

Appendix 8.12 – Fire Engineering

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Attn: Rob Tierney

Review of Fire Engineering Design Overviews for WISCS: Westpac Stadium Concourse Option

I have reviewed the following documentation:

Westpac stadium extension: Indoor Community Sports Centre, Stephenson and Turner, containing drawings and reports as listed on the contents page, dated 11 March 2009, in particular the reports by Beca on the previous proposals for an indoor stadium at this location.

Westpac Stadium Concourse Indoor Sports Facility Letter from Beca Carter (Patrick Breen) to Maskell consulting dated 31 March 2009.

Emails between various parties.

Summary of Fire Engineering Considerations.

There are essentially five options for design of egress from the new indoor stadium:

1. Not permit simultaneous or overlapping use of both buildings.
2. Entirely separate the egress so the indoor stadium egress does not use the existing concourse.
3. Design the entire complex to allow for simultaneous evacuation of the indoor and the Westpac stadium.
4. Design the entire complex for staged evacuation, however each venue must be able to safely evacuate either venue while occupants are arriving or leaving an event in the other venue.
5. Treat the stadia as separate buildings and allow egress from one building to the other.

The implications of each option will now be discussed in detail.

Option 1 No Simultaneous or Overlapping Use.

This option is the easiest to achieve, however any overlap would include time before and after events, hence the time between one event finishing and another starting would be in at least 1-2 hours.

In order to satisfy the fundamental principle of egress design of having more than one final exit the indoor stadium must have two final exits. Provision must therefore be made for the entire occupant load to exit in a direction other than southwards towards the railway station. An alternative route must be

available from each stair down from the indoor stadium at concourse level. This exit must lead to a *safe place* but may be through the Westpac stadium. Note that the Westpac Stadium already has two exits, to the south and the spiral ramp to the North.

Option 2 Separate Egress

The indoor stadium would have to have at least two completely separate egress routes that reach a street from which the occupants can disperse from. Given the large number of occupants best practice would be for these to exit onto different streets (in this case Thorndon Quay and Waterloo Quay) or failing that a large distance away from each other and the locations at which the exits from the Westpac Stadium reach the streets.

Option 3 Simultaneous Evacuation

In this case occupants of the new stadium must have an egress to the north or east as described in option 1 and in the event of a fire in or near the indoor complex, all occupants of the Westpac Stadium must be able to exit without going through or near the indoor stadium.

This would also require a detailed Fire Engineering Analysis of the existing Stadium, with the potential for significant requirements for new work in order to bring the stadium up to current standards of fire safety and understanding of fire engineering and egress design. The original designer s indicate such significant work may be required in an email from Jason King (Beca) to Patrick (Breen?) dated 31 March 2009. In this email Jason states "It is not desirable to revisit the stadium design as the regulatory and technological environment has changed, such that there is a possibility that the stadium design would need to be altered to meet current requirements".

Option 4 Staged Evacuation

Staged evacuation requires the spaces to be fully sprinklered and fire separated. Most of the existing Westpac Stadium is not sprinklered.

As with Option 3 this would also require a detailed Fire Engineering Analysis of the existing Stadium, with the potential for significant requirements for new work in order to bring the stadium up to current standards of fire safety and understanding of fire engineering and egress design.

Although each space can be evacuated separately in an emergency, if the 36,500 occupants of the Westpac stadium are leaving after an event, and an emergency occurs in the indoor stadia, then the combined occupant load will be trying to egress through the same part of the concourse.

It is not possible to physically prevent occupants of Westpac Stadium from entering the concourse under the indoor stadium once they have started to move. If the front of a large mass of people are stopped, the people behind are unaware those in front have stopped and keep moving. This leads to the people in front being crushed against any barriers. Many will be unable to breathe, with the likely consequence of a large number of fatalities as seen in many historical instances when crowds moved towards blocked exits (e.g. Hillsborough Stadium, April 15, 1989, 96 fatalities).

Hence the assessment of the occupant load on the concourse during an evacuation of the indoor stadium must include any occupants either in or entering the concourse from Westpac stadium.

Option 5 Separate Buildings.

