ICOMOS
Conference paper 2007

Over Exposed or blown away!.....Architecture in the Extreme

"Extreme beginnings: the effect of cyclones on the development of Innisfail Far North Queensland"

From the earliest days of white settlement in North Queensland, cyclones have shaped the way settlers have responded to living with destructive winds, torrential rains, storm surges and flooding. These extreme events have inflicted a heavy toll on the built environment and brought about structural changes in many towns to counter the effects of nature. This paper explores the development of the Innisfail area in an extreme tropical environment. By following the relationships between cyclones and the evolution of construction methods, a more enduring built environment has emerged. In particular these structural changes have come under scrutiny provided by the recent severe Cyclone Larry. The destructive impact on significant heritage places is high and appropriate conservation remains a challenge for those charged with protecting it.

Although cyclones are largely associated with the areas in Australia above the Tropic of Capricorn, covering the Far North east coast of Australia continuing over the Top End, Northern Territory to below Broome in Western Australia, they have been tracked as far south as Sydney and certainly were a feature familiar to the early settlers of Brisbane. For the purpose of this paper, the area is contained between Mackay to Cooktown with a central emphasis on Innisfail. It covers a period from the earliest recorded "blow" near Cairns in 1858, until the present recent catastrophic event in 2006 which many are familiar with; Cyclone Larry.

Brought on by a desire to expand pastoral settlement after the separation of Queensland from New South Wales in 1859 and excited by the discovery of mineral rich fields (including gold, tin and copper), North Queensland provided the backdrop whereby new settlers, predominantly Europeans, flocked to capitalise on the riches and ventured to make their fortunes. Reports of rich fertile lands suitable for all agriculture, in particular, sugar and coffee growing initiated interest in the Johnstone River district to be opened up and settled. [1] A settlement soon became established and named Geraldton after T. H. Fitzgerald one of the first selectors to arrive.[2] Geraldton (later renamed Innisfail) quickly grew to provide goods and services to the emerging sugar industry and arriving Chinese workers were soon engaged in banana growing with agriculture dominating the landscape of Geraldton/Innisfail district.[3]

In the Southern Hemisphere a tropical cyclone is an extreme weather condition that begins as a low pressure system which intensifies with winds that circulate clockwise around the centre. In Australia such systems are monitored and upgraded to severe tropical cyclone status when the average or sustained wind reaches or exceeds the speed of 120 km/h. In the Northern Hemisphere tropical systems are referred to as

Rob Dusting, FRAIA Architect Sandi Robb, B. Soc.Sc (Hons)
Cultural Heritage, Environmental Protection Agency Queensland

hurricanes or typhoons. The Australian Bureau of Meteorology uses a five category system to classify a tropical cyclone with Category 1. being the lowest, with wind gusts less than 125 klm/hr, to Category 5. with wind gusts over 280 klm /hr. While classified as a Category 5 cyclone, Cyclone Larry had reduced to a Category 4 at the time it hit land fall. This means that its destructive winds at the point of hitting Flying Fish Point were between 225-280 klm /hr. Believe me, the fish were flying, but so too was the corrugated iron, timber and tinnies.!

From early settlement, cyclones have been identified as part of the Queensland experience. Since 1858, there have been over 209 cyclones along the east coast of Queensland, (approximately 1.5 cyclones per year). In the 149 years since Separation occurred and Queensland proclaimed a State over 119 cyclones have been tracked in North Queensland between Mackay and Cooktown and 44 between Cairns and Cardwell.[4]

Detailed observations recorded in newspaper articles at the time reveal three key features in the physical damage sequence of buildings. These features include; building failure through impact of sustained wind load on tie downs and insufficient connections, building failure through flying debris, and further damage caused by either tidal surge, flooding or torrential rain in subsequent weeks after the event.

The behaviour of buildings at times of high wind stress is largely due to individual building structural resistance capabilities to wind load pressure, to which, the lack of sufficient connections at critical structural points exacerbates the load fatigue and usually results in failure either as partial damage or destruction. Wind load pressure both large and sustained can cause suction uplift which, when applied to a truss or rafter support has been estimated as comparable to the weight of a small car.[5] Therefore a breach or lack of a critical connection point can bring about the demise of a building through a sequence of building failure which may begin with one or two sheets of galvanised iron lifting before the whole roof is blown away and the walls collapse.

Buildings are complex structures made up of many load sharing elements which incorporate footings, structure and cladding. However, the structural success of a building also goes back further into design, height, roof pitch, distribution of window or door openings and orientation. These factors all contribute to the likelihood of survival. Earlier construction techniques often incorporate a steep pitched gable or hipped shaped roof. While steep roofs may suffer less up-lift the place is more susceptible to the risks associated with damage by flying debris as the steep pitched roof is more vulnerable on the windward side and upwind slope of the angle. In particular if the fixing of the adjoining house is substandard at the critical rafter /top plate connection the roof can completely blow away and becomes lethal debris.[6]

Building failure through damage wrought by flying debris impacts heavily upon adjoining structures by creating a breach in the building's structural resistance capabilities which contributes to an increase in stress upon the remaining portion of the building. Failure of building elements such as fascias, guttering, roofing iron and

Rob Dusting, FRAIA Architect Sandi Robb, B. Soc.Sc (Hons)
Cultural Heritage, Environmental Protection Agency Queensland

ancillary garden elements such as trees, the outside toilet or garden shed combined with the severe wind speed, projects the item with such force that it becomes a lethal projectile.

