CORE 2016 MELBOURNE:

MELBOURNE'S 50 NEW GRADE SEPARATIONS - DESIGNING THE NEW STATIONS FOR THE FIRST FOUR GRADE SEPARATIONS: BURKE, NORTH, CENTRE, AND MCKINNON ROAD

Jonathon Parker

Rail Team, Arup, Melbourne, Australia

Corresponding Author: Jonathon.parker@arup.com

SUMMARY

This paper describes the design of four new stations in Melbourne's metropolitan railway network. All four stations are to be rebuilt in order to allow for the removal of busy level crossings at nearby roads. The four new grade separations make up the first package of works to be delivered as part of the Victorian State Government's strategic plan to remove 50 level crossings across Melbourne by 2022.

This paper focuses on how the station design team, consisting of Arup and Grimshaw Architects, tackled a number of the key design challenges that have significantly influenced the final layout and form of the station.

The process of design is an evolutionary one. With many more grade separations planned in Melbourne over the coming years, this paper hopes to capture a number of the key station design learnings that may be applied on similar projects in the future.

1 INTRODUCTION

Level crossings are considered by many as both dangerous and inefficient. Congestion caused by levels crossing constrain the capacity of both the road and rail network. During the AM peak on Melbourne's worst railway lines, boom gates can be down for as much as 15-20 minutes at a time[i]. Not only do level crossings delay traffic, they limit Public Transport Victoria's (PTVs) ability to run more frequent train services on the network.

In late 2014, the newly elected State Labor Government announced a massive programme of level crossing removal projects. By 2022 the State had committed to removing 50 of the most dangerous level crossing on the Melbourne network[ii]. Of the approximately 50 level crossings identified, a large number of these are located next to existing stations. Thus in many cases removing the level crossing effectively means rebuilding or significantly modifying the nearby station.

Figure 1: Level Crossing Removal Project – each red dot represents a proposed new grade separation

In mid-2015 the newly formed Level Crossing Removal Authority (LXRA), awarded its first package of works, combining two tenders into one contract. The four grade separations consisted of Burke, North, McKinnon and Centre Roads. The four nearby stations comprised of Gardiner, Ormond, McKinnon and Bentleigh Stations respectively

The project is being delivered by an alliance model comprising the members from; LXRA, VicRoads, PTV, MTM, John Holland (contractor) and KBR (lead consultant). For the purposes of this paper the project shall be referred to by the acronym BNMC so named after each of the four grade separations.

Although rail projects and level crossing removal projects in particular rely heavily on well integrated multi-disciplinary, multi-party teams, the station design has been led by Arup with Grimshaw appointed as architects. Urbis have been engaged as landscape architects at the stations and across the broader rail corridor.

The design philosophy and principles adopted on BNMC builds on the design teams experience on other past projects. Arup, in many cases working alongside the same partners as on BNMC, have undertaken design for a number of new or upgraded stations in the Melbourne metropolitan region in the past five or so years. These include Nunawading, Mitcham, North Melbourne, South Morang, Epping, Ringwood, Cardinia Road and Lynbrook Stations[iii].

In particular, the design team has drawn on their experience on Mitcham Road Grade Separation, a project with many similarities to BNMC including; the same core delivery team (John Holland, KBR, Arup, Grimshaw), a similar delivery, and a similar road / rail arrangement comprising the lowering of the rail into the cutting.

Each of the four new stations share many features in common. All stations share the same basic arrangement consisting of the main buildings and station entrances located on a concourse that straddles over the rail cutting. Platforms are therefore located down within the cutting and are connected by a range of vertical transport options consisting of a combination of lifts, ramps and stairs. Ormond Station is the only exception to this, instead of a ramp the station layout provides for a second entrance and a second pair of lifts.

Stations share a similar architectural language. Features such as perforated metal panels have been used for screens along ramps, stairs and the back of platforms. Vertical fins evenly spaced along the perimeter of waiting rooms and bike storage shelters have been provided at each station. Canopies over the concourse area are perhaps the main architectural statement. The design varies at each station but consistencies of colour, form and style appears throughout.

Functionally each stations differs considerably. Gardiner Station is situated on the Glen Waverley Line, and has a conventional two side facing platforms. Ormond, McKinnon and Bentleigh by contrast are all located on the Frankston Line. The Frankston Line contains an additional third track to accommodate an express train service. This has resulted in three platforms at each of these stations, one side facing in the down direction and two platforms incorporated into an island configuration.

