PUBLIC BUILDINGS FOR POST DISASTER FUNCTION
CQ BRANCH CONFERENCE BEST PAPER

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Stuart Grallelis is a Senior Structural Engineer with more than 10 years of experience within the engineering and construction industry. Stuart has worked in a variety of engineering roles in both the public and private sectors, delivering a range of engineering projects covering residential, commercial, industrial and government sector buildings and infrastructure.

Stuart has been involved in the design and delivery of the Queensland Cyclone Shelters program and cyclone refuge assessments with Project Services, as well as countless designs for structures in the cyclonic region of the Queensland coastline, including design of the recent Local Disaster Co-ordination Centre in Yeppoon.

CQ Branch Conference Best Paper: Public buildings for post disaster function – structural engineering design experience

Background
Not all public buildings are built for post disaster function, but a majority of post disaster function buildings are public infrastructure. Buildings of this nature are not constructed very often, but many local and state government bodies may have exposure to them, be it in a design, construction, maintenance, operational or asset management capacity. As such, it is important to understand the inputs, impacts and considerations specific to a building of this nature.

Key considerations
- Building importance level
- Wind loading and cyclonic wind effects
- Flooding and/or storm surge
- Earthquake
- Fire and bushfire
- Place of refuge
- Pre/during/post event operations

Project application
Post disaster function structures in Queensland are primarily designed to withstand cyclonic events, generally for the purpose of post disaster recovery or as a place of refuge. The normally public nature of the buildings requires consideration of stakeholder needs outside of the primary post disaster function of the structure. This results in the need to tailor the design approach to achieve desired outcomes, requiring a carefully considered balance to be struck between the form and the function of the building.

Often, these two aspects can be at odds to each other in the design process. This can be detrimental to the capability to provide an efficient and suitable engineering design, particularly if the client and/or stakeholder focus is on the aesthetic or form of the building. To this end, there is greater importance in defining the necessary inputs and expectations at the preliminary phase of design – particularly with respect to providing relevant advice and sometimes education to enable informed decisions to be made and compromises reached, alleviating the potential of later issues arising.

Some examples of such considerations include:
- Definition of the building importance level or alternatively, adoption of user defined return periods
- Definition of windspeed by standards or by defined cyclonic category
Siting and orientation of building for flood, surface flows, wind directions, debris potential, etc.

Physical and planning constraints for allotment or road reserve, accesses, parking

Material selection and suitability and the impact on efficiency of construction

Building purpose and amenity

Building form with respect to developing a shape conducive to loading conditions and incorporation of protective and load effect reduction aspects (wind vortex disruption, cyclone shutters, ventilation, etc.)

The Queensland Cyclone Shelter Program provided State Government funding for the design and construction of cyclone shelters to provide critical emergency shelter to communities in Central and North Queensland during and following a cyclonic event.

$58.5 million for 10 shelters along the Queensland coast (3 alternatively funded and delivered)

Multi-Purpose year round sports facility for community use

Coordination center and place of refuge for 750 people during cyclones

Category 5 cyclone rated (306km/hour wind gust).

The shelters are:

Capable of providing protection from winds up to 306kilometer/hour experienced in a Category 5 cyclone

Located outside storm tide inundation areas and not vulnerable to landslip and creek or river flooding

Located so that the floor level of the shelter building will be above the height of a 1-in-10,000-year storm tide event or a 1-in-500-year defined flood event

Located sufficiently away from significant hazards such as hazardous materials, large trees, power or communications towers and potential sources of large windborne debris

Located in communities where large numbers of people are at risk of storm tide inundation, or

Located in a centre away from the coastline to which a coastal community at risk of storm tide inundation can safely evacuate prior to the impact of the cyclone.

Two examples of such projects are the Queensland Cyclone Shelter Program (2012/13) and Livingstone Shire Council’s Local Disaster Co-ordination Centre (LDCC) (2017/18).
These shelters help make Queensland safer and more resilient in the event of a cyclone.

The shelters are not only used in emergencies, they also operate as multi-purpose sports facilities and are available for year-round use by the community. As such, they were designed to accommodate various community activities, whilst being capable of full lockdown and use as a place of refuge at any notice. The building was designed to incorporate many aspects to suit this need, including internal water storage, controlled ventilation systems, wind vortex diffusers at external corners and roof edges, debris screening and protective shutters.

The Livingstone Shire Council’s LDCC provided a number of challenges to the project team to ensure design and construction delivery outcomes met the expectations and requirements of all stakeholders.

- **Initial budget of $5 million**
- **10-week design timeframe**
- **12-month scheduled from commencement to completion**
- **Required to be utilised as a public amenity and pre/during/post disaster function center**
- **3 story building with sacrificial zones and self-contained for post disaster relief operations**
- **Category 5 cyclone rated (306 kilometer/hour wind gust)**

The LDCC building was to be utilised as a community hub, including commercial tenancies and public spaces and facilities throughout the building, with the top floor being used for

**LDCC sacrificial zones**

**Yeppoon shelter**
local emergency services and coastguard operations. In addition to this, the building was to be designed for full lockdown during a cyclonic event with the disaster co-ordination facilities operating from the top storey.

The location of the building within a public space resulted in a requirement for aesthetic considerations to be met with, adding complexity to the design. Where possible, the incorporation of aesthetic aspects into the engineering of the structure was made possible. Despite the compressed timeframes of the project and requirement for many compromises along the way, the design and delivery teams produced what has been a successful building outcome for council and the community.

Implementation or initiatives
This project referenced the Design Guidelines for Queensland Public Cyclone Shelters. These guidelines primarily address the safety for people in the shelter and provide a method of assessment to ensure the shelter is ‘fit-for-purpose’. They address the temporary use of a building or portion of a building, with basic amenities to provide safe shelter for a large number of people during severe tropical cyclones.

These guidelines are to be used in conjunction with the relevant classifications contained in the Building Code of Australia for the use of the building when not being utilised as a cyclone shelter – in this case a multi-purpose sports facility.

Learnings:
- Define design requirements at the outset
- Understand client expectations (form vs function)
- Ensure all stakeholders are on the same page
- Ensure the design team have a shared vision
- Design to fit the purpose to achieve a positive outcome.