GUIDELINES AND IMPLEMENTING RULES ON EARTHQUAKE RECORDING INSTRUMENTATION FOR BUILDINGS
GUIDELINES AND IMPLEMENTING RULES

NBCDO Memorandum Circular No. 01 Series of 2015 Issued to All Building Officials Dated Mar. 12, 2015

Signed by DPWH Sec. Rogelio Singson

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Manila

MAR 12 2015.

NBCDO MEMORANDUM
CIRCULAR No. 01
Series of 2015

SUBJECT: GUIDELINES AND IMPLEMENTING RULES ON EARTHQUAKE RECORDING INSTRUMENTATION FOR BUILDINGS

TO: All Building Officials
City / Municipal Engineers and Others Concerned

In the interest of the service and to ensure compliance of all concerned to the provisions of "Section 105.2 – Earthquake Recording Instrumentation of the National Structural Code of the Philippines (NSCP) and Section 102 of the National Building Code of the Philippines, otherwise known as P.D. 1096", it is hereby directed that the GUIDELINES AND IMPLEMENTING RULES ON EARTHQUAKE RECORDING INSTRUMENTATION FOR BUILDINGS approved by DPWH as part of the IRR of the National Building Code, shall be adopted immediately. The memorandum dated July 15, 2013 issued by then NBCDO Acting Executive Director Emmanuel P. Cuntapay, is hereby superseded.

All Building Officials must submit to the undersigned a quarterly report, Attention: The National Building Code Development Office, for monitoring of compliance to the said Guidelines and Implementing Rules.

For strict and immediate compliance of all concerned.

ROGELIO L. SINGSON
Secretary

Department of Public Works and Highways
Office of the Secretary

WIN5V14952

Encl.: (1) Section 105.2 of NSCP, 2010, 6th Edition
(2) Section 102 of the National Building Code of the Philippines
(3) Guidelines and Implementing Rules on Earthquake Recording Instrumentation for Buildings
(4) Memorandum dated July 15, 2013

7.5.1 JVD/GRV
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Secretary

Department of Public Works and Highways
Office of the Secretary

WIN5V14952
Memorandum dated March 13, 2015 Addressed to All Building Officials Signed by NBCDO Director Atty. Johnson Domingo
MEMORANDUM

TO: ALL BUILDING OFFICIALS
   City/Municipal Engineers and Other Concerned

Office of the Building Official
Caloocan City
Received
By: [signature] Date: [Date]
9:45am

Forwarded herewith is the NBCDO MEMORANDUM CIRCULAR NO. 01, Series of 2015, directing All Building Officials, City/Municipal Engineers and Other Concerned that the GUIDELINES AND IMPLEMENTING RULES ON EARTHQUAKE RECORDING INSTRUMENTATION FOR BUILDINGS approved by the DPWH as part of the IRR of the National Building Code, shall be adopted immediately.

For your information and compliance.

ATTY. JOHNSON V. DOMINGO
Acting Executive Director
National Building Code Development Office
The Guidelines & Implementing Rules

- Provides **earthquake recording instrumentation schemes** for buildings to record building response during major seismic events for subsequent analysis.

- Provides **immediate alarm annunciation** to ensure that the building occupants can be moved to safety.
History

- Was first required in **National Structural Code of the Philippines (NSCP) 1992, 2nd edition** for **strength design capacity** on the building based on seismic parameters of the **Uniform Building Code (UBC) of U.S.**

- Due to experiences in **1994 US** and **1995 Japan** earthquakes, **structural code developers** started to recognize the importance
  - not only **strength** as well
  - **serviceability**
  - **performance**
History

- DPWH reiterated the **NSCP provision in 2001 5th edition and the latest 2010 6th edition** as it was deemed necessary to improve our understanding of the **building response** based on **real seismic event** from local earthquake generators by enforcing placement of earthquake recording instrumentation for buildings.
The provision states that “unless waived by the building official, every building in Seismic Zone 4 over fifty (50) meters in height shall be provided with not less than three (3) approved recording accelerographs. The accelerographs shall be interconnected for common start and common timing.”

