HANDBOOK NO. 5

THE NATIONAL BUILDING CODE, 2024

STRUCTURAL DESIGN

NCA

NATIONAL CONSTRUCTION AUTHORITY

OVERVIEW

This handbook covers the following part of the National Building Code:

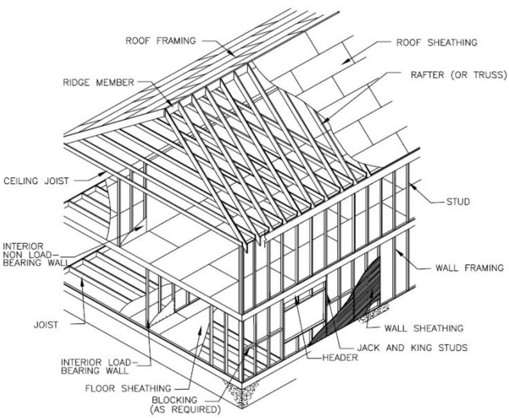
Part VI – Structural Design

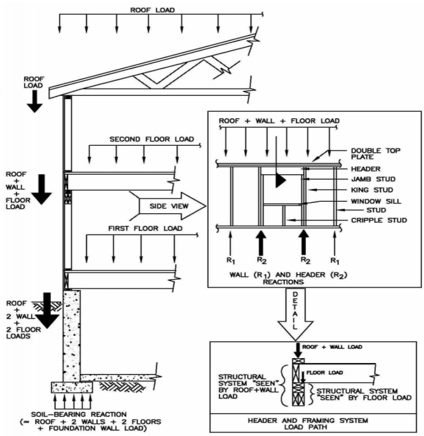
2.0 PART VI - STRUCTURAL DESIGN

This part comprises Paragraphs 60 to 86 of the Code.

The provisions outline in this part deal with compliance to Structural design requirements of a building. A building is a constructed structure designed to provide shelter, accommodate human activities, or house equipment and operations.

It is typically composed of multiple interconnected systems and materials to ensure durability, safety, and usability.





3.0 Importance of Structural Design

1. Ensures the safety and stability of structures.
2. Prevents structural failures or collapses.
3. Enhances durability and minimizes maintenance needs.
4. Facilitates efficient use of resources and materials.
5. Aligns with regulatory requirements and environmental considerations.

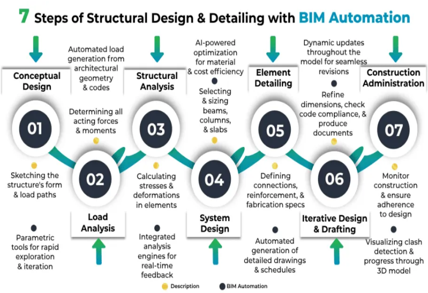
Fig 1: Structural design considered

Highlight of Main Requirements: -

Every building, structural element or component of a building and an incidental structure shall be designed to provide adequate structural resistance, serviceability, durability and reliability.

The structural design shall be done so that the building is able to

1. withstand wind, seismic and accidental loading
2. resist floatation, collapse of significant movement from hydrostatic hydrodynamic scour, caused by a defined flood event.
3. comply with elevation requirements
4. comply with material requirements and utilities
5. enable occupant egress



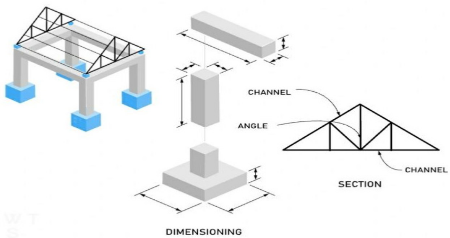


Fig 3: Structural Design process

A structural design shall be governed by ultimate limit state design requirements and pass serviceability limit state design checks in accordance with the relevant Eurocodes

Appropriate structural details must be provided in the structural design.

