Structural Concerns Specific to Data Center Design

Floor loading (superimposed live load) shall be a minimum of 7.2 kPa2 (150 lbf/ft2) with 1.2 kPa (25 lbf/ft2) hanging dead load (weight that can be supported from the underside of the floor or roof). This floor load is adequate for most data center areas.

1.2 kPa (25 lbf/ft2) hanging dead load, the recommendation in this standard is a uniform load of 12.0 kPa (250 lbf/ft2) with 2.4 kPa (50 lbf/ft2) hanging dead load to provide flexibility in the location of higher floor loads such as large storage arrays, printing facilities, and densely populated blade server cabinets.

In specific regions of the access floor area where this equipment is located, the structural engineer should be notified of the specific operating weights.

Floors for battery rooms should be designed for a minimum superimposed live load of 12.0 to 23.9 kPa
(250 to 500 lbf/ft2).

Roof areas over battery rooms should be designed to support a minimum suspended dead load of 1.4 kPa
(30 lbf/ft2).

Raised Access Floors

Raised access floors are commonly used in data centers. When raised access floors are in use, all raised access floors shall meet Rwanda standards board special access floor requirements.

Raised access floors shall be designed and tested as a Designated Seismic System and shall have Special Certification Requirements as defined in the Rwanda standards board. The response spectra shall be calculated at the bottom and at the top of the raised access floor to determine the demand on the equipment mounted on the floor. The response spectra shall be computed for the in-structure response accounting for the structural support in addition to the response characteristics of the raised access floor.

The Rwanda standards board do not appropriately address seismic vertical ground motions and the amplifications of vertical ground motions in the structure. The nuclear industry and military industry require the calculation of the seismic demand because of vertical ground motions that is referred to as the seismic demand. UFC 3-310-04(Seismic Design of Buildings) can be used as a reference to determine a methodology to seismically qualify raised access floors.

Because of the importance of data centers, an in-structure response analysis should be used to compute the coupled response of a raised access floor. A coupled response can then be used to

develop response spectra for equipment mounted on the raised access floor.

Equipment that is determined to be mission critical shall be designed and tested to determine the seismic demand and the equipment fragility. The seismic demand of mission critical equipment shall be determined at the point of attachment of the equipment.

Equipment determined to be mission critical shall specify the performance expectations. The seismic demand shall be determined at the point of attachment. The point of attachment may be a structural element, or it may be a nonstructural component (such as a raised access floor). If required, a coupled dynamic analysis may be required to determine seismic demand.

Wind

In the design of data centers, the implementation team should verify the wind-loading calculations with Rwanda Environment Management Authority for wind and it has to be considered in the project plan.

Earthquake

Data centers are placed in International building code Risk Category IV because of their criticality. The owner may elect to use a reduced Risk Category rating of II if the facility does not have to operate after an earthquake.

Designating a facility as Risk Category IV will still not necessarily ensure a data center will be functional following a major earthquake. If a facility is intended to be operational with a high degree of confidence following a major seismic event, it should be designed in accordance with the provisions of UFC 3-310-
04(seismic design of building) for Risk Category V.

For data centers, special attention must be paid to the design of specific nonstructural components, such as raised access floors, that will have a direct impact on the survivability of the computer functions after an earthquake.

Depending on the height of the raised access floor and the amount of a mass supported as well as the magnitude of the earthquake, it may be necessary to isolate the access floor from the rest of the structure.

The process of isolation is generally referred to as base isolation. Base isolation is also a valid consideration for the entire building. Base isolation creates other concerns for elements that cross the plane of isolation. Care must be taken in the anchorage of generators, chillers, fans, switchgear, piping and conduit, and racks. The force on the support for these elements will be substantially increased as a function of their mass multiplied by the dynamic coefficients addressed in the code enforced earthquake design. The in- structure demand response spectra must be compared to the fragility of the nonstructural component.

Blast and Terrorist Attack

Many data centers are designed to resist the effects of a terrorist attack. Terrorist attacks can be in many forms, but the most prominent attack is in the form of a blast from some manner of vehicle-borne improvised explosive device (VBIED). Security experts and law enforcement should be consulted to quantify the size of an explosive device.

Security and physical site barriers should be constructed to maximize the distance that a VBIED can be from the data center. The blast dynamic pressures can be calculated and compared to the response of the data center structure and building envelope elements. Guidance for blast-resistant design may be found in the regulations of Rwanda standards board.

Smaller explosive devices can be mitigated by screening processes that place the threat at a defined distance from the facility.

Terrorist attacks can take many forms that can include introducing chemical, biological, or radiological agents into a facility. Protection should include screening for compounds that could be brought into a facility clandestinely and controlling air supply into a facility.

Revision #2
Created 3 October 2025 11:28:52 by RISA
Updated 3 October 2025 11:31:35 by RISA