# CTS Information Bulletin June 2004

## Design, specification and installation of roof battens

The catastrophic loss of roof and wall cladding during tropical cyclone Tracy resulted in the identification and continuing research into this extreme wind loading and the low cycle fatigue failure mechanism. The consequences of failure pose a serious threat to the occupants through the loss of structure and to neighbours through flying debris. Damage inspections following Cyclone Vance also highlighted these issues.

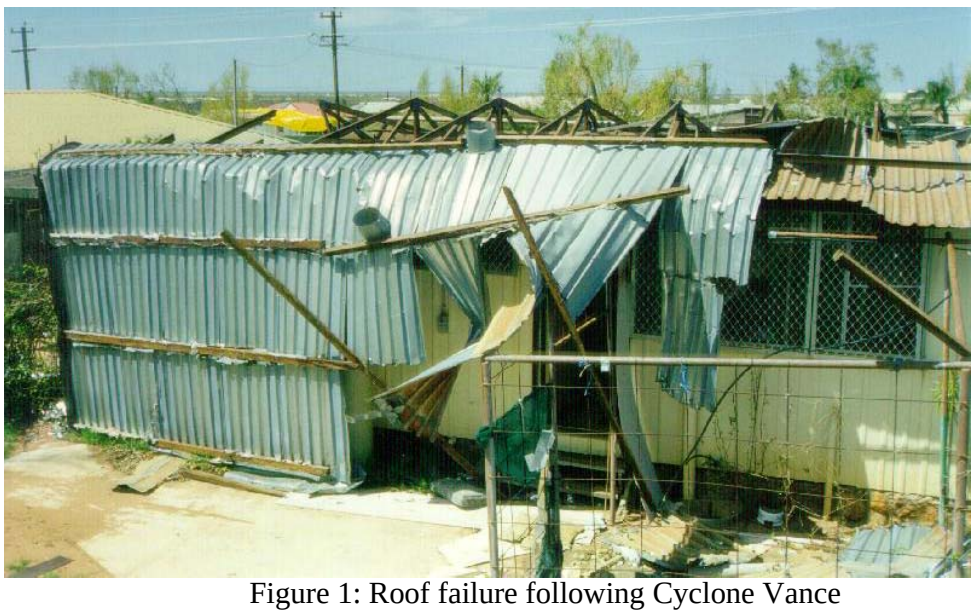


Figure 1: Roof failure following Cyclone Vance

The Building envelope (wall and roof cladding) during cyclonic events is subjected to severe dynamic wind loads. For domestic construction, when investigating disengagement or separation of cladding from a structure, five modes of failure from wind loading can be demonstrated;

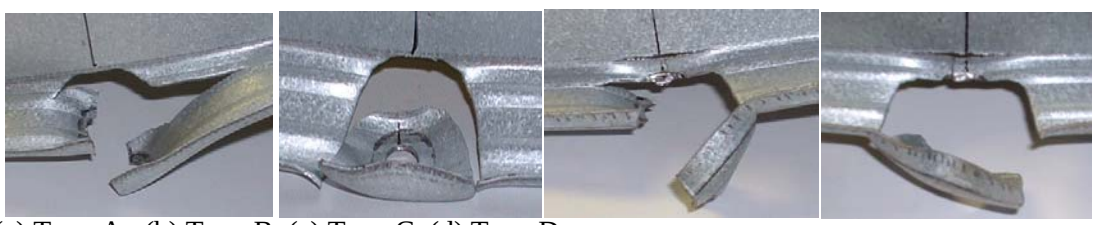
(a) cladding cracking/tearing and then disengaging from cladding fixing,
(b) cladding fastener breaking or withdrawing from batten,
(c) batten splitting/cracking reducing holding capacity of cladding fastener,
(d) batten failing at truss support, and
(e) batten/truss fixings failing.

Wind damage investigations following cyclones which hit northern Australia in the 1970s, found that most thin gauge sheet metal roof failures were initiated by fatigue cracking at the cladding fastener and the subsequent disengagement of cladding. This is reflected in latest changes to the wind loading code, *AS/NZS1170.2:2002* where Clause 2.5.5 states explicitly that cladding, its fixings and immediate supports shall demonstrate performance in resisting fatigue loading under the simulated cyclonic loading of 10200 load cycle pressure sequence defined in *AS4040.3*. Therefore, as per the Station's philosophy of testing the system and not just a component in isolation, the test includes the cladding, fixings, battens and batten fixings.

The requirement of applying cyclic loads on tributary areas supported by batten-truss connections is frequently queried by roofing system designers. Studies carried out by the CTS have shown that the batten-truss connections are subjected to fluctuating wind loads with the same characteristics to those acting on cladding fasteners. In fact, the CTS has shown that the batten truss connection tributary area is subjected to a larger number of load cycles than that of the cladding fastener tributary area. Therefore the batten and its connections needs to be designed for and tested to cyclic load criteria just as cladding is.

Research into light gauge metal top hat battens has indicated that the performance of the cladding/batten connection and batten/truss connection is susceptible to fluctuating loading as is many forms of cladding. The battens are susceptible to fatigue failure at loads smaller that their static failure load. Findings from the study showed that the fatigue performance of the battens was sensitive to several parameters such as the batten fixing condition (initial screw tightness, location, enough room in batten leg, screw head not touching web), the cross sectional shape of the batten, metal grade, and thickness.

It was observed that the battens exhibited different failure crack modes for different cyclic load levels as is the case for cladding. The range of crack patterns for the constant amplitude cyclic tests are shown in Figures 2 a, b, c, and d. The crack Type A and B were consistent with the higher loading (i.e. greater than about 60% of the average static failure load), whereas Type C and D crack patterns were associated with the load ranges lower than 60% of the average static failure load. The occurrence of different crack failure modes highlights the importance of satisfactorily representing the increasing then decreasing wind loads that occur during a cyclonic event.



(a) Type A (b) Type B (c) Type C (d) Type D

Figure 2: Fatigue failure of top hat battens for constant amplitude cyclic tests

The CTS is not advocating the use of one batten type over that of another. Some metal battens in the marketplace have been tested to the Australian Standard cyclic load criteria. We are however advocating that manufacturers, designers, certifiers and builders need to be aware when specifying the use of a roofing system (which includes the cladding, the cladding fixings, the battens and the batten fixings) that it has been designed and tested to appropriate cyclic load criterion. There is therefore a responsibility to ensure that the roof batten system is tested by the manufacturer, and then installed in accordance with the manufacturer's specifications.