ISSN NO: 2770-4491
November 2024

Methodology For Inspection Of Elevator Systems After Strong Earthquakes And Their Field Testing Under Dynamic Loads

Olimkhon Khondamir,
Senior Lecturer at the Civil Engineering and Architecture, Ajou University in Tashkent (Uzbekistan).
Mirhamidova E'zoza, Giyasov Shaxriyor
Second-year students, enrolled in the Faculty of Architecture.

Abstract: The study outlines a methodology for inspecting elevators after earthquakes and conducting field tests to assess their dynamic characteristics. The tests are carried out in two stages: sudden load release and vibrational impact. Seismometric equipment is used to measure displacements and accelerations of both the elevator and the building. This method helps identify the impact of building design features on elevator performance and enhances their safety in seismically active regions.
Keywords:

Methodology of Field Testing for Elevator Installations under Dynamic Loads and Measurement Equipment

The research methodology is based on the theory of dynamic testing of structures using seismometric equipment. The objective of these field tests is to experimentally evaluate the dynamic parameters of passenger elevators under dynamic loads affecting buildings and structures.

There are several methods to induce oscillations in buildings to record their dynamic parameters. During field studies, the following parameters of building and elevator oscillations are measured:

- Horizontal displacements and accelerations of structural elements of the building in two mutually perpendicular directions adjacent to the elevator structure.
- Horizontal displacements and accelerations of the elevator car in two mutually perpendicular directions.
- Horizontal displacements of the counterweight and elevator winch.

Stages of Field Testing for Elevator Installations

Field tests of elevator systems consist of two stages, which differ in the type of external impact applied to buildings where the elevators are installed:

1. **Stage One** involves testing through a sudden release of horizontal load (tension release). At this stage, oscillations of standard passenger elevators installed in buildings with various structural designs are studied. The purpose of these tests is to experimentally determine the influence of building design features on the oscillatory processes of elevator installations.
2. **Stage Two** includes vibration testing based on the effect of inertial forces generated by powerful vibration machines. This method allows for studying the oscillations of buildings and elevator systems under significant external impact amplitudes.

Vibration tests are conducted to obtain data on the dynamic characteristics of buildings and structures under high-stress conditions.

Measurement Equipment and Registration Methodology

The success of these tests largely depends on proper organization, selection of the type of equipment used, and accurate calibration of the seismometric devices.

The measurement of oscillation parameters is carried out using electrodynamic sensors of various designs that operate on the same principle. According to the developed scheme for placing equipment during the testing of passenger elevators and buildings, the following seismometric devices were used:

1. **Seismometers** for recording large displacements.
2. **Instruments** for recording small shifts.
3. **Accelerometers** for recording accelerations.

ISSN NO: 2770-4491
November 2024

For data recording, the following were used:

- **Oscillographs** for recording accelerations and data from the first two instruments.

Advantages of the Galvanometric Recording Method:

1. Separation of the sensing and recording parts of the instrument.
2. Capability to adjust channel amplification over a wide range.
3. Protection of the recording part from oscillation effects.

The primary advantage of this method is the synchronous recording of oscillations from various points of the building on a single tape. The vibration recording equipment was installed in a special van located at a certain distance from the test object.

Calibration and Adjustment of Recording Equipment

To ensure accurate results during experiments, damping shunts were included in the galvanometer circuits. Six sets of shunts were installed in shunt boxes, allowing the reduction of the seismometer readings by multiples (2, 5, 10, 20, 50, 100 times).

The calibration of instrument channels involves determining the scale correspondence between the amplitude of oscillations at the test point and the amplitude of the light beam deflection in the oscillograph's galvanometer. Calibration graphs are constructed for each recording channel.

Conclusion: The conducted methodology for inspection and field testing of elevator systems after strong earthquakes enables an experimental evaluation of their dynamic characteristics under various external impacts. The two-stage approach—horizontal load release and vibration testing—helps identify the influence of building design features on elevator performance and assess the behavior of elevator systems under significant dynamic loads. The use of modern seismometric equipment and precise calibration ensures high measurement accuracy, which contributes to the improved safety and reliability of elevators in seismically active areas.