The third area of damage upon buildings associated with cyclones is tidal surge, flooding or weeks of solid rain. This has created a different set of problems in the past for buildings, and typically undermined the ability to clean up and reconstruct quickly.

1860-1900

Until the 20th century, emerging northern settlements received little or no prior warning to cyclones, relying solely on the telegraph system (if available) or barometers. Communities were often caught unaware and unprepared. With a constant influx of arrivals, settlements expanded at a rapid pace and often on an ad hoc basis. Built for the interim and using whatever means was at hand, early houses and shops were utilitarian in form, beginning with a canvas or tent, and progressing onto simple bush structures. Settlers for most part, constructed buildings of bark or rough sawn slab huts with a shingle roof but variations occurred according to knowledge and cultural background. [7] Nearly all houses at the time had dirt floors, and this tradition extended into the next century for those who could not afford otherwise.[8] Dwellings and commercial stores which had shingle roofs were considered a better class of building as the shingle provided an effective barrier of resistance against wet season downpours.

By the late 1880s buildings were typically one of two types; a gabled or hipped roof two-roomed cottage with a verandah front and rear or a pyramid roof four roomed house with a verandah at the front. [9] It was constructed of sawn timber, stud framed with internally lined chamfer boards and the external framing left exposed. While many were raised a metre or so off the ground on timber stumps, some dwellings in towns were still constructed literally on the ground. As the family grew, skillion roofed extensions were added, verandahs enclosed and in some cases an extra gable added to produce a multi-gabled house. From the early 1890s bricks were being used for a few commercial premises but by and large construction was largely undertaken in timber but galvanised corrugated iron was also popular as it provided a cheap alternative that was quick to erect and waterproof.[10]

In the first forty two years between first settlements of North Queensland in 1858-1900, twenty cyclones crossed the coast between Mackay and Cooktown. One fifth of these crossed between Cardwell and Cairns affecting the Geraldton/Innisfail district. One of the first recorded cyclones was experienced at Cardwell in 1867. This cyclone damaged private dwellings, commercial stores and government buildings alike. [11] In Cairns nearly ten years later, the settlement was nearly wiped out as was Cardwell again in 1890 which left it with only four dwellings intact and the local school and court house were almost blown away. At the same time Townsville, experienced a tidal surge and high winds which wrecked 15 houses and blew at least 30 homes off their blocks.[12] In 1894, a tidal surge from a cyclone 150 km away, severely impacted on the young settlement of Geraldton. It was the first time the settlement experienced flooding and disbelief was characterised in a news paper which observed "*that*

Geraldton itself is flooded is a phenomenon in itself".[13] Later that decade a cyclone, Sigma, crossed near Townsville and devastated the township.[14]

The type of damage buildings suffered from tropical extreme weather conditions can be summarised as the following; either partially or totally destroyed, with very few buildings remaining intact. More substantial dwellings and commercial premises constructed of timber and corrugated galvanised iron or brick, were universally damaged through total or partial loss of roof sheeting, collapse, blown off their stumps and/or collapse, or damaged by flying debris to such an extent that collapse occurred. As Government and public buildings were generally better designed and more likely to remain upright, they were considered more cyclone resistant and a pattern of sheltering in them was established.[15]

Analysis of early sources indicates that early temporary structures were not capable of withstanding high wind force. There was a lack of sufficient tie down fixing at all of the critical points most notably; bark or corrugated galvanised iron to battens; battens to rafters; rafters to top plate; cross bracing; wall framing; tie down to bearer; bearer to stumps, and stumps not embedded sufficiently into the ground. Houses which were considered "better class" suffered less damage but some collapsed when breached by debris. Corrugated galvanised iron became lethal in high winds but remained a preferred building material due to it being portable, cheap, and recyclable. It was noted that buildings with shingled roofs suffered less damage. This may have been due to the small area shingles, individually fixed were not so susceptible to uplift because the air could freely pass between them. [16] However despite the good performance of shingles their usage was undermined by galvanised corrugated iron which was considered a superior product.