The waiver was temporarily suspended since the Philippine needs to have its own earthquake baseline data for validating the seismic design parameters used during and future structural design of building in order to support earthquake disaster mitigation efforts.
Guidelines’ Objectives

- Developed primarily to **Safeguard lives**

- **Clear understanding** of the actual dynamic behavior of buildings/structures under earthquake loading

- **Confirm the structural design parameters** used or to be adopted in compliance to the specific provisions of NSCP.
Uses of Recorded Data

- The recorded data will be used to improve the safety provisions of local structural code in order to:
  - reduce loss of lives and limbs
  - properties during future damaging earthquakes

- The recorded data will be used to improve understanding of the behavior and potential damage of building under the dynamic load of earthquakes.
Uses of Recorded Data

- Sited uses of the recorded data can be achieved through the development of an integrated network that measures the earthquake source, transmitted ground motions, and structural response.
- These measurements will be correlated with observations of structural response to evaluate the current design and construction practices in order to minimize damage to buildings during future earthquakes.
Uses of Response Data

- **Response data from several buildings** will also be used as the **basis** for the government's **earthquake disaster mitigation/remedial and rehabilitation strategies** including its emergency response and relief operations programs.

- The recorded data are also important parameters for:
  - buildings' safety re-evaluation
  - resumption of occupancy
Other Uses of Seismic Recording and Instrumentation

- The seismic recording and instrumentation machine must be used to set off alarms at specified intensity levels
  - triggering real-time alarm information
  - trigger automatic switch off for utilities
Application

The requirements of Earthquake Recording Instrumentation (ERI) shall apply to

- **all existing buildings** listed in Table 1, located in **Seismic Zone 4 (entire Philippines except, Palawan and Tawi-Tawi located in Zone 2)**, prior to issuance of Certificate of Occupancy.

- **Building Permits** shall only be issued on buildings required for seismic instrumentation when **site or location of Seismic Instrumentation Room (SIR) has been indicated or incorporated in the plan.**
# Application

## TABLE 1. SEISMIC INSTRUMENTATION REQUIREMENTS

<table>
<thead>
<tr>
<th>TYPE/HEIGHT OF BUILDING</th>
<th>LOCATION</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GOVERNMENT BUILDINGS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Hospitals, schools and other buildings above fifty (50) meters in height</td>
<td>At least 3 accelerographs located at: 1. Ground Floor/lowest Basement; 2. Middle Floor, and 3. Floor below Roof</td>
<td>ERI in compliance with this IRR</td>
</tr>
<tr>
<td>B. Hospitals with fifty (50)-bed capacity or more and schools with twenty (20) classrooms or more but not than three (3) storeys</td>
<td>One Accelerograph installed at Ground Floor/lowest Basement</td>
<td>ERI in compliance with this IRR</td>
</tr>
<tr>
<td>C. Provincial/City/Municipal Halls and Buildings</td>
<td>One Accelerograph installed at Ground Floor/lowest Basement</td>
<td>ERI in compliance with this IRR</td>
</tr>
</tbody>
</table>
## Application

<table>
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<tr>
<th>TYPE/HEIGHT OF BUILDING</th>
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<tr>
<td>PRIVATE BUILDINGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Buildings above fifty (50) meters in height</td>
<td>At least 3 accelerographs located at: 1. Ground Floor / Lowest Basement 2. Middle Floor, and 3. Floor Below Roof</td>
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<tr>
<td>B. Hospitals with fifty (50)-bed capacity or more and schools with twenty (20) classrooms or more but not less than 3 storeys</td>
<td>One accelerographs installed at the Ground Floor / Lowest Basement</td>
<td>ERI in compliance with this IRR</td>
</tr>
<tr>
<td>C. Commercial buildings with occupancy of at least 1,000 persons or gross floor area of at least 10,000 square meters.</td>
<td>One accelerographs installed at the Ground Floor / Lowest Basement</td>
<td>ERI in compliance with this IRR</td>
</tr>
<tr>
<td>D. Industrial buildings with occupancy of at least 1,000 persons and gross floor area of at least 10,000 square meters</td>
<td>One accelerographs installed at the Ground Floor / Lowest Basement</td>
<td>ERI in compliance with this IRR</td>
</tr>
</tbody>
</table>

Blueprint of the as-built plans of the buildings;
IMPORTANCE OF CERTIFICATION

Newly constructed buildings must install prior to Certificate of Occupancy.