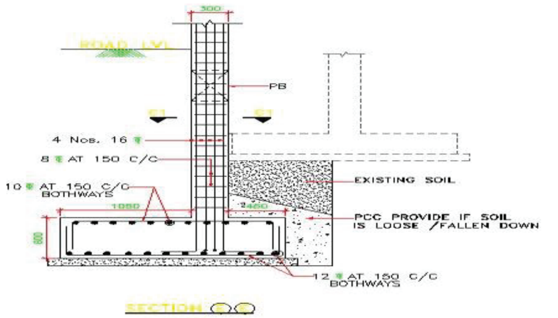


Fig 4: Column Base structural Detail

Construction materials used in the structural elements must be in accordance with provided specifications and appropriate testing to be done on those construction materials that need approval

Fig 5: Construction materials and laboratory material testing

A structural design shall be done by a qualified Engineer who shall confirm that the structure has been erected in accordance with the approved design, and shall furnish to the approving authority a certificate to that effect.
The engineer shall supervise and provide quality control at all stages of the design and construction of structural works.

Fig 6: Engineers designing and supervising structural works

Fig 7: Geotechnical investigation

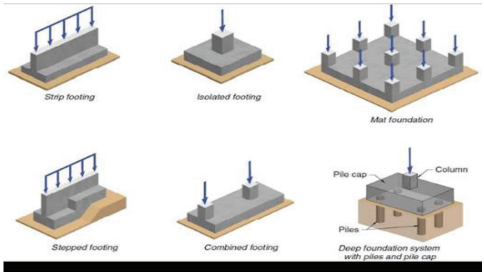


Fig 8: Types of foundation

The soil on which the foundation is laid must not be a heaving soil, shrinkable clay, or a soil with a collapsible fabric. The soil on which the foundation is laid must not be a heaving soil, shrinkable clay, or a soil with a collapsible fabric.

Fig 9: Black cotton soil

Fig 10: Cracks on walls due to foundation failure

The width of a continuous strip foundation shall be not less than 600mm where a foundation is for a load-bearing wall and 400mm where a foundation is for a non-load-bearing internal masonry wall.

Where the strip foundation is laid at more than 1 level, at each change of level, the higher level of the foundation shall extend over and unite with the lower level of the foundation for a distance that is not less than the thickness of the levels of the foundation, and is at least 300mm.

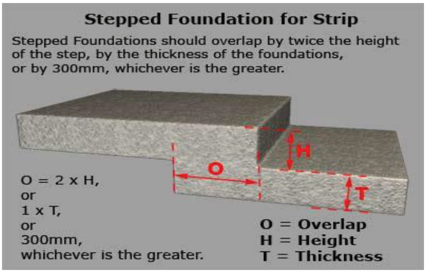


Fig 11: Stepped strip foundation

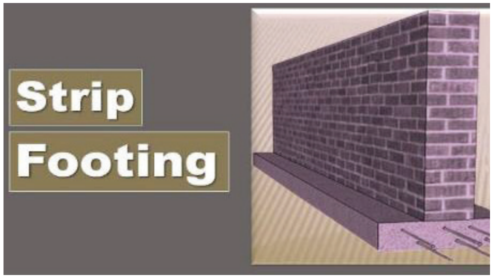


Fig 12: Typical strip foundation

The foundation of a load bearing structure of a single storey building, can be constructed as a strip foundation of plain concrete situated centrally under the walls or piers and shall be constructed in such a manner that ensures the thickness of the concrete is at least that of its projection from the base of the wall or footings, and is at least 250mm.

If a single storey residential building is constructed with external walls of a thickness of 150mm, the thickness of the concrete used in the strip foundation may be reduced to at least 150mm if the bearing capacity of the subsoil is at least 75kN/m2.

Where an excavation related to a building is carried out and the excavation is likely to impair the safety or stability of any property or service, the owner shall take adequate precautionary measures to ensure that the safety and stability of the property or service, is maintained.

Fig 13: Protection of excavation from collapse

An owner shall, at least, seven days prior to the commencement of an excavation, notify the approving authority, in writing, of an intention to excavate and obtain an approval to do so.
An excavation for foundation that exceeds a depth of 3m shall be designed by an engineer and shall be taken down to firm natural ground, the bottom shall be horizontal, cleaned and, where necessary, stepped or dowelled to prevent lateral movement.
If foundation is cast in a filled ground, then approved design measures shall be taken to ensure the stability and the serviceability of the building.