Extreme cyclonic weather became accepted as an inherent part of North Queensland life but it highlighted the problems of building homes in a tropical environment. One observer of the 1867 Cardwell cyclone remarked *"for the greater part of those blown down were either entirely without braces or braced so slightly that very little strain was necessary to overturn them"*[17] However the public response to cyclones can only be measured by the lack of structural changes which were made. For the most part, settlers re-erected their dwellings and commercial businesses as they always had except for some individuals. In direct response to cyclones experienced in the early 1890s, the Government Telegraph Office and Courthouse in Cardwell were fitted with knee bracing bolted between the bearer and the stumps and two churches were fitted with retrospective buttressing, one being completely rebuilt with both the buttressing and a very high pitched gable. [18]

1900-1920

Between 1900 and 1920, eighteen cyclones crossed the coast between Mackay and Cooktown; a third of them affecting the Geraldton/Innisfail district. At the time North Queensland houses were generally uniform in style with few modifications. As noted by Bell, *"The pattern established in the prosperous years of late 1880s persisted virtually unchanged until the First World War and in some cases struggled valiantly into the 1920s."*[19] After 1900, diagonal bracing to the walls was generally adopted to resist distortion

Rob Dusting, FRAIA Architect Sandi Robb, B. Soc.Sc (Hons)
Cultural Heritage, Environmental Protection Agency Queensland

and the distance between the studs reduced. Structural resistance capabilities were further reinforced by external walls additionally clad with chamferboard and strapping fitted between the bearer and the stumps. Some individuals rebuilt from experience with one securing his house by attaching 24 angle irons between the stumps and bearers and four iron bars running from the wall plate to the bed plate, one at each corner. [20] State government buildings were also strengthened in a similar fashion. The State Hotel Babinda constructed in 1917 is an example of a similar type of structural reinforcement. [21] It is also considered the only State Government enterprise to have made a profit!

Bricks were a popular construction material for substantial commercial building at the turn of the century until WWII. However they were not proven to be reliable or endurable during cyclones with cyclone Leonta (Townsville, 1903) destroying a brick constructed school and the hospital. When new technology became available, northerners were happy to explore it. Reinforced concrete was first used as a structural form in North Queensland for the Gairloch Bridge, Halifax FNQ as early as 1889,[22] but the transition as a building material in commercial buildings took another thirteen years to be adopted. Some of the earliest examples of reinforced concrete in Queensland (and Australia) are found in Cairns and Innisfail.[23]

Cyclones affecting North Queensland towns may have contributed to the adoption of reinforced concrete as a preferred construction method for those who could afford it.[24] Also repeated economic strain as a result of a cyclone may have prompted A.S Mellick to construct the first reinforced building in Geraldton (1907).[25] Certainly it is not surprising to learn that three of the substantial buildings erected in the north in 1907 came after a severe cyclone affected the Cairns and Geralton district in 1906. Geraldton experienced severe cyclone associated flooding in 1911[26] and 1913 which impacted substantially on the town (now officially called Innisfail) and the district. So great was the flooding that several houses were seen floating down the river.[27] However in late January 1918 a cyclone crossed at Mackay and created widespread damage, a tidal wave/surge wall of water estimated at of 25 ft (or approx. 7.5 metres high) followed by widespread flooding. Of the 1200-1400 houses in Mackay, it was estimated that only ¼ escaped damage; a large proportion totally collapsed. Houses and commercial buildings were left unroofed as well as hotels, churches, public halls, two-storeyed ones and those of a better class.[28]

Five weeks later, March 1918, an unnamed cyclone destroyed Innisfail. [29] Of the domestic dwellings in Innisfail, 95% were damaged or collapsed[30] with only 7 houses counted in the town which could be described as habitable.[31] Almost every building lost its roof with only five commercial places and three government buildings left intact. The visiting Anglican Bishop noted *"Over this bewildering scene raised the parapet of a concrete store, maintaining a precarious equilibrium on the ends of two walls, half destroyed –and 12 inch walls at that"* [32] Sheets of iron were scattered all over the place and buildings were either collapsed in heaps or on top of sodden bedding, furniture and clothing. [33] One building which remained intact was the Johnstone Shire Hall. The architect was praised at the time for his building design and complimented for the work he had undertaken to increase strength of the building in

such a high risk area. [34] The path of the cyclone affected both Babinda and the Atherton Tablelands as well with damage recorded inland west past Herberton and north past Mareeba. [35]

Certainly the intensity of the 1918 Innisfail cyclone demonstrated that the impact of a cyclone may damage all types of buildings. Building failure sustained during the cyclone remained consistent with earlier key features with the exception of one noticeable difference: that additional bracing and the application of external chamfer boards strengthened buildings to such an extent that many remained intact *"were those secured to their ground plates by steel rods running from top to bottom – the ground plates, of course being bolted to the blocks."*[36] or partially intact even when blown off the stumps, And as only 7 houses remained habitable it could be concluded that the usage of cyclone rods was not limited. Roofs on the other hand appeared to be as vulnerable as ever with one observer remarking that the court house roof went *"like a packet of envelopes"* , [37] and damage to Innisfail buildings created by flying debris was widespread. One survivor noted *"When a portion of the place next door went through the back of their building that started their building going"…*[38] Interestingly enough paling fences by and large remained intact, most likely due to the ability of the wind to pass through the spacing. [39]