Furthermore, Gardiner and McKinnon Stations are 'Local' stations, Ormond is a 'Host' station, while Bentleigh is a 'Premium' station. The classification reflects the varying importance and patronage of each of the stations and is discussed in more detail in Section 3.4 Station Facilities.

Figure 2: Ormond Station–to be rebuilt as part of the new North Road Grade Separation.

2 KEY FEATURES FOR STATION DESIGN

Although each station is different, there are a number of features that have significantly influenced the form upon which the final design has taken shape. This section of the paper discusses three of these features; platform layout, vertical transport and station concourse.

2.1 Platform Layout

The platform layout, and in particular platform widths, was a key parameter when establishing the overall footprint of the station. The design team on BNMC sought to optimize the overall layout ensuring the footprint remained within the rail corridor whilst maintaining safety for the patrons and adequate room for future patronage forecasts

As is typical for stations in railway cuttings, the design team needed to allow for a number of additional constraints that further reduce the effective width of the rail corridor when compared with the existing station at grade. These included the need for retaining wall profiles, barriers to prevent vehicles entering the cutting and the provision of buried services at surface level.

Another consideration was the need for the platforms widths to conform to modern design standards. The existing stations on BNMC, as with most historical stations on the network, have platform widths that are significantly less than that required by modern standards. A notable example of platform widths built to be in accordance with historical standards is the very busy Flinders Street Station in the centre of Melbourne.

In order to optimize the platform widths, the design team removed platform furniture from critical locations and undertook an access study to demonstrate satisfactory egress times in case of an emergency

So as to achieve the minimum 'clear' widths the design team rationalized the provision of platform furniture (bins, and seats and alike) at spatially constrained locations. Where the minimum width could not be achieved the team undertook an access review along the platform considering a range of issues such as DDA requirements, door positioning of the trains when they stop at the platform (so as to ensure adequate flow of patrons getting on and off of the train), and emergency egress requirements. This information was then fed into MTMs standard waiver review process to achieve dispensation from the standard where required.

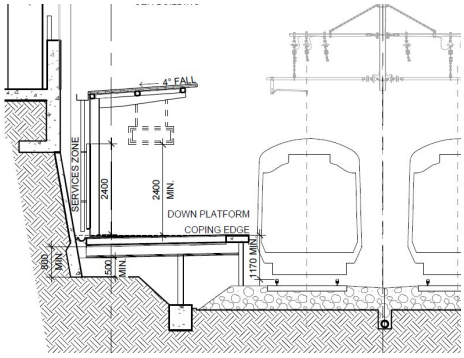

Figure 3: Gardiner Station – Bins and seats were removed along the narrowest lengths of platform so as to maintain a minimum clear width.

Figure 4: Flinders Street Station – Typically narrow platform widths on historical stations

From a design perspective, platform layouts were considered in conjunction with the vertical transport requirements so as to ensure that movement of patrons from the concourse level down to the platform level and vice a versa can be facilitated.

2.2 Vertical Transport (Lifts, Stairs, and Ramps)

Vertical transport for new stations on the Melbourne network typically consists of a mixture of stairs, ramps and lifts. In some of the new Premium category stations, escalators are also installed. Some notable recent examples of this are; Footscray, Ringwood and North Melbourne Stations.

The provision for step free access to the platforms is to ensure DDA compliance and a satisfactory outcome for mobility impaired patrons. DDA compliant access typically consists of both ramps and lifts. The provision of both modes and multiple exit points offsets reliability concerns about lifts and provides improved emergency egress options in case of a fire on the platform[iv].