Proposed buildings Instrumentation site must be indicated in the plan prior to issuance of Building Permit.

Existing buildings Must install prior to Annual Certificate of Inspection Business Permit.
Instrumentation of Selected Building

- All owners of existing buildings listed in Table 1 shall provide accessible seismic instrumentation room for the installation of appropriate earthquake recording instruments. Location of said instruments shall be determined by a Civil/Structural Engineer.

- For proposed buildings, the Civil/Structural Engineer shall include the layout, installation requirements, and location of the instrument in the structural plan submitted for building permit purposes.
The actual installation of the instruments shall be under the supervision of the Certified Civil/Structural Engineer verified and confirmed by the Building Official.

For existing buildings, the installation and operation of these instruments shall form part of the requirements of the Annual Certificate of Inspection issued by the Building Official.
Instrumentation of Selected Building

- Owners of existing buildings with already installed Earthquake Recording Instrumentation (ERI) shall be notified by the Building Official to comply with these guidelines accordingly, in case the specifications of the ERI installed do not conform as prescribed in these guidelines.
Instrumentation of Selected Building

- However, the jurisdiction of the annual inspection shall be limited only on reporting the existence of the seismic instruments in a building, detailed installation number, latest certification of the local building official and a narrative physical condition as it was found by the Building Official.
Instrumentation of Selected Building

- For newly constructed buildings, the installation of these instruments shall form part of the requirements for Certificate of Occupancy issued by the Building Official, indicating there on Earthquake Instrument Notification Procedures in Compliance to these guidelines and rules.
Standard Specifications

<table>
<thead>
<tr>
<th>DPWH guidelines: Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accelerograph</strong></td>
</tr>
<tr>
<td>• Seismic qualified as tested by recognized international testing laboratory</td>
</tr>
<tr>
<td>• Stores seismic activity information as gathered by the attached accelerometer</td>
</tr>
<tr>
<td>• Equipped with fault detection</td>
</tr>
<tr>
<td>• Provides real-time alarm information (either audio, visual or both) during an earthquake event.</td>
</tr>
<tr>
<td>• Equipped with internal battery back-up power to ensure continuous operation during a power fluctuation.</td>
</tr>
<tr>
<td>• Minimum design life: 10 years and should be demonstrated and certified to have a 40,000-hour (minimum) mean time between failures</td>
</tr>
<tr>
<td>• Minimum of three components (vertical, longitudinal and transverse)</td>
</tr>
<tr>
<td>• Natural Frequency: Above 50 Hz</td>
</tr>
<tr>
<td>• Damping: Approximately 60-70 percent critical</td>
</tr>
<tr>
<td>• Sensitivity: 2g</td>
</tr>
<tr>
<td>• Bandwidth: DC to 100 Hz</td>
</tr>
<tr>
<td>• Environment: IP 67</td>
</tr>
</tbody>
</table>
Standard Specifications

**Recording**
- Sampling Frequency: Minimum of 100 samples per second
- Time: From at least 20 seconds before the ground shaking begins until 30 seconds after the last triggering level motion
- RMS Noise: System noise shall be less than 40μg measured over 0-30 Hz
- Media: Memory Card
- Continuous Recording: capable of continuous recording
- AD Converter: 16 bits

**Timing**
- Interval: Half a second or less
- Accuracy: Plus or minus 0.2 second per 100 seconds
- Type: GPS or NTP Server

**Triggering**
- Method: Pendulum or other device using earthquake motion as an exciting force
- Level: Accelerograph: 0.5 to 100 gals nominal velocimeter: 5 μm/s to 1 mm/s
- Time: Full operation of accelerograph/velocity in not over 0.1 second after activation.