Community perceptions that public and reinforced concrete buildings were safe in times of extreme weather were confirmed.[40] The public response to the destruction was pragmatic. In Babinda, the community purchased a corrugating iron roller so the community could overcome the shortage of iron, and recycle damaged sheets.[41]

1920-1980

Over the next sixty years Innisfail was affected, either through wind force, debris or flood damage, by 23 cyclones which consisted of more than 1/3 of all cyclones to cross the coast between Cooktown and Mackay. After the 1918 cyclone it was evident that major changes needed to occur at both community and government level and the issue was raised with local Municipal Councils to introduce building By-Laws to protect the public. [42] It was hoped that by introducing minimum standards of building, the economic costs of rebuilding could be alleviated within community. [43] This was achieved through legislative provisions, most notably, the *Local Authority Act 1902*.[44] Through amendments to this Act, local governments could divide the town into first and second class areas and ensure that in the former only buildings of fire proof material could be erected. This meant that local councils such as Johnstone Shire Council could control the type of building constructed in the first class areas.[45] In 1925, Edith and Rankin Streets were proclaimed first class areas and by doing so the Johnstone Shire created a zone whereby commercial and public buildings would be cyclone resistant.

The move towards reinforced concrete structures was considered a practical approach to ensuring cyclone protection. In 1923 at the start of the boom, over 15 reinforced concrete buildings were underway in Cairns alone and Innisfail experienced the construction of approximately 55 commercial or public buildings over the next twenty years. [46] A large proportion of projects in Innisfail were designed by prominent North

Queensland Architects R. Hill and Taylor and constructed by the Dutch born brothers Van Leeuwin who had all of the equipment required to erect a substantial reinforced concrete building.[47]As the town was being rebuilt, it is not surprising that decorative features reflected a range of influences. Over half of the buildings were classed as Interwar Modernist with Art Deco decorative features such as the Johnstone Shire Hall (1938) followed by more utilitarian Modernist style which characterised many of the smaller businesses. Those constructed in the Interwar Modernist Classical style were predominantly prominent buildings and they included the brick and concrete Hotel Grand Central (1926) and the Court House (1942).

An influx of Italian immigrants direct from Italy to work in the sugar industry in the early 1920s influenced perceptions of the decorative style of buildings and skilful builders such as Mose Romano constructed many of the reinforced concrete homes around the district.[48] Reflecting the prosperity of the region and the multicultural nature of the community, reinforced concrete buildings incorporated examples of Moorish, Tuscan, or Chinese influence as well as regional influences.

Secure in its improvements to building structures, Innisfail turned its attention to damage caused by cyclone related flooding and after the 1934 flood, See Poys constructed their new department store with flood resistant doors. By the 1940s damage in Innisfail was limited to fencing, some debris damage caused by flying sheets of corrugated iron, and the ubiquitous flooding. However other towns not affected by cyclones over the years became complacent in their vigilance towards structural reinforcement. The *Townsville Daily Bulletin* editorial said it all in 1950 when its headline said "Cyclone Connie Demonstrates Need for Constructing Stronger Homes". While acknowledging change since the turn of the century it warned, *"the strength factor has not been adequately implemented and so, the havoc of Cyclone Connie."* Similarly after the 1958 Bowen cyclone, local building contractor George Burgher summarised the effect of the cyclone when he observed that the failure of buildings was a result of poor workmanship.[49]

While the By-laws were under revision, the finger pointed solely at the authorities for not being stringent enough through building inspections to ensure that cyclone measures were being correctly implemented. In April 1958 the Townsville Daily Bulletin reported *"Mr Hansen, who is in charge of reconstruction work following the 1958 and 59 cyclones said he felt the looseness of local authority building by laws, which allowed people to put up almost anything, was responsible in many cases for the heavy damage incurred."* [50] Evidently people were prepared to take risks with the building standards of the time.[51] When commenting on the devastating effects of cyclone Althea (Townsville, 1972) Professor Walker of James Cook University noted that housing damage in cyclones such as Althea was due to *"inherent weakness of the traditional approach to housing construction"*.

Category 3 Cyclone Althea (1971) damaged 16 % of houses in Townsville and was only rivalled at the time by Category 4 Cyclone Tracy (1974) which destroyed over 70 % houses in Darwin. [52] After the destructive cyclones the Centre for Disaster Studies located in the faculty of Engineering and Geography at James Cook

University Townsville was established. The Institute for Disaster Research enabled a thorough investigation of the effects of cyclones and related activity on houses and buildings. [53] Although the study looked at two study areas; houses less than five years old and those which were older, the findings concluded building failure was substantially greater in houses less than 5 years old. This was attributed to poor design and by failure though loss of roof sheeting and/or roof structure.[54] Debris damage, while considerable, was secondary to the primary failure of the roof and failure of windows impacted on the capacity of the roof to withstand wind force pressure.