This is identical to the option above except that if they are separate buildings then fully sprinklering the Westpac Stadium is not required to be sprinklered throughout however must be fire separated by fire resistant construction and/or distance. The definition of what is another building appears to vary and is often is a matter for argument between designers and Building Consent Authorities.

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It is not possible to physically prevent occupants of Westpac Stadium from entering the concourse under the indoor stadium once they have started to move. If the front of a large mass of people are stopped, the people behind are unaware those in front have stopped and keep moving. This leads to the people in front being crushed against any barriers. Many will be unable to breath, with the likely consequence of a large number of fatalities as seen in many historical instances when crowds moved towards blocked exits (e.g. Hillsborough Stadium, April 15, 1989, 96 fatalities).

Hence the assessment of the occupant load on the concourse during an evacuation of the indoor stadium must include any occupants either in or entering the concourse from Westpac stadium.

Review of Design Overview

In my view none of the options above have been adequately addressed in the design, except for option 1. This will reduce the availability of both stadia. The effect of the structure below the indoor stadia on its impact on the egress from the Westpac Stadium was shown to be negligible in *Beca's Westpac Stadium Trust – Indoor Sports Complex, Building Services Outline Description (Rev B, 27 June 2002)*, in that the south concourse would have a has 31.4 m effective egress width compared with the 25.2 m effective width required by the Green Guide for the 21,991 occupants expected to exit Westpac stadium to the South. It goes on to say that normal exit from Westpac stadium with all the occupants exiting to the south would be slower, and indicates that the affect on egress of the interaction with physical barriers such as the indoor stadium ticketing booth by occupants exiting and the impact on crowd behaviour of exiting via a closed rather than open space is uncertain.

The letter from Beca to Maskell Consulting does not address egress from the indoor stadia but lists requirements for ensuring the indoor stadium does not substantially affect egress from the Westpac Stadium by maintaining the concourse under the indoor stadium as a *safe place*. These requirements will add substantial additional costs and prevention of transient fuel loads from being located there in the long term is unlikely to be achieved. I note that transient fuel loads are often present in the internal circular concourse in Westpac Stadium despite the intent of the original fire report that these be sterile spaces.

Option 2 and 3 both require additional egress routes that terminate in a safe place and option 3 also requires a new evacuation scheme for Westpac stadium.

Option 4 and 5 are likely to require additional egress to cope with normal exit from one building as well as total evacuation of the other. Detailed two-dimensional interactive egress modelling is required to demonstrate that such egress would work when there are a number of diverging and converging flows, variety in choice of exit, variable response times and travel speeds. This must be properly peer reviewed and it is unlikely a suitable reviewer for egress design would be available in New Zealand. In my view the simple egress width calculations used to date are not adequate.

Treating the space under the indoor stadium on the concourse as a *safe place* in another building in terms of egress may be seen to be in compliance with the definitions in *Acceptable Solution C/AS1, Approved Document for New Zealand Building Code - Fire Safety Clauses*, however the Acceptable Solutions by their very nature are biased towards “normal” or “typical” buildings, which do not need to be designed (other than in an emergency) for the entire occupant load to simultaneously exit. It cannot be assumed that an emergency evacuation of one stadium will not occur during the time occupants are leaving or entering the other stadia before or after an event. Any attempt to stop the movement of a large group of people to prevent them from moving along the concourse will likely result in multiple fatalities from crushing in a “crowd disaster”.

Conclusions

In my opinion egress from the stadia has not been properly addressed other than the physical impact of structure on reducing egress widths on the concourse in the event of an emergency evacuation from the Westpac stadium. At this level there are substantial implications in terms of fire safety features required for the proposed indoor stadia and the concourse and car-park beneath it.


Regardless of the egress option chosen, other than not permitting simultaneous or over-lapping use of both stadia, additional egress must be provided. The amount of egress required may be reduced by optimising the design.

Egress design must be based on a detailed two-dimensional model rather than a simple calculation of egress width requirements and must be independently peer reviewed by an individual with expertise in egress design.

Any option that requires revisiting the Westpac Stadium design will likely require significant additional work.

If we can be of further assistance or you require further information please let me know.

Yours sincerely

A handwritten signature in black ink, appearing to read 'G C Thomas', with a long horizontal stroke extending to the right.

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