DEAD LOADS VS LIVE LOADS

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In the engineering and construction industry, dead loads and live loads are two fundamental concepts that play a pivotal role in determining the strength and stability of a building. Dead loads and live loads are distinct yet interconnected factors that engineers must carefully consider when designing structures. They are essential components of the structural analysis process, influencing everything from material selection to safety margins.

Understanding the differences between dead loads and live loads is pivotal for engineers, architects, and construction professionals. It shapes their decisions regarding the choice of materials, the design of support structures, and the overall safety of a building. Balancing these two forces is crucial to ensure that the structure remains stable and secure.

Dead Loads

Dead loads refers to a structure's static, non-moving weight or any permanent components that form an integral part of the structure. These loads combine the weight of all the structural materials and components used to construct the building that are considered fixed [1].

Dead loads include the weight of all the materials used in the construction of a structure, including but not limited to:

i. The building's framework - beams, columns, walls, and floors.
ii. Roofing materials - shingles, tiles, or metal sheets.
iii. Flooring materials - concrete slabs, wood, or tiles.
iv. Exterior cladding materials - brick, stone, or siding.
v. Interior finishes - drywall, paint, and ceiling materials.
vi. Permanent fixtures - cabinets, sinks, and built-in furniture.

Dead loads are crucial for maintaining the structural stability of a building or structure. They provide vertical support and counteract the forces and moments that the structures experience. Engineers calculate dead loads by estimating the weight of each component and material used in the construction and then total up the weight to determine whether the total dead loads are static and known in advance. Dead loads are generally distributed uniformly over the entire structure [1]. Thus, every structural element must be designed to carry its share of the weight. For example, the columns and beams in a building are sized to support the weight of the floors and roof evenly.

Under the design phase, engineers must carefully consider dead loads to ensure all the components can safely support them without excessive deflection or stress. The design process involves determining the size and strength of structural members, selecting appropriate materials, and ensuring that the foundations can withstand the total load of the structure. Engineers often apply safety factors to their calculation which is 1.4 for dead loads, to account for any uncertainties in load estimation, variations in material properties, and potential construction errors [1]. These safety factors help ensure the safety and durability of the structure.

Dead loads remain relatively constant unless the structure undergoes modifications or renovations. In such cases, engineers must recalculate the dead load distribution to ensure that the existing structure can support any added weight.

Live Loads

Live loads, commonly referred to as "occupancy loads" or "variable loads," remain changes in forces that structures receive due to the presence of people, equipment, furniture, vehicles, and other temporary loads. Live loads can vary widely depending on the building's purpose and

occupancy. Hence, engineers must plan for a maximum live loads that is likely to be much more extreme over the course of its lifetime.

Live loads can be categorized into different types based on their sources and usage. Common types of live loads include:-

i. **Occupancy Loads**: The weight of people, furniture, and equipment in buildings or structures. The specific load values depend on the expected occupancy and use of the space.
ii. **Snow Load**: The additional weight imposed by accumulated snow on roofs, decks, and other horizontal surfaces. Snow loads vary based on geographic location and climate.
iii. **Vehicle Loads**: The weight of vehicles on bridges, parking garages, and roadways. Vehicle loads include static loads and dynamic loads.
iv. **Storage Loads**: Loads from stored materials or goods in warehouses, storage facilities, or industrial structures. These loads can vary in density and distribution.

Live loads in Malaysia are specified in BS 6399-1 and depend on the type of occupancy and use of the building or structure. These loads account for the weight of people, furniture, equipment, and any other movable loads [2]. The code provides guidelines for calculating live loads based on factors of occupancy type, location, and intended use.

Moreover, live loads are variable in nature, and engineers must consider the worst-case scenarios when designing structures. These involve estimating the maximum expected live loads for a given space or structure type. For example, in a commercial building, engineers must consider the maximum number of occupants that the space can accommodate and the weight of heavy equipment that may be present.

The next aspect to be considered in designing live loads is the structural engineering factor. It is a safety margin, known as the “factor of safety” which is 1.6 for live load [2]. This margin accounts for uncertainties in load estimation and ensures that the structure can safely support the live loads it may encounter during its service life. Live loads might fluctuate over time owing to changes in occupancy or use. Inspections and maintenance are necessary to spot and resolve problems involving live loads or other structural elements.

Summary of the Differences between Dead Loads and Live Loads

The fundamental distinctions between dead loads and live loads are outlined in Table 1. It is crucial to note that the actual figures for dead loads and live loads will vary based on parameters such as building occupancy, location, and the specific design standards. These concepts are used by engineers to guarantee that structures are built safely and sustainably.

Table 1: Dead Loads vs Live Loads

Aspect	Dead Loads	Live Loads
Nature of Load	Static, permanent loads that do not change	Dynamic, temporary loads that can change over time.
Examples	Building materials, structural components.	People, furniture, vehicles, equipment, snow.
Variability	Remains relatively constant over time.	Varies in magnitude, location, and duration.
Calculation	Calculated from the weight of materials.	Based on occupancy type, usage, and standards.
Safety Factors	Considered with factors of safety for safety.	Considered with factors of safety for uncertainties.
Impact on Structure	Provides vertical support; counteracts loads.	Can cause deflection, vibration and stress.
Design Consideration	Structures sized to support total dead loads.	Must accommodate maximum expected live loads.
Factor of Safety (FoS)	1.4	1.6

Conclusion

In conclusion, it is essential for structural engineers and construction professionals to comprehend the differences between dead loads and live loads. The cumulative impacts of these loads must be efficiently supported by the structure without causing it to undergo excessive stress, deflection, or deformation. To ensure the safety and durability of the structure's element, it is vital to comply with the local construction codes and standards. A key aspect of structural engineering is accurately estimating dead loads and live loads to ensure that structures function efficiently and securely throughout their service lives.

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