the urban spaces around them provide excellent public areas and rationalise functional needs.
Station buildings play a major role in the urban spaces and public realm (Bertolini, 1998).

The same level of thought that goes into the architecture of the station, type of trains, the fitting of carriages and the graphics, needs to be employed for fixed infrastructure in the rail environment.

The public realm elements such as landscaping, walkways, roads, bridges, elevated track-structures, and sound barriers are critical components to be considered in quality urban design (Bournet, 2001). The architectural language of these elements, and its appropriateness to the location, are paramount (Roös P. & Juvara, M, 2012). The holistic integration of all these elements will provide for a development that results in an urban environment with “sense of place” (Ahmed, 2001).

**Urban Integration**

Urban integration involves the correct inter-relation between the railway station infrastructure and the urban space that it occupies. It recognises the specificity of the location: its structure, functions, movement needs and, very importantly, character. With due consideration of engineering feasibility, different alignments, or positioning within the urban space (side or centre of a corridor for example) can generate different urban solutions (Vuchic, 2005).

Ground floor, building fabric and landscape treatment of surrounding spaces is also integral to the design, so that the value added of the new rail station, and the rail corridor is maximised (SKM, 2011). Opportunities for development must be identified, and design guidance prepared to take advantage of the transport corridor (Roös P. & Juvara, M, 2012).

**Environmental Sustainability**

Station and transit buildings have a long operation life, and are interconnected with their urban environment. These projects leave behind a legacy long into the future. It is thus extremely important to provide environmentally sustainable outcomes, and consider mitigation of environmental impacts, especially on-going impacts, and the direct link between the rail project and the communities that it will serve. It is also essential to pre-empt any future adaptation of station buildings and infrastructure against possible changes to the climate. The outcomes of the sustainable station design solutions will continue long after construction is completed, and potentially may
have a visible, positive impact throughout the whole life of the station and transport corridor assets.

**Integrated Sustainable Design**

It is well known that the built environment, including associated transport infrastructure and services, makes a major contribution to greenhouse gas emissions worldwide and that the development of more sustainable cities and infrastructure is essential (Jabereen, 2006). For railway station design, the design team needs to understand the symbiotic relationship which rail projects and transit centers have with the built environment. Design needs to acknowledge that sustainable transport is core to creating cities that are liveable, walkable, and sustainable, whilst also providing a higher quality of living. These aspects are used as basic principles to inform an integrated sustainable design methodology.

Applying lessons learnt from recent projects demonstrating these principles of sustainable design is the Regional Rail Link project (RRLA, 2011), Melbourne Metro Underground Rail Study, and the Rowville Rail Link Study (DOT, 2012). These projects include the development and implementation of an Integrated Sustainable Design Method (Roös, 2011).

**Economy**

The global economic crisis has prompted two parallel debates about the nature and workings of urban areas. In battered Western economies, consumer spending has rapidly decreased and Governments no longer promote shopping as the goal of a strong society (Roös P. & Juvara, M, 2012). In parallel, new studies on urban societies are focusing on subjective aspects of ‘Quality of Life’ and well-being, which include sense of belonging, community and other indicators that point to urban identity (Girardet, 1992).

Urban centres are key to identity and social interaction of the city, they are the places that give their name to whole communities, as well as play the important role of a stable local economy (Williams, 2000). Strong centres play a key role by creating necessary focal points at the urban scale, and connect spaces to living communities (Alexander, 2002).
A new way to sustain urban centres as community places is the development of railway stations as sustainable urban centres, providing a breath of functions beyond the transport system (Vaughan, 2009). Stations link the high-density urban environments where walkable communities can flourish in a social, and economic positive outcome (Elkin, 1992). The regeneration of Flinders Street Station in the CBD of Melbourne provides for this opportunity of creating a sustainable urban centre.