**Power**
- Battery maintained by charger

**Communication**
- Ethernet: 10 base-T or 100 base-TX
- Protocol: TCP/IP FTP/SFTP
Location and Installation of Instruments

- instrument shall be located so that access by qualified technical personnel is maintained at all times and is unobstructed by room contents with the a sign stating, “MAINTAIN CLEAR ACCESS TO THIS INSTRUMENT” shall be posted in a conspicuous location. No instrument shall be located in refuge area.
Data Retrieval and Interpretation

- Immediately after the occurrence of Intensity 6 earthquake or greater – Building Official shall require the owner to retrieve the data and to have the data interpreted by Certified Civil/Structural Engineer.

- The data interpretation shall be submitted by the Owner to DPWH for storage, post-earthquake safety evaluation of the buildings and emergency response demands through the concerned Building Official.
Data Storage and Archiving

- Shall be at DPWH Central Office or other data centers designated by the DPWH.

- ASEP, upon request to the DPWH, shall be provided by the said data.
Certificate of Installation of Earthquake Recording Instrumentation

- Upon compliance of the building owners to these Guidelines, Building Official shall issue

  “CERTIFICATE OF INSTALLATION OF EARTHQUAKE RECORDING INSTRUMENTATION”

(POSTED IN A CONSPICUOUS PLACE, PROPERLY PROTECTED/SECURED IN THE GROUND FLOOR LOBBY OF THE BUILDING AS WELL AS AT THE SITE OF EACH INSTRUMENT)
CERTIFICATE OF INSTALLATION

EARTHQUAKE RECORDING INSTRUMENTATION

Is being awarded to the Department of Public Works and Highways Central Office located at 20th St., Bonifacio Drive, Port Area, Manila on the 26th of June 2015.

Name of Earthquake Recording Instrument Installed: Green Seismograph + Intensity Meter

Engr. Armando Andres
Building Official

Dry Seal
Prohibition

- Mixing/combination of seismic equipment’s peripherals and parts with other brands or maker must not be done because these systems and parts are not interoperable (or if they are, it diminishes its accuracy) and will definitely contribute to the dysfunctionality of the machine in time.

- EXAMPLE: every part/peripheral of the system must be of the same brand or maker.

- **Accelerograph** → **Sensor/accelerometer** → **Monitor** → **Other peripherals** → MUST BE SAME BRAND OR MAKER.
Each component of seismic monitoring system shall be tested individually and as a complete system for proper functioning of all operational features:

**EXAMPLE:**
LOOKING FOR FAULT DETECTION SYSTEM, INTERNAL ALARM, MIXING OF PERIPHERALS, RECORDING ACCELEROGRAPH ETC to make sure of its compliance.

*Testing equipment* from company with **INTERNATIONAL TESTING CERTIFICATION** shall be allowed to make the testing.
ONLY CALIBRATED RESULTS SHALL BE SUBJECT TO COMMISSIONING AND ACCEPTANCE

Issuance of necessary permits by Building Official

TEST RESULTS MUST BE SIGNED BY THE SUPPLIER and SHALL BE SUBMITTED TO THE BUILDING OFFICIAL

Requirement for the certification of the Building Official
Support and Maintenance

- Supplier should provide guarantee that the system shall have a maintenance period for at least 10 years.
- SERVICE PERIOD – maximum service interval is one year.
- CALIBRATION TESTING – shall be made in a per year basis to ensure that the integrated systems are in its proper operational efficiency.
JOINT INSPECTION

- **Building Owner**, **Building Official** and **Supplier** shall INSPECT, TEST and COMMISSION the seismic monitoring system together to ensure that systems are in proper operational procedure and comply with the requirements of these guidelines.
Equipment Obsolescence

- **Uselessness, outmodedness, unfashionableness**
- Shall not hinder the proper continuous operation of the equipment throughout 10 years duration.
- When the equipment supplier finds that the instrument must be removed from the building for repair, **there must be a service unit as a temporary replacement** to continue the collection of data, if and when there is an occurrence of an earthquake during the duration of the repair.
Effectivity

- Shall take effect 15 days after its publication once a week for three consecutive weeks in a newspaper in a general circulation. *(Feb. 21, 2015 - effectivity date)*

For STRICT and IMMEDIATE COMPLIANCE

March 12, 2015