

Residential Building Design and Structural Assessment

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Task 1

The carport is made primarily from steel and is gable-roofed, and was designed by the BCA requirements part 3.4 clause 3.4.2.6. According to Smith, Henderson, and Ginger (2015), steel is suitable since the structure is a permanent one which requires durability and the structural integrity will be maintained if the work is done as stipulated in the clause mentioned above.

Stability against Wind Forces

Roof coverings are subject to substantial and fluctuating uplift forces much higher than that of the roof; hence screws have been used to secure the roof from being blown off by strong winds. Additionally, the rafters, trusses, and tie-downs thereof are of large enough sizes to guarantee stability against wind forces.

The footings of the carport were also adequately embedded to guard against uplift forces occasioned by winds. The carport is supported by a wall on one side, which being permanent, also provides stability.

Stormwater

Elaborate drainage for stormwater has been provided, which collects the water from the gable roof.

Fire safety

The BCA requires that smoke detectors be installed for fire detection and early warning to protect from further spread of the fire.

Task 2

Materials

Timber framing is suitable as it meets the essential requirement in part 3.4.3, which requires, among

other things, that the building be a single story and be in an area with a design wind speed of not more than W41 (Board, 2015)

Stability against wind forces

The uplift forces that act on the roof coverings are quite dynamic and higher than that of the roof; hence the roof coverings were screwed to protect it from the effects of strong winds. The rafters used are also large enough to offer stability against strong winds. The footings of the carport have been designed to be very heavy to safeguard against the uplift of the structure by the strong winds that are prevalent in the area.

Stormwater

The plants are growing on the green roof help to arrest most of the storm water reducing the overflow which is directed into channels that lead on to farms.

Fire safety

A smoke detector is provided for early detection of any fire incidents.

Task 3

The house is located in Melbourne, wind classification N2 and soil classification M. The water table is 1.8m below the underside of the basement slab.

Relevant design standards

AS 2870/2011

AS/NZS 1170.2/2002

Main materials:

Concrete is indispensable when it comes to building basements and foundations. It is also resistant to environmental conditions, and this ensures durability.

Structural integrity: Concrete is strong in compression, offering powerful resistance to forces that act on the building throughout its lifetime.

Steel provides lightweight framing and is moisture resistant, thus most suited for the Mediterranean climate in Melbourne.

Structural integrity: It possesses a high strength in tension, undergoes tension hardening and is therefore suitable for use as reinforcement to concrete, adding to the ability of the structure to bear loads safely.

Stormwater management

Provide drainage systems that accommodate a return period of 1:100 years (Board, 2015). Also, eaves gutters should be provided for a 1:20-year return period, making sure no water enters the building.

Basement Walls

Laying the basement on undisturbed soil that will not compact under the weight of the house. Additionally, designing a more massive footing to provide an excellent hold on the soil is necessary (Smith, Henderson & Ginger, 2015). The rationale is that the soil is predisposed to moderate ground movements as a result of fluctuating moisture content. The other aspect of the basement walls is using a reinforced concrete base, the size of which is dependent on the level of the finished grade. This guarantees the structural adequacy of the basement walls.

Waterproofing

In addition to using reinforced concrete poured foundation to provide waterproofing, it is necessary to fit drainage below the basement floor slab as well as below the trench around the walls. Board (2015) recommends using gravel without stone dust below the slab, with spaces in between to facilitate water movement. Properly grading the surroundings of the building to avoid the formation of puddles as this can compromise the waterproofing.

Provision of services to the building

Utility services such as water, electricity, gas, and heating have to be provided. Piping for electricity has to be done as construction work progresses.

Fire safety

Using fire resistant material in construction, fitting the building with fire extinguishers at each level and incorporating emergency exits to be used if a fire should break out are some of the factors that

must be taken into account in the construction of this building.

The house in Townsville is an area with wind classification C2 and soil classification S. The water table lies approximately 1.6m below the natural ground level.

Materials

Concrete: the versatility of concrete as a construction material cannot be overstated. Its high strength performance in different environmental conditions suits it for use in this tropical climate as well.

Timber has the high tensile strength to withstand static, dynamic and transient loads, such as winds. It is, therefore, a critical consideration in this area that experiences cyclonic winds.

Structural integrity. Since the timber will be used in a tropical savanna climate, it will not be exposed to so much moisture as can compromise its structural strength and durability.

Storm Water Management

Since storms are of a much smaller intensity and rarely occur besides, it is sufficient to provide detention systems to capture the storm water for future use.

Basement

Similar to the class M requirements, except that the ground is prone to only slight movements, a smaller footing will suffice.

Waterproofing

Waterproofing of the basement is done from its interior by the application of cement-based slurry to both walls and floor. This will help contain the hydrostatic pressure of water and keep the basement waterproof. Waterproofing is paramount because the basement lies at the same level as the water table, with some parts being fully submerged.

Services

Water, electricity, gas, and cooling services will have to be installed per BCA guidelines.

Fire safety

Fireproofing the timber, fitting a fire extinguisher, and emergency exits are all essential aspects of fire safety that must be considered.

References

Board, A. B. C. (2015). National Construction Code Volume Two–Building Code of Australia.

Smith, D. J., Henderson, D. J., & Ginger, J. D. (2015, February). Improving the wind resistance of Australian legacy housing. In *Proceedings of the 17th Australasian Wind Engineering Society Workshop*.