**The Opportunity: Flinders Street Station**

The first railway line built in Victoria was a suburban railway from Melbourne to Port Melbourne in 1854, and on this line the Flinders Street Station, Australia’s first city railway station was built as a result of an architectural competition held in 1899 (Ward, 1982) (Davies, 2012). Today the station is the city’s central transport hub and a much loved Victorian landmark. Constantly visitors to Melbourne will photograph the distinctive corner of the station with the ‘clocks’ under the dome, which has become an iconic image of Melbourne (MPV, 2011). It is also a landmark in continuous operation as a station, protected and valued for its ongoing use as both origin and destination for most suburban train services.

The station plays a vital role in the urban context of Melbourne. It is located in the city as such that a central position links the city, the precinct north of the Yarra river with Southbank’s arts precinct, to the east Federation Square, Birrarung Marr Park, and on to the sports and entertainment precinct (Davies, 2012). This location provides the opportunity to design new functions to revitalise place and introduce new activities, such as a potential transport theatre and design library centre as indicated in Figure 2.
Recently the opportunity to redevelop this station was realised when the State Government of Victoria, Major Projects Victoria, launched a staged design competition seeking innovative design proposals that will reinvigorate the historic Flinders Street Station, improve its transport function and unlock the urban design and development potential of the precinct (MPV, 2011).

The required overall objectives for the regeneration of the station are (MPV, 2011):

- Upgrade the station to its former glory, in the tradition of other great cities around the world, as a Victorian and international icon and a focus of the Melbourne Central Business District (CBD);
- Restore and protect the Administration Building and other heritage elements to include adaptive re-use of areas that have high public interest, such as the ballroom, to be accessible to the public;
- Improve all aspects of the transport function of the station and adjacent transport modes and cater for significant growth in transport patronage;
- Better integrate the station with its surrounding precincts, such as Federation Square, providing better linkages between the CBD and the Yarra River;
- Better utilize the land adjacent to rail and air space above rail on the western portion of the site;
• Provide significant civic space while allowing for a distinctive and memorable architectural outcome with a mix of uses; and
• Provide a value-for-money solution capable of being (at least partially) self-funding.

In a complex operating rail environment, the achievement of the above objectives is a challenge, as well as very difficult to incorporate in a design solution. Adding the aspirations of achieving high environmental sustainability targets compounds on the complexity, and requires a carefully planned integrated design process and method.

**The Method – Integrated Sustainable Design**

Complex processes and challenges are involved in the incorporation of sustainability initiatives into the design of railway stations and their related transport infrastructure and the urban precinct. For sustainability to be successfully integrated, the objectives and requirements for Environmentally Sustainable Design (ESD) must be considered at a very early stage in any railway station project. This requires an integrated design approach. The approach has two key features. Firstly, the whole design team is committed to the opportunity to be involved and actively contribute to achieving sustainability requirements, and secondly, design decisions will embed sustainability which will be carried through to the construction stages of the project and have long term whole of life sustainable outcomes. Design decisions consider sustainability as an holistic approach, and by using the Integrated Sustainable Design Methodology, as demonstrated in Figure 3, sustainability outcomes consider economic, environmental as well as social principles.
**Application of the Method**

Using the Integrated Sustainable Design Method (Roös, 2011), and to deliver effective solutions that integrate environmentally sustainable principles throughout the life cycle of the Flinders Street Station project, the competition entry design team included as fundamental inputs to all design decisions the following design principles in the architecture, building, engineering and urban design (John Wardle Architects - Grimshaw, 2013):

- **Holistic approach** - identify the urban context with key requirements in relation to ecology, biodiversity corridors, green landscape and local environment;
- **Integrated Environmental Design** - Passive design, solar optimization, thermal and local climate responsive, adaptive design;
- **Resilience** - Climate change impacts and future changes in environment;
- **Energy Efficiency** - Efficient local energy and renewable energy design solutions, net zero energy buildings, including a local centralized CCHP (Combined Cooling, Heating and Power) energy center;
- Materials - Materials selection to minimize toxicity;
- Waste efficient strategies, recycling and re-use;
- Water Conservation - Water efficient design, recycling options, rainwater harvesting, systems to avoid runoffs (demonstrated in Figure 8 below);
- Economy - Whole of life thinking, life cycle analysis and sustainable whole life costing, value for money solutions;
- Constructability - Efficient construction options and minimize waste; and
- Delivery - Sustainability principles can only be implemented from design through construction if it is supported by a robust Sustainable Design Strategy.

