

# Estimation of Shielding Effectiveness for Electromagnetic Interference using an Infinite Plate Model

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## Introduction

- AC magnetic fields from electrical utility services have been observed to induce artifacts in images from high-sensitivity digital detectors used in mammography systems<sup>1</sup>.
- The site of a new mammography facility was observed to have AC magnetic fields of magnitudes great enough (>2 mG) to raise serious concerns that artifacts may be present in clinical images after installation was complete.
- A shielding design was implemented to attenuate AC magnetic fields and potential electromagnetic interference (EMI).



Horizontal line artifacts produced by AC magnetic fields on a digital mammography detector

## Methods

