FINDINGS

Certain house types can benefit from retrofitting for severe wind events

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Detailed vulnerability modelling was used to determine benefit cost ratios of ten representative Australian house types

Introduction

Houses built prior to 1985 have not been designed according to contemporary engineering based design codes and can be significantly more vulnerable to wind damage compared to newer housing.

The efficacy of a range of retrofitting options for 10 representative Australian houses (an example shown in figure 1) were analysed using the VAWS wind vulnerability modelling software and benefit cost ratios were calculated based on the annual average loss over a 30 year period.

Methods

The development of the VAWS vulnerability modelling software has been a major part of this BNHCRC project. The program simulates structural, debris and water ingress damage of a house based on input data from wind tunnel studies and testing of structural elements. Using a Monte Carlo approach, a damage index as a function of wind speed can be calculated for a range of retrofitting scenarios, shown in figures 2 and 3 which show vulnerability functions for a metal roofed house and a tile roofed house.

Benefit-Cost ratios were calculated based on cost information from a professional quantity surveyor and the net benefit of retrofitting calculated based on the annual average loss derived from the damage index functions.

Results

The benefit cost ratios, shown in table 1 account for the probabilities of wind damage occurring through the annual average loss calculations for the different wind regions. As such, there is generally no benefit of retrofitting the representative house types in the non-cyclonic wind regions A. On the other hand, benefit cost ratios close to and exceeding 1.0 were determined for certain retrofitting scenarios in the cyclonic wind region C.

Additionally, it was found that tile roof houses greatly benefit from certain retrofitting scenarios. Mainly due to the reduction of water ingress damage at lower and more frequently occurring wind speeds.

Discussion

The current benefit cost analyses only account for cost related to the damage of the house. Accounting for costs related to the disruption of economic activity in the community and mental health impacts of the event on citizens and other intangible costs would improve the benefit to cost of retrofitting older houses. However, this level of analysis is outside the scope of the current BNHCRC Project.

Further reductions in costs can occur when there is increased demand in the market for retrofitting. For example, the average costs of a full roof upgrade (scenario 9.4) during the Queensland Household Resilience Program were significantly lower than those calculated by the quantity surveyor, yielding a B/C ratio of approx. 2 for a full roof upgrade on house type 9. Additional benefits that are not accounted for in this study are potential reductions in insurance premiums that may be offered to customers for implementing retrofitting measures.

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Tables and figures

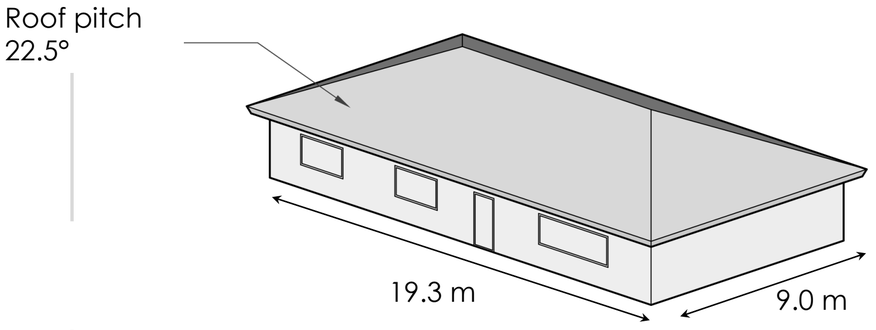

Figure 1 Overall dimensions of the hipped roof generic house types

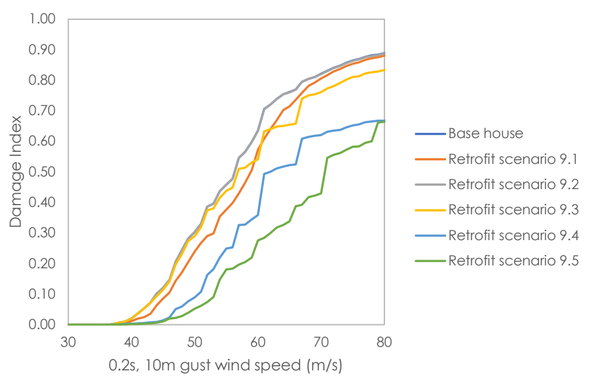

Figure 2 Vulnerability functions for house type 9 – brick veneer + metal roof cladding

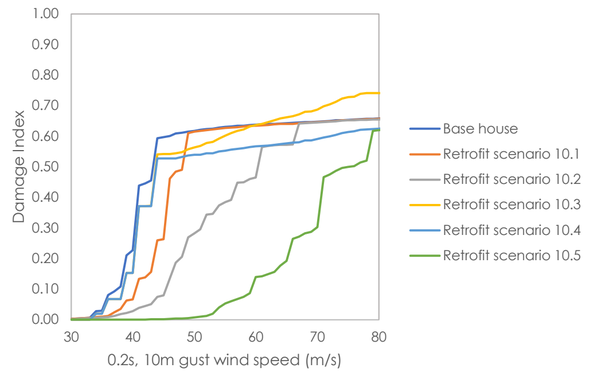

Figure 3: Vulnerability functions for house type 10 – brick veneer + tile roof cladding

Generic House Type	Retrofit Scenario	Retrofit Description	Benefit/Cost Ratio Region A	Benefit/Cost Ratio Region C
House Type 9	9.1	Window protection and door upgrade	0.00	0.94
-Brick Veneer	9.2	Roof sheeting upgrade	0.00	0.00
-Metal Sheet	9.3	Roof sheeting and batten connection upgrades	0.00	0.03
-Hip	9.4	Roof sheeting, batten connection and roof structure upgrade	0.00	0.56
	9.5	All upgrades 9.1 to 9.4	0.00	0.53
House Type 10	10.1	Window protection and door upgrade	0.06	9.03
-Brick Veneer	10.2	Additon of Sarking	0.02	4.75
-Tile	10.3	Addition of tile clips + batten connection upgrades	0.01	0.68
-Hip	10.4	Addition tile clips + batten connections and roof structure upgrade	0.01	0.58
	10.5	All upgrades 10.1 to 10.4	0.02	3.60

Table 1: Benefit cost ratios for a range of retrofitting scenarios for house types 9 and 10.

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