**Sustainable Design Outcomes Flinders Street Station**

The integrated sustainable design considers a holistic environmentally sustainable outcome that is embedded in the Flinders Street railway station on a precinct wide scale. The proposed design solution, considering the brief from Places Victoria, included functional, transport, operational, heritage and urban integration requirements. Response to the brief from the John Wardle Architects, Grimshaw and SKM competition entry team, included in the design environmental sustainability considerations. The design results in integrated sustainability with the potential achievement of a Regenerative Net Zero Energy Building Precinct (RNZEBP), demonstrated in Figures 4 to 7 below. The vision for the project is to include aspirational outcomes for targeting a 6 star rating under both the Green Star Communities Tool and the potential new Green Star Custom Tool for Railway Stations.

To achieve best practice sustainable design outcomes, the whole design team was involved establish best for project sustainability targets. The design response uses passive bioclimatic inspirations, using nature as teacher in building design and results in the integration of passive thermal labyrinth ventilation, climate responsive facades, and intelligent environmental building systems. The consideration of these passive bioclimatic principles is paramount in local sustainable design practice (Hyde, 2008).

Opportunities for water efficiency as well as innovative technology for energy harvesting are included. Innovative design solutions includes a regenerative-net zero energy precinct, aspiring to be carbon neutral through the inclusion of a centralized energy centre utilizing combined cooling, heating and power technology for all buildings, including the track side energy storage initiative from regenerative braking of trains.
Figure 4: Central Energy Centre (Source: Grimshaw / John Wardle Architects / SKM, 2013)

Figure 5: Trackside Energy Recovery System (Source: Grimshaw / John Wardle Architects / SKM, 2013)
The design philosophy is underpinned by a cradle to cradle approach, considering a whole-of-life outcome which will not only result in a precinct that performs in an energy efficient and ecologically manner, but also translates into a precinct with a railway station and buildings that considers the minimisation of waste and includes better functionality with extended sustainable outcomes in the reduction of maintenance and operational costs.

Figure 6: Kinetic Energy Harvesting (Source: Grimshaw / John Wardle Architects / SKM, 2013)

Figure 7: Solar Photo Voltaic PV Panels (Source: Grimshaw / John Wardle Architects / SKM, 2013)
Conclusion

Train stations are places of connection in our cities and are the gateways of urban space. This paper argues strongly that stations are places of high symbolic value, railway stations have the potential to be centres for urban communities, initiate activity that in essence provides the three pillars for sustainable development, supporting social, economic and environmental outcomes. Adding into the mix of the sustainability paradigm, place making of railway stations can be transformed into sustainable urban centres and through signature architecture be the symbolic representation of community culture.

The Flinders Street Railway Station has the opportunity to be a catalyst as a strong city centre and can strengthen its key role as a necessary focal point at the urban scale, and connect the surrounding spaces to a living central precinct. The Flinders Street Railway Station can act as a catalyst for creating an urban park in the centre of Melbourne, demonstrated in Figure 9 below. Considering the opportunities for
integrated sustainability opportunities for the station precinct, the Flinders Street Railway Station redevelopment can set new benchmarks for environmental sustainability. This opportunity created by the redevelopment of the Flinders Street Station into a Regenerative Net Zero Energy Building Precinct should not be wasted.

Figure 9: Central Elevated Park - Flinders Street Station (Source: Grimshaw / John Wardle Architects, 2013)

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