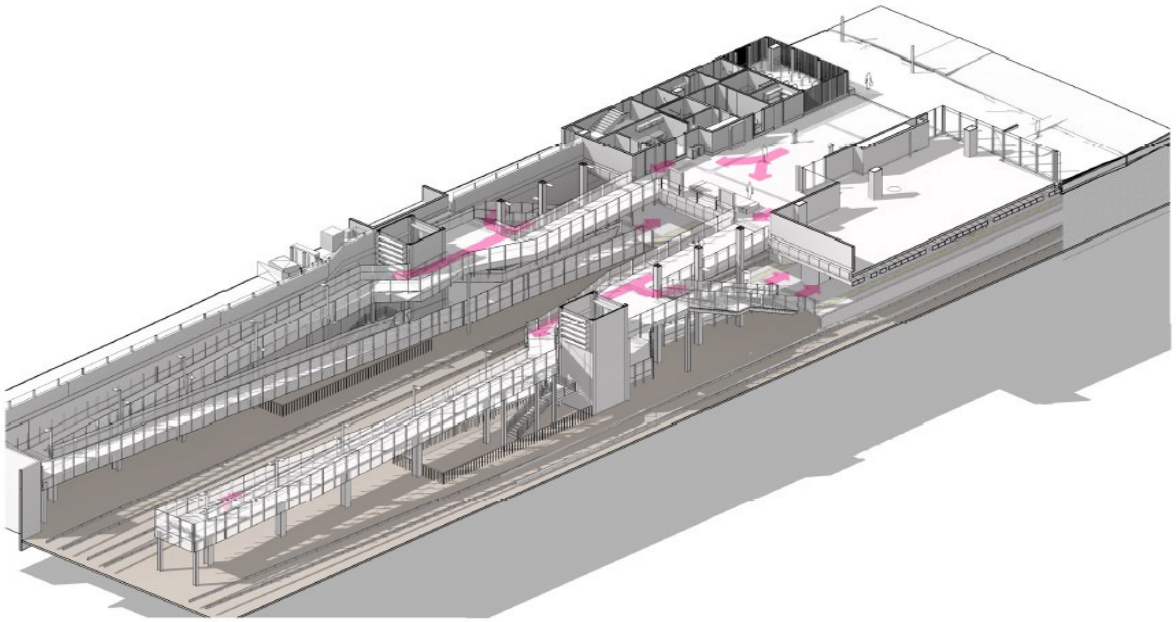

Figure 5: McKinnon Station – Main entrance ramps, stairs and lifts are all located at the end of the platform to due to spatial constraints of the station footprint.

The accommodation of all three modes of vertical transport create a number of challenges. For example the provision of ramps present a considerable capital investment and depending on the level difference can wind up being exceptionally long. In the case of Mitcham Station the ramp length exceeded 65m. The challenge to the design team is to integrate them into available station footprint and to minimize the visual bulk they impose on the stations appearance.

Figure 6: Ramp Layouts – Mitcham Station a double switch back was use due to tight spatial constraints.

Vertical access must also be assessed from a fire and life safety perspective. Emergency egress requirements typically dictate that patrons must be able to reach a position of safety (away from the platforms) within a maximum time. The design team must work with the Melbourne Fire Brigade, the client and building surveyor to agree a credible emergency scenario which will determine the number of patrons assumed to be needing evacuation. This analysis informs key design decisions such as width of stairs and ramps.

On BNMC the team addressed the vertical transport challenges at the most spatially critical stations of Ormond and McKinnon by positioning the vertical transport for the main entrance off the ends of the platforms. By removing the need for valuable platform space to be taken up with the stairs and ramps – as shown in the figure below, this approach allowed to minimize overall.

Lift design within the rail environment demands close attention. More than most elements on the station the lift core seeks to achieve a compromise between architectural distinction and structural requirements. The use of glazing in lifts has been carefully assessed. Issues considered in determining the extent of glazing included; the use of A/C (to cool both shaft and lift car), passive surveillance and visual permeability achieved by glazing, maintainability of glazing, and capital cost. The design team have ultimately adopted limited use of glazing on the lift shaft

that seeks to balance competing objectives of visual appeal and functionality

2.3 Station Concourse

The concourse is typically framed as the deck structure spanning across the top of the cutting that forms the entrance to the station. The concourse typically serves two main purposes:

- Firstly as the main entrance to the station and a structure that is the same or similar level to adjacent road level. It may also be integrated into a forecourt area in front of the station entrance – as has been the case on Gardiner Station.
- Secondly as a suspended platform to base the main station buildings, any retail and the main station canopies.

For the design team minimising structural depth of the concourse was a key requirement so as to reduce the excavation required for the cutting. Following on from the successful outcomes at Mitcham and Nunawading grade separations, the solution adopted on BNMC consisted of precast concrete beams beneath a structural slab followed by a layer of screed and finally an architectural finish – usually paving. This solution provides a good span to depth ratio, low maintainability and ease of construction. For shorter spans the preferred beams are 'planks', rectangular solid shaped beams that have the advantage of a 'clean' architectural profile under the soffit. For longer spans 'super-tees' were chosen for their economy and size. To maximize structural efficiency and remove maintenance requirements of bearings all beams were integrally connected into the abutments.

Figure 7: Mitcham Station – Services were concealed behind cladding (second gap) to avoid unsightliness.

