Tool Seismic Design Guidelines

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1 INTRODUCTION

Many semiconductor manufacturers have facilities in areas susceptible to seismic activity, design criteria and local regulatory requirements may be more stringent to protect against this increased site vulnerability. For example, local soil conditions and building design may produce significantly higher seismic accelerations or in some jurisdictions, certified tool drawings and calculations may be required y regulators.

The following guidelines are intended to provide an overview of design and installation considerations for seismic protection of semiconductor manufacturing equipment.

2 GUIDELINES

2.1 General

The equipment should be designed to control the risk of employee injury, adverse environmental impact, equipment and facility damage due to movement, overturning, or leakage of chemicals (including liquid splashing) during a seismic event. The design should also control equipment damage due to the failure of fragile parts (e.g., quartz ware, ceramics) during a seismic event.

NOTE: These criteria are intended to accomplish two things:

- Allow equipment suppliers to correctly design the internal frame and components to withstand seismic forces.
- Allow equipment suppliers to provide end-users with the information needed to appropriately secure the equipment within their facility.

Because preventing damage to equipment may be impractical, the design should control the failure of parts that could increase a hazard (e.g., hazardous materials release, fire explosion, etc). These parts should be accessible to allow damage to be evaluated following a seismic event.

NOTE: It is recommended that a hazard analysis be conducted by equipment suppliers to evaluate both the risk of the parts failure and the effectiveness of control measure.

2.2 Design Loads

The equipment, subassemblies, and all devices used for anchoring the equipment should be designed as follows:

- If equipment contains hazardous production materials (HPMS), the equipment should be designed to withstand a horizontal loading of 95% of the weight of the equipment acting at the equipment’s center of mass.
- If equipment does not contain HPMS, the equipment should be designed to withstand a horizontal loading of 63% of the weight of the equipment acting at the equipment’s center of mass.

NOTE: Subassemblies may include transformers, vessels, power supplies, vacuum pumps, monitors, fire suppression components, or other items of substantial mass that are attached to the equipment.

- Horizontal loads should be calculated on the x-axis and y-axis independently or on the axis that produces the largest loads on the anchorage points.

- Evidence of structural engineer's calculations address the above requirements should be provided

NOTE: Because equipment may be placed into service anywhere in the world, it is recommended that its seismic protection design be based upon requirements that allow the equipment, as designed, to be installed at most sites worldwide. The above loads are based on 2006 International Building Code (IBC) requirements for rigid equipment using worst-case seismic data (horizontal and vertical acceleration) and are assumed to satisfy most of design situations worldwide.

- Tool suppliers together with the user should consider a design method appropriate for effective anchoring.

NOTE: If the equipment or internal component is flexible as defined by the IBC, is located above the mid-height of the building, or is within 8 km of a major active fault, the horizontal design loadings above may not be conservative enough. Conversely, several conditions make these horizontal design loadings overly conservative (e.g., rigid equipment with rigid internal components located at grade or sites with favorable soil conditions). For these conditions, designs based on the most detailed approach in the IBC may prove more economical. It is recommended that tool suppliers engage a professional mechanical, civil, or structural engineer to make these determinations.

2.3 Documentation

- Tool suppliers should provide users with the following data about the tool and procedures for installation. The information should be included in the installation instructions as part of the documentation.
  - A drawing of the equipment, its support equipment, its connections (e.g., ventilation, water, vacuum, gases), and the anchorage locations
  - The type of feet used and their location on a base frame plan drawing
  - The weight distribution on each foot
  - Physical dimensions, including width, length, and height of each structurally independent module
  - Weight and location of the center of mass for each structurally independent module
  - Acceptable locations on the equipment frame for anchoring

NOTE: A structurally independent module reacts to seismic loads by transferring loads to its own anchors, as opposed to transferring the loads to adjacent modules.

2.4 Anchoring Methods

- Locations of the tie-ins, attachments, or seismic anchorage points should be clearly identified by tool suppliers. The tool suppliers should designate one of the following tool anchorage methods for users:
  - Anchored on raised floor panel
  - Anchored on raised floor with tension bar/wire on a reinforced concrete slab

  - Anchored on a retrofitted steel or reinforced concrete foundation

- Tool suppliers should provide the seismic attachment point hardware (e.g., brackets, bolts) and appropriate design, calculation sheet, and installation drawings to users before the tool is moved in.
- For special foundation designs provided by tool suppliers, the supplier should help confirm that the user's foundation meets requirements for seismic events. Tool suppliers are solely responsible for the seismic design of equipment and anchors. Users are responsible for the seismic design of the reinforced concrete slab and raised floor.
- For special foundation designs required for equipment for a specific purpose, the tool supplier should confirm that the user's foundation meets requirements for micro-vibration resistance or provide users with an appropriate design for foundation manufacturing and installation.

3 SUMMARY

It is the expectation of ISMI's members that tool suppliers will provide hardware and design documents including manufacturing sketches of the seismic anchorage kits to facilitate safe equipment installation.

Seismic anchorage kits should

- Be designed according to IBC codes
- Meet seismic requirements where 450mm factory built
- Consider upper floor seismic acceleration enlargement
- Indicate ways that the kits can be fixed:
  - On the raised floor panels
  - On a dedicated steel structure or reinforced concrete foundation

Tool suppliers should also provide installation guidance and calculation sheets.

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