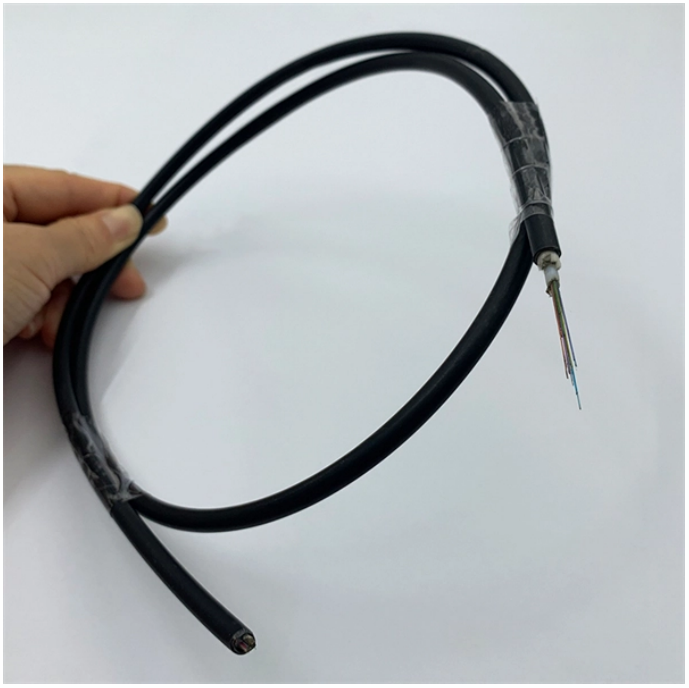
Case Study of Seismic-Resistant Server Rack Construction in the Philippines



Overview

Telecommunication system is one of the critical lifeline systems for national life and post-earthquake emergency response. Telecommunication equipment is the necessary components to preserve communication functionality of telecommunication system. The severe damage and functionality loss of data center buildings resulting from damage to telecommunication equipment are frequently reported following earthquakes. Thus, there is an increasin. Telecommunication system is one of the critical lifeline systems for national life and post-earthquake emergency response. Telecommunication equipment is the necessary components to preserve communication functionality of telecommunication system. The severe damage and functionality loss of data center buildings resulting from damage to telecommunication equipment are frequently reported following earthquakes. Thus, there is an increasing need to understand the performance of telecommunication equipment during earthquakes.Seismic investigation of three server cabinets in internet data center buildings are presented in this study. The seismic damage and dynamic

characteristics of server cabinets were evaluated and explained in terms of the natural frequency, stress, acceleration, dynamic amplification factor, and deformation by triaxial shaking table tests. The input acceleration time histories were generated based on the required response spectra in YD 5083 code and AC 156 code, with seismic intensities ranging from 0.1 g to 1.2 g. Based on the test results, the effects of different mass distributions inside the cabinets and earthquake inputs were investigated. The seismic damage limit states of server cabinets were identified based on observed damage phenomenon. The corresponding seismic fragility models of server cabinets were developed based on shaking table tes. ••Shaking table tests were conducted on three server cabinets.••The seismic response of server cabinets was investigated.••The seismic damage limit states of server cabinets were identified.••Seismic fragility curves of server cabinets were developed.••The efficiency of different IMs in predicting the damage states was estimated.Server cabinetShaking table testSeismic performanceSeismic damageAs technology rapidly increases and the information age expands, cloud computing is becoming a quite important service. To maintain the cloud computing service, internet-based data is usually managed from remote locations, all data is entered, saved, processed, and backed up on central servers. The data center is a location where all of these servers are assembled. In addition, data communication networks are quite important for immediate post-earthquake emergency management and community resilience. And the post-earthquake functionality of data communication networks relies on the normal operation of data center buildings. Over last two decades, telecommunication networks including the data center buildings and the inside telecommunication equipment suffered serious damage under huge earthquakes. Damages to non-structural components (NSCs) including equipment can affect the normal operational capacity of internet data center (IDC) buildings, which can cause an increase in number of deaths and result in economic, architectural, and historical losses of the community. Damages of telecommunication cabinet equipment with insufficient or inappropriate connections to the ground or floor slab are usually found in historical earthquakes, as presented in Fig. 1. Therefore, the design and test codes of telecommunication equipment such as YD 5083 code in China required the designers and constructors to ensure the effectiveness of anchor and the seis. 2.1. SpecimenThe server cabinet is used to install panel, plug box, and electronics devices, which constitute an integral installation box. It provides appropriate environment and safety protection for the inside electronic devices and equipment to ensure normal operation. A server cabinet is usually composed of the main frame, top plate, bottom plate, lateral plate and doors in a cuboid shape. The actual tested server cabinets were considered to be typical of that utilized in the IDC buildings. The details of specimens are summarized in Table 1 and shown in Fig. 2. The cabinet has a total weight of

176 kg and overall dimensions of 600 mm (width) × 1200 mm (length) × 2200 mm (height). For shaking table tests, different mass distributions were considered. The total additional masses for Cabinet 1, 2, and 3 are 500, 300, and 500 kg, respectively. Five cage pallets were fixed on the frame by screws and the additional masses were distributed along the height of the cabinets in these pallets, as shown in Fig. 2. The additional mass block weighted 10 kg/piece and 10 or 6 pieces were fixed to the pallets by screws rigidly for Cabinet 1, 3 and Cabinet 2, respectively. The main material of the frame is cold rolled steel plate with a thickness of 2.0 mm and is welded as a whole structure. The door is made of hot dip galvanized steel with a thickness of 1.5 mm. The lateral plate, bottom plate, and top plate are 1.0, 1.

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