ROOF PITCH ANGLE

TECHNOLOGY DESCRIPTION

TECHNICAL DESCRIPTION

The pitch angle of the roof is indirectly proportional to the resistance against wind forces. Simply put, the steeper the pitch, the less the atmospheric pressure change forces on it when it is associated with an aperture for venting. An increased pitch roof of 8/12 to 9/12 is steep enough to resist uplift but shallow enough to resist overturning. Flat and low-slope roofs typically fail in high winds due to a force known as "uplift."

The steep roof pitch angle is a traditional roofing style in the Caribbean, which tells the steepness of the roof. The pitch of the roof is indirectly proportional to the resistance against wind forces. The steeper the pitch, the less atmospheric pressure change forces on it. The increased pitch roofs resist uplift, with 30 ° or 7/12 pitches being the best performers in storms[1] . In addition, when planning for storms, Gibbs (2000) advises steep pitches of 30° and 40°[2].

CLIMATE RATIONALE OF THE TECHNOLOGY

Hurricanes pose the most significant annual risk to infrastructure for the Caribbean region. The increased heavy rains and high winds are usually too powerful for the average roof to withstand, resulting in devasting roof damage or loss. Traditionally, construction methodology focused on steep roof pitches which are more resistant to high wind gusts. There are a number of these buildings remaining which have become historic homes that continue to withstand the test of time. Unfortunately, the construction of pitched roofs has declined significantly across the region as individuals progress towards modern roof designs with reduced pitches. As a result, modern roofs are more susceptible to hurricane damage as those designs do not aid in reducing wind load. However, steep roof pitches are steep enough to resist uplift but shallow enough to resist overturning. Coupled with an aperture in the roof design, pitched roofs greatly reduce atmospheric pressure within and around the structure.

Climate change has led to an increase in the occurrence of high-intensity hurricanes making landfall on the small island developing state (SIDS) of Antigua and Barbuda. Historically, most tropical depressions impacting the islands were of low intensity, usually tropical storms, or Category 1–3 hurricanes. Only nine Category 4 and two Category 5 hurricanes have been recorded since 1850[3], with eight of these more intense storms occurring in the last 15 years. Before 2017, there was no Category 5 hurricane formed in the Eastern Caribbean. Given the history of major hurricanes, the country's current infrastructure is designed to minimally withstand the impacts of hurricanes up to Category 3. However, continuing warming conditions over the Atlantic Ocean are resulting in an increased intensity of hurricanes in the Caribbean, with Antigua and Barbuda experiencing its first recorded Category 5 hurricane which was Irma in 2017[4].

[1] Taher, R. (2007). Design of Low-Rise Buildings for Extreme Wind Events. *Journal of Architectural Engineering. 13: 1*
[2] Gibbs, T (2000) Detaining for hurricanes
[3] Antigua and Barbuda Meteorological Services. Antigua Tropical Cyclones 1851–2018. Available at: http://www.antiguamet.com/Climate/HURRICANE_SEASONS/AntiguanStorms.txt
[4] Antigua and Barbuda GCF Funding Proposal

Antigua and Barbuda has historically been impacted by hurricanes. Due to climate change there has been an increase in the frequency of high-intensity storms, this includes category 5 hurricanes with wind speed less than or equal to 252 km/h. Damages amount to US$136 million with US$52.2 million in infrastructure alone, due to 2017 Hurricane Irma. This event caused 45 % of houses in Barbuda to experience roof damage.

Since existing building codes in Antigua and Barbuda have not accounted for Category 4 and 5 hurricanes, the impacts of such events have been severe, causing significant damage to houses and infrastructure, as well as disrupting basic services such as health, education, telecommunications, electricity, water, sewage, and waste systems.

The transition of the building sector to withstand climate change impacts will be costly. Category 4 and 5 resiliency standards can be incorporated into new buildings much easier than existing structures. The challenge of upgrading existing buildings to be Category 4 and 5 resilient is the cost which is estimated to be over US$ 6.4 billion[5]. Compare this to the 2020 GDP of Antigua and Barbuda which was US$1.42B, a 14.86% decline from 2019 (US$1.66B)[6].

AMBITION OF THE TECHNOLOGY

SCALE FOR IMPLEMENTATION AND TIME-LINE

The best roof pitch angle will be implemented as a pilot project in small scale residences. Public awareness campaigns will be carried out aimed at 20% of new buildings incorporating the technology by 2030.

EXPECTED IMPACTS OF THE TECHNOLOGY

With a standardised roof pitch angle that could withstand category 4 and 5 hurricanes, it is expected that this would increase the resilience of buildings on the islands. This in turn would reduce the destruction that buildings would incur if a category 4 or 5 hurricane impacts the country. This would in turn contribute to a decrease in the rebuilding cost for the private sector and government.

POLICY ACTIONS FOR TECHNOLOGY IMPLEMENTATION

EXISTING POLICIES IN RELATION TO THE TECHNOLOGY

There are currently no policies relating to the roof pitch angle for buildings in Antigua and Barbuda. However, the Building Code recommends nothing less than 4/12 for homes and 3/12 for verandahs.

PROPOSED POLICIES TO ENHANCE TECHNOLOGY IMPLEMENTATION

For this technology to be implemented, there needs to be an update to the building code for buildings to have a specific roof pitch angle that would be able to withstand category 4 and 5 hurricanes. Once this is included and

[5] Resilience cost data from applications to the Sustainable Island Resource Framework (SIRF) Fund.
[6] https://www.macrotrends.net/countries/ATG/antigua-and-barbuda/gnp-gross-national-product

implemented, the building being constructed would have to adhere to the requirements in order to gain approval from the Development Control Authority (DCA).

COSTS RELATED TO THE IMPLEMENTATION OF POLICIES

The cost of the implementation of the policy for this technology is estimated to be USD 20,000. These funds would be used to draft the specifications of the roof pitch angle to update the building code.

USEFUL INFORMATION

CONTACT DETAILS

TNA Coordinator: Jamila Gregory | Department of Environment ("DOE")

E: Jamila.Gregory@ab.gov.ag | **T**: +1 268 562.2568

Technology Champion: Department of Environment

E: doe@ab.gov.ag | **T**: +1 268 562 2568; +1 268 462 4625

LINKS TO TNA REPORTS

https://tech-action.unepdtu.org/country/antigua-and-barbuda/