REFERENCES

1. Друмя А.В., Поята И.А., Степаненко Н.Я., Шумила В.И. **Основные параметры Карпатского землетрясения 31 августа 1983 года** // Экспресс-информация. Серия 14. Строительство и архитектура. - 1987. - № 8. - С. 5 – 8.
2. Завриев К.С., Назаров А.Г., Айзенберг Я.М. и др. **Основы теории сейсмостойкости сооружений**. - М.: Стройиздат, - 1970. - 224 с.
3. Zaynutdinova D.B. **Prediction of Seismic Effects during Microzonation** // Conducting Seismic Microzonation for the Future Development Areas of Tashkent and its Suburban Zone. - Tashkent: Report of the Institute of Seismology, Academy of Sciences of Uzbekistan SSR, - 1984. - pp. 88 - 102.
4. Zaynutdinova D.B. **Forecast of Seismic Effects Based on Instrumental Seismological Observations** // Dissertation Abstract. - Irkutsk: - 1986.
5. Измайлов Ю.А., Чуприна А.А. **Поведение каменных зданий при Карпатском землетрясении** // Экспресс-информация. Серия 14. Строительство и архитектура. - 1987. - № 5-8. - С. 27 - 31.
6. **Engineering Analysis of Earthquake Consequences in Japan and the USA** / Translated from English under the editorship of Bykhovany. - M.: Gosstroyizdat, 1961.
7. Ионов А.А. **Исследование вибраций пассажирских лифтов грузоподъёмностью 350-500 кг и скоростью до 1 м/с** // Труды ЦНКБ по лифтам. - М.: ЦНИИТЭстроймаш, - 1973. – С. 118 – 127.
8. Ионов А.А., Мирский Г.Г. **Пути снижения вибрации пассажирских лифтов** // Труды по лифтам. - М.: ЦНИИТЭстроймаш, - 1973. - С. 93 - 99.
9. Korchinskiy I.L., Polyakov S.V., Bikovskiy V.A. et al. **Fundamentals of Building Design in Seismic Regions**. - M.: Gosstroyizdat, 1961. - 319 p.
10. Лисицын Д.Ф. **Расчет пружинных буферов для лифтов** // Труды ЦНКБ по лифтам. - М.: ЦНИИТЭстроймаш, - 1973. - С. 31 – 41.
11. Medvedev S.V. **Engineering Seismology**. - M.: Gosstroyizdat, - 1962. - 284 p.
12. Милютин А.П. **Динамика лифта на упругом основании** // Труды ЦНКБ по лифтам. - М.: ЦНИИТЭстроймаш, - 1973. - С. 69 – 75.

ISSN NO: 2770-4491
November 2024

13. Милютин А.П. **Динамика лифта на упругом основании** // Труды ЦКБ по лифтам. - М.: ЦНИИТЭстроймаш, - 1973. - С. 75-79.
14. Мирский Г.Г. **Ловители резного торможения** // Труды ЦНКБ по лифтам. - М.: ЦНИИТЭстроймаш, - 1973. - С. 40 - 55.
15. Назарова М.К., Сигал Ф.Р., Погребинский И.М. **Исследование воздействия Карпатского землетрясения 1986 г. на лифтовые сооружения в зданиях, построенных в Киеве** // Экспресс-информация. Серия 14. Строительство и архитектура. - 1987. - № 12. - С. 32 - 34.
16. Назарова М.К., Мелибаев А.А. **Исследование сейсмостойкости лифтовых установок** // Abstracts of the conference: Scientific-Theoretical and Technical Conference of Professors, Lecturers, Graduate Students, and Researchers of Tashkent Polytechnic Institute named after A.R. Beruni. Tashkent, 1989. - С. 80.
17. Наварова М.К. **Натурные испытания зданий повышенной этажности и лифтовых установок на динамические воздействия** // Архитектура и строительство Узбекистана, 1989.