Recommendations were adopted as mechanism for changes to the Building Codes. [55] Key recommendations included that design specification should be adopted for buildings above latitude 22°S in North Queensland; essential community infrastructure should be built to withstand winds 180mph and incorporate a bunker type unit for community protection; local building By-laws needed to be strengthened to improve specification for essential items such as the roof, block work and glazing requirements; and smaller buildings were to be studied to improve construction techniques based on modern engineering. Investigations into the housing wind resistance of roof sheeting and fixing methods was to commence immediately to resolve design inadequacies and collection of raw cyclone data needed to be ongoing. In addition the role of armed services needs to be incorporated in community relief projects should a large cyclone cross the coast.[56]

Communities in North Queensland benefited from this information as practical outcomes were put forward to improve building capabilities to withstand wind forces and prevent load failure. Improved fasteners and methods of application were recommended such as a standardization of spacing for cyclone rods, screwed joints, framing anchors, bolted joints, bent metal strapping and toothed metal plates and triple grips incorporated into buildings.[57]

1980-present

In 1982 the Queensland Home Building Code was introduced in response to the extensive damage experienced with Cyclone Althea and Cyclone Tracy. Provisions set out in the code were aimed at constructing buildings designed to resist stress. They were also complemented by a set of manuals formulated by the Timber Research and Development Advisory Council of Queensland which gave details for bracing walls, hollow concrete masonry construction, and roofing.[58] By 1984 with building regulations tightened, it is plausible to assume that most buildings in Queensland were being designed and constructed with high resisting cyclone capabilities. This was placed to the test in 1986 when cyclone Winifred crossed the coast at Miriwinni just north of Innisfail. Category 3 Cyclone Winifred damaged 20-30% houses built prior to 1980s. [59] The failure rate of buildings was substantially lowered and restricted to roofing iron lifting and often still attached to the batten. This indicates that while roof to batten connections were improved by the use of roofing screws, the batten to rafter fixtures were still failing. Flying debris also remained a critical element in the pattern of destruction.

From the early 1980s to 2006 over 29 recorded cyclones crossed the coast in North Queensland of which 10 affected Innisfail through wind, debris or flood damage.[60] The most recent cyclone, and that which is compared to the destructive force of the 1918 cyclone which hit Innisfail, was that of Cyclone Larry, in late March 2006. Post cyclone surveys undertaken by the Centre for Disaster Studies at James Cook University have revealed that the mean average age of houses in Innisfail at the time the cyclone crossed was 46 years old with 36% of the houses with damage surveyed between 30-49 years old. Up to 67 % of houses were considered older than 50 years old and are possibly those constructed after the 1918 event. Roof loss was largely confined to buildings over thirty years old and approximately 1 in 20 or 5% of houses severely damaged or destroyed. [61] It was found that both old and new houses were often built to cyclone standards and that damage to areas was patchy indicating that irregular wind gusts and debris damage were a significant contributory factor to buildings. We also discovered that roadside signs are not only erected to help motorists drive more carefully but a subversive plot by engineers to assess comparative wind speed. [62]

The Cyclone Testing Station which released a report in September clearly identified that older houses did not perform as well as recently constructed ones. The report also indicated that newer houses may have performed better as they had not been susceptible to accumulative stress load from previous cyclones. Most common building failures were loss of roof battens due to lack of fastening, loss of rafters or trusses when anchored to the top plates with skew nails only, loss of struts and ridge members when not tied down, and masonry failure to name a few. In short where structural anchorage was in accordance with the AS1684-part 3 Cyclonic areas, which included all new buildings they performed well. However older building where insufficient anchorage was apparent, the result was building fabric loss. Older Queensland buildings were also identified after Cyclone Larry as the most significant buildings at risk of extreme tropical cyclone events. They are recognised as key area of concern by the insurance industry [63] which may place them at risk in the future from a lack of support by insurers which may lead to further loss if demolition is proposed as a preferred option.

In 2006 alone the estimated loss of property was estimated at over $400million but the extent of loss and damage placed less than that of cyclone Tracy, 1974. This was attributed to improved quality of design and improved building standards. However the cost to heritage buildings can be measured through the loss or damage to significant cultural heritage places. This includes damage to many places on the Queensland Heritage Register including Johnstone Shire Hall, Former St Andrews Church, Paronella Park, WWII Igloo Hall, Yungaburra Police Station, Babinda Hotel[64] to name a few as well as many others of local heritage significance. Other places which suffered collapse and/or loss of heritage fabric included the Cairns Plywood Sawmill on the Atherton Tablelands and McCowat Farm near Innisfail. The type of damage observed by heritage officers on inspection included roof loss, uplift damage, wall damage, blown in shutters, debris damage, water damage from prolonged rain period and damage to landscape and grounds.