Welding in the fabrication of structural steel work shall be undertaken only if approved in the design.

A canopy or a cantilever shall be of an approved design and construction ensuring stability of the structure and at least 3.2m above the level of the footway. The end of the canopy shall be off set from the kerb line by not less than 0.7m.

The upper surface of every canopy, shall be properly **water proofed** and designed to prevent the discharge of water directly into a road.

Fig 14: Cantilevered canopy and balconies

The **dead load** of a building or any part of the dead load shall be calculated from the unit weights given in KS EN 1991-1-1 (Actions on Structures, General Actions – Densities, Self-weight, Imposed Loads on Buildings), or from the actual known weights of the materials used.

Imposed load shall be in accordance with the requirements of KS EN 1991-1-1 (Actions on Structures, General Actions, Densities, Self-weight, Imposed Loads on Buildings).

The calculation for the imposed load on a roof shall be in accordance with KS EN 1991 (Actions on Structures).

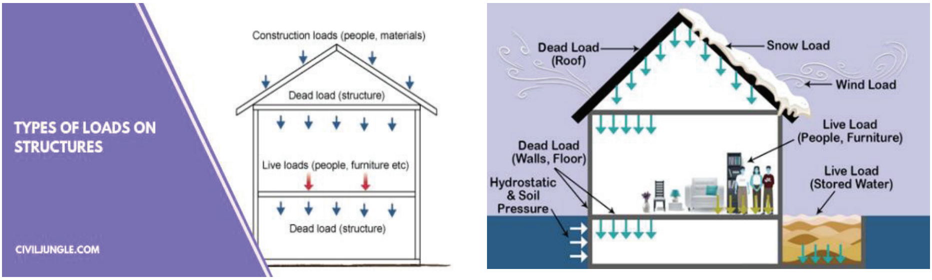


Fig 15: Types of loadings on a building

Dynamic loading on a building that is susceptible to swaying or activities that could introduce vibrations at resonance frequency shall be designed in accordance with KS EN 1991 (Actions on Structures).

Wind load design of a building, structure and any component thereon shall be considered in accordance with KS EN 1991-1- 4 (General Actions – Wind Actions Suitable Wind Pressures) and the varying heights or different structural shapes and other factors that may be involved.

Earthquake load design shall be in accordance with KS EN 1998 (Design of Structures for Earthquake Resistance) using the seismic zoning map of Kenya as provided by the Ministry responsible for Mines and Geology to determine earthquake intensities.

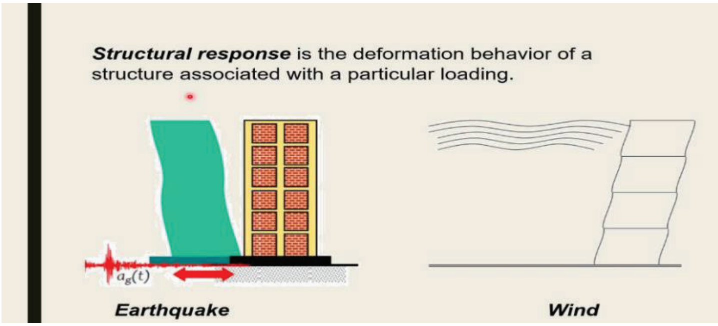


Fig 16: Effects of earthquake and wind loading on a building

Construction works shall be designed and built in such a way that in the event of a **fire outbreak**, the load bearing resistance of the construction works shall take such period of time to allow necessary rescue to be carried out.

Design for thermal movement shall be done and Where necessary, a check that thermal movement shall not lead to overstressing shall be done by provision of movement joints **(expansion joint)**

Fig 17: Expansion joint details

9th Floor, KCB Towers Kenya

P.O.Box 21046-00100

+254 709 126 102/172/173

www.nca.go.ke

info@nca.go.ke