2.4 Station Facilities

In the Melbourne metropolitan network the requirements for station facilities depends greatly on the classification of the station; local, host or premium. Local stations, as the name suggests are for local, un-staffed stations and require minimal station facilities. Premium stations by contrast, are designated for stations accommodating high volumes of patrons, staffed from first train to provide for a larger range of services. These services can include a ticket office, public toilets, waiting room, staff change rooms, toilets, Myki barrier gates and a station master's office. The premium station is staffed approximately 18 hours a day, between the first trains to the last. New stations, irrespective of their classification, contain a bike storage area that is operated by Bicycle Victoria and a Public Security Officers (PSO) facility.

The station buildings are located on the station concourse at the main entrance to the station. The layout of facilities takes into account the different requirements of the paid and unpaid zones and the need to have public functions grouped together likewise back of house.

In the case of BNMC, prefabricated construction has been selected as the preferred construction method. This technique of construction has a number of advantages a) the quality of workmanship is factory controlled and b) the actual installation process is very quick - minimising working time in the rail environment.

Cladding and finishing of the buildings has been driven by the need for robustness and whole of life economy. Cladding solutions on recent stations include compressed fiber cement (CFC) sheeting, aluminum composite panels, vitreous enamel (VE) and precast concrete. VE panels have been used effectively on recent projects such as Ringwood and Nunawading Stations and have been used on BNMC for Gardiner and Ormond Stations. The material has a hard ceramic outer layer that is highly resistant to graffiti and UV.

Figure 8: Nunawading Station – Prefabricated buildings provide ease of installation and improved quality control of workmanship. Vitreous enamel cladding provides a hardwearing and attractive finish

2.5 Platform Amenity at Ormond Station

One of the challenges of designing a station with platforms positioned within a cutting is the need to address the particular amenity issues that patrons experience when standing well below ground level. At Ormond Station approximately 65m of the platform is covered overhead by the concourse and roadway above. In this situation the undercroft creates a semi-enclosed environment for patrons when standing on the platform. The challenge for the design team was to make this area amenable for passengers and an area that is pleasant to be in.

In the case of Ormond, an early concept devised during the tender stage included a large sky light designed to complement the conventional station lighting and provide direct sunlight down onto the platform. The skylight was proposed to be situated in the forecourt so as to provide a distinctive feature for patrons first entering the station. Ultimately this idea was withdrawn due to a range of concerns, these included; difficulty to maintain, risk of vehicle impact, and the localized extent of illuminated area at platform level. Nonetheless the design team remained committed to providing a suitable level of amenity.

Platform surface finish was closely examined, and in particular opportunities for replacing the black asphalt, that absorbs large quantities of light, with a lighter coloured surface, which reflects light back up, were investigated. Light coloured pavers presented further challenges. In particular the need to ensure that there is adequate contrast between the platform surface and the DDA tactiles. The solution comprised of light coloured concrete pavers but only in limited areas away from the DDA tactiles - for example away from the platform edge.

The design team considered a number of alternative lighting options, eventually landing on combined platform lights, feature lights, speakers and rail passenger information items (clocks and PID's) into an integrated bespoke T-pole arrangement.

Figure 9: Ormond Station Platform – Ways in which amenity was addressed included of high quality lighting and selective platform surface finishes.

3 CONCLUSION

The Victorian state government has committed to the removal of 50 of Melbourne's most dangerous and congested level crossings within 8 years. Due to their close proximity to the level crossings, this will lead to a significant number of stations to be rebuilt or modified on the network over the same period.

This paper has discussed how the station design team has tackled the challenges of new stations at the first four of these 50 level crossings on BNMC project. In particular, this paper has identified a number of the key design considerations that had a significant influence over the final layout and functionality of the stations.

The process of design has been an evolutionary one, learning from the successes and mistakes of past projects. With many more similar station rebuilds likely in Melbourne over the coming years, it is hoped that this paper will assist in the appreciation and improvement of other upcoming station designs.

4 REFERENCES

Reference notes:

1. [i] http://www.theage.com.au/victoria/rail-crossing-frustrations-rise-as-peak-hour-gridlocks-suburbs-20120701-21b5f.html

2. [ii] http://levelcrossings.vic.gov.au/

3. [iii] Most of the projects listed have been undertaken in partnership with other consultancies however these stations have been selected due to the Arup have been the lead consultant for they key station disciplines of; station buildings, building services, fire consulting, lighting, acoustics, and in most cases OCS.

4. [iv] Due to the relatively vulnerable nature of the lifts on the network, they are frequently targets of vandalism and as such have suffered from reliability issues. Disability groups have been critical of the lack of redundancy and operating costs. This is changing with a new directive from PTV being developed that allows for the removal of ramps in favour of two lifts in certain circumstances. A new design guide released by PTV Public Transport Precinct Policy – Vertical Access Requirements and Design Guide outlines some of these issues further.