Without a doubt cyclones are a notable feature of the north Australian landscape. The relationship between the pattern of destruction through major cyclonic events and changes to construction methods is clearly established. Between 1858 until 2006 the three key areas of failure identified as having a significant negative effect upon buildings remains consistent.[65] Buildings more than 50 years old and have sustained a number of cyclonic event are also at risk with each cyclone though the process of metal corrosion, timber, rot, termite attack and stress damage incurred over previous cyclones. There is a greater need to encourage maintenance, identifying key weaknesses and upgrade structures to ensure the conservation of Queensland's cultural heritage.

But should heritage places in tropical extreme environments be made more cyclone resistant for their future preservation? We argue that yes, preventative measures should be undertaken as part of proactive conservation heritage management strategy and in line with conservation principles set out in Australia ICOMOS Burra Charter. The approach recommended is in line with Article 3.1 *"changing as much as necessary but as little as possible"* (DAMANPALAP). so that the cultural heritage significance of the place is retained and to ensure that provisions are made for the enjoyment of present and future generations as set out in Article 2.4. (*"Places of cultural significance should be safeguarded and not put at risk or left in a vulnerable state.")* In addition, Article 4.2 allows for an upgrade for material to *"offer substantial conservation benefits"*. [66] As a first step in the conservation management strategy we put it to Australia ICOMOS to consider incorporation within the next Burra Charter update, additional guidelines for conservation of places in extreme environments to acknowledge that these cultural heritage places are particularly vulnerable to substantial damage or total loss.

Thank you

Rob Dusting, FRAIA Architect Sandi Robb, B. Soc.Sc (Hons)
Cultural Heritage, Environmental Protection Agency Queensland

ENDNOTES

[1] D. Jones, 1961, *Cardwell Shire Story*, The Jacaranda Press, Brisbane, pp. 180-187 Although well known by aboriginal people prior to the arrival of early white settlers, the Johnstone River was accidentally discovered in early 1873 by Sub-Inspector Robert A. Johnstone. By the end of the year a government backed expedition with a mandate to search for suitable agricultural lands was launched led by George Elphinstone Dalrymple and accompanied by the Government Botanist, Walter Hill.

[2] *ibid.* p. 219 & A.L. Martinuzzi, "Places and after Whom they are named", 1991, Innisfail and District Historical Society, Stories from Innisfail's Past, Volume 7, p. 12

[3] In 1910, Geraldton underwent a name change owing to a mix up by a wayward container ship seeking to port in Geraldton, Western Australia, and the duplicity of name rectified by the town being renamed Innisfail after Fitzgerald's sugar plantation home and after his home in Ireland.

[4] J. Callaghan, Bureau of Meteorology, Brisbane, "Tropical Cyclone Impacts Along the Australian East Coast, From November to April, 1858-2000", http://australiasevereweather.com/cyclones/index/html This means that slightly less than 25% of the total numbers of cyclones noted have crossed between Cairns and Cardwell with the area accounting just under 50% of the total number of cyclones to have affected North Queensland alone. This does not take into account the full impact of secondary damage such as flooding brought on by cyclones which cross further north at Cooktown or south at Townsville.

[5] David Henderson & Bruce Harper, 2003, *Queensland Climate Change and Community Vulnerability to Tropical Cyclones: Cyclone Hazards Assessment –Stage 4, Report,* Cyclone Testing Station, School of Engineering, James Cook University & Systems Engineering Australia Pty Ltd in conjunction with Queensland Government. p. 15. This was an estimation of damage resulting from Cyclone Tracey which destroyed Darwin in the Northern Territory in 1974.

[6] *Ibid.,* p. 40

[7] John Pryce-Davis,, the Cross over Hinchinbrook: Anglican Parish of Ingham 1886-1896, Diocese of North Queensland, p.17 & Cathie May, 1984, *Topsawyers: the Chinese in Cairns 1870-1920,* Studies in North Queensland History No 6, Department of History and Politics, James Cook University, p.102 For example, Danish and Scottish settlers near Halifax utilised local split palm trees for walls and fronds for thatching (in the Scottish style) when constructing the first Church of England church near Halifax, Chinese banana farmers in the Cairns, & Innisfail district utilised the long grass, to construct blady grass huts By bundling sheaths together for the walls and thatching them together for the roof securing them to battens with cane and South Sea Islanders, brought in for the sugar industry, wove great palm fronds mats and secured them to a framework for walls to construct interim buildings

[8] 1993, Innisfail and District Historical Society, Vol. 9, p.10

[9] Peter Bell, 1979 Vernacular Domestic Architecture in North Queensland Mining Towns, James Cook University. p. 8 & Architects and Builders Journal 7 March 1923 Editorial p. 1

[10] Bell, 1979, p. 10

[11] Josephine Sullivan, 2006, "Coping with cyclones North Queensland 1864-1980" Draft PhD Thesis, James Cook University, p.13. It left a whaleboat high and dry on a dune above the beach almost 100 yards inland.

[12] Callaghan, date unknown, unpaginated

[13] *The North Queensland Herald,* 18 April 1894, p.12

[14] In 1899, a huge cyclone passed over Charlotte bay near Cooktown completely destroying make shift dwellings belonging to Aboriginals, Chinese and Europeans and is still measured in intensity by reports that 55 pearl luggers completely disappeared, 45 were wreaked, and dolphins were found 15.2 metres up on the cliffs of Flinders Island.

[15] Belgium Garden State School Newsletter, 1 June 2007, p.2 & *The North Queensland Herald,* 18 April 1894, p.12. During tropical Cyclone Sigma 1896, up to 50 persons were accommodated at the Belgium Gardens State School and remained there in the day that followed as houses were secured or alternative arrangements met. Similarly during cyclone Zeta in 1894, which crossed above Cape Tribulation, severe flooding was experienced in Geraldton/Innisfail and 130 people took refuge in Public buildings most notably the Divisional Board Hall.

[16] Sullivan, 2006," Draft PhD Thesis, p.13 At the time of the 1867 Cardwell cyclone, it was observed that the better class of houses suffered less damage and in particular those with shingle roofs. This was also borne out in 1878 Cairns where most structures lost their roof, the hospital shingle roof remained intact.

[17] *ibid*. p.13 Letter to the *Port Denison Times.*

[18] Pryce-Davis,p.18

[19] Bell, 1979, p. 8. He went onto note, *"it is sometimes difficult on stylistic grounds to distinguish a north Queensland house built in 1886 to one built in 1914."*

[20] *Townsville Daily Bulletin,* Letter to the Editor, 29 March 1918. The introduction of reinforcing is a result of his prior experience in the 1896 cyclone Sigma, Townsville.

[21] Peter Bell 1999, "History of Babinda, Extract History from Cultural Heritage Study Babinda", for Cairns City Council, Natural Resource Assessment Pty Ltd, unpaginated.

As the only hotel to be built to service the needs of thirsty sugar cutters, the State Hotel Babinda was designed as a showpiece hotel and it incorporated both first and second class rooms. It remains a major landmark building in the

town. The notion that State constructed buildings were a better class of building is evident in the fact that it survived (although damaged) the 1918 cyclone as well as the recent cyclone Larry 2006.

[22] Miles Lewis, 200 Years of Concrete in Australia, Concrete Institute of Australia, pp. 31 & 34.
The first reinforced bridge in regional Queensland was constructed over the Mary River, Maryborough in 1896 but its use around Australia occurred in the mid 1880s as bridges and aqueducts.

[23] Dr Dawn May, 1997, The Building Boom in Cairns, "1907-1914", paper presented to FNQ Branch of the National Trust, 5 February 1997. For example in Far North Queensland five reinforced concrete buildings were constructed including two department stores between 1902 and 1907.

[24] Calls had been made after every major flood for years for a more permanent structure to service the district before the Gairloch Bridge was constructed.

[25] D. Jones, 1973, Hurricane Lamps and Blue Umbrellas, G.K. Bolton Printers, Cairns. p. 213. Constructed in 1907 by A. S Mellick, it was built using day labour. It was a prominent refuge of shelter for people in the 1918 cyclone and was a key building in turning the community view to reinforced buildings.

[26] William Birchley, 1997, "Memories of Innisfail in the early days", Innisfail and District Historical Society, 1995, Vol.13 In the 1911 flood many people sheltered in the Johnstone Shire Hall above the reach of flood waters.

[27] *Townsville Daily Bulletin,* 4 February 1913

[28] *Townsville Daily Bulletin,* 5 February 1918

[29] The lowest pressure reported was 938 hPa with maximum sustained wind speed estimated at 140-150 klm /hr but this is subject to speculation as the barometer needle fell off the page. Just as the Mackay cyclone showed just five weeks previously, the storm surge was estimated as one of the highest in North Queensland measuring over 8 ft or 3.1 mtrs. Though located 4 klm inland along the South Johnstone River, what remained of the rainwater tanks was filled with brackish water

[30] *Townsville Daily Bulletin,* 15 March 1918

[31] *Townsville Daily Bulletin,* "Interview with Mr J Robertson", 16 March 1918

[32] *Northern Herald,* 11 April 1918. This was Mellicks reinforced concrete store.

[33] *Townsville Daily Bulletin,* 23 March 1918. Damage to town estimated at £500,000

[34] *Northern Herald,* 21 April 1918

[35] *Townsville Daily Bulletin,* 16 March 1918. The bathroom and lavatory of the second class portion of the Babinda State Hotel were completely separated from the main building and the cost considerable. Damage at the time was estimated at £2500 the place was tarpaulin to cover the other rooms so that the first class rooms could be utilised for accommodation to house the needy.

[36] *Townsville Daily Bulletin,* 26 March 1918

[37] Interestingly enough so too did an old bark humpy near Mareeba, one of the first in the district.

[38] *Townsville Daily Bulletin,* "Interview with Mr J Robertson", 16 March 1918

[39] *Townsville Daily Bulletin,* 20 March 1918

[40] *Townsville Daily Bulletin,* "A Great Cyclone Experience", by R.G Johnson, 22 March 1918 Buildings which sheltered people including the timber Johnstone Shire Hall (300), the basement of Mellicks reinforced concrete building (200) and the basement of Nolan's newly constructed building. (150)

[41] Bell 1999, unpaginated. It was used again after the 1956 cyclone and after the 1986 cyclone. It still sits behind the Queensland Ambulance building as a reminder of extreme cyclonic conditions.

[42] *Townsville Daily Bulletin,* 14 March 1918

[43] *Townsville Daily Bulletin,* Letter to the Editor, 29 March 1918

[44] *The Local Authority Act 1902* superseded the *Divisional Boards Act 1879* when Divisional Boards were abolished and city, towns and shire councils were created. *The Local Authority Act 1902 was amended in 1910, 1922, '24, '25, '27 and 1929*

[45] Architects and Builders Journal, 11 October 1926, p. 17

[46] Architects and Builders Journal, "Measuring Sand for Concrete", 7 April 1923 & Architects and Builders Journal, 7 August 1923, p.10; The rate of construction was bolstered by technological advancements in the early 1920s which enabled sand to be reliability measured in bulk proportions as well as a more efficient delivery of cement introduced through the gravity system and the use of a gantry. This development was celebrated in the Architects and Builders journal as saving "*much time and labour especially in the erection of tall reinforced concrete structures."*

[47] Johnstone Shire Council, Finance Books, 1936-1939, held at the Johnstone Shire Council. The Van Leeuwin brothers not only had the equipment for large scale construction they very successfully tendered for projects though the proposition they put forth, that is to receive a percentage of the cost of works and through the supply of all equipment. Of course as costs of materials increased their returns reduced, a point not missed by the Johnstone Shire Council in the construction of the new Shire Hall in 1938. This development was celebrated in the Architects and Builders journal as saving "*much time and labour especially in the erection of tall reinforced concrete structures."*

[48] Johnstone Shire Council, "Cultural Heritage Study Innisfail CBD" for Johnstone Shire Council, Natural Resource Assessment Pty Ltd, 1998.

[49] Sullivan, 2006, Draft PhD Thesis, Chapter 12, p. 21. He was involved in the analysis of building failures which conclude that poor work included spans of over 20 feet (6.1 metres) fixed only the centre of the rafters by collar ties; cyclone bolts incorrectly placed through a batten between the rafters instead of beside the rafter; battens and rafters placed too far apart or too few cyclone bolts, tie bolts and anchor bolts; long sheets of roofing iron had insufficient fixtures to the rafters and some with only the ends fixed at the centre batten. Comprehensive in his analysis he supported a public campaign to be vigilant in maintaining an old roof and he was quick to advise that it was not enough to drive in old roofing nails as the heads just pulled off. Instead he advocated the need to use additional screws or replace ineffective battens
[50] *ibid.*, p. 23
[51] *ibid.*, p. 21. He was reflecting on house he constructed with one wall facing the sea on a headland having extra bolts and braces on the critical windward side. While all guttering and window shades were blown off the house remained intact.
[52] Henderson & Harper, 2003, p. 7
[53] Sullivan, 2006, Draft PhD Thesis, Chapter 14, p.38 The Cyclone Structural Testing Station was established in 1977 in the Department of Civil and Systems Engineering at James Cook University.
[54] *ibid.*, Chapter 14, p.5
[55] Henderson & Harper, 2003, p. 7
[56] Sullivan, 2006, Draft PhD Thesis, Chapter 14, p.6
[57] *ibid.*, Chapter 14, p.39
[58] Henderson & Harper, 2003, p. pp. 23 & 37
[59] *ibid.*, pp. 23 & 37
[60] Callaghan, date unknown, unpaginated
[61] David King & Douglas Goudie, 2006, *Cyclone Larry March 2006 Post Disaster Residents Survey*, Centre for Disaster Studies, James Cook University, pp. 44-45
[62] D. Henderson, J. Ginger, C. Leitch, G Broughton & D. Falck, 2006 *Tropical Cyclone Larry , Damage to Buildings in the Innisfail Area.* School of Engineering, James Cook University, p.13
[63] Wayne Goodall, 2007, " The Insurers Plan, Action and Response to natural disasters", a paper delivered to the Coastal Cities Natural Disaster Conference held in Sydney 20-21 February 2007, p. 6
[64] Queensland Heritage Register listing numbers: Johnstone Shire Hall (QHR 601579), Former St Andrews Church (QHR 602332), Paronella Park (QHR 602017), WWII Igloo Hall (QHR 601815). Yungaburra Police Station (QHR 600477), Babinda Hotel (QHR 602189) Cairns Plywood Sawmill (QHR 600481) and McCowat Farm (QHR 600632).
[65] This includes, impact of wind load against insufficient connections, flying debris, and tidal surge or flooding had been reduced.
[66] *The Burra Charter; The Australia ICOMOS Charter for Places with Cultural significance.* 1999 Australia ICOMOS Inc. p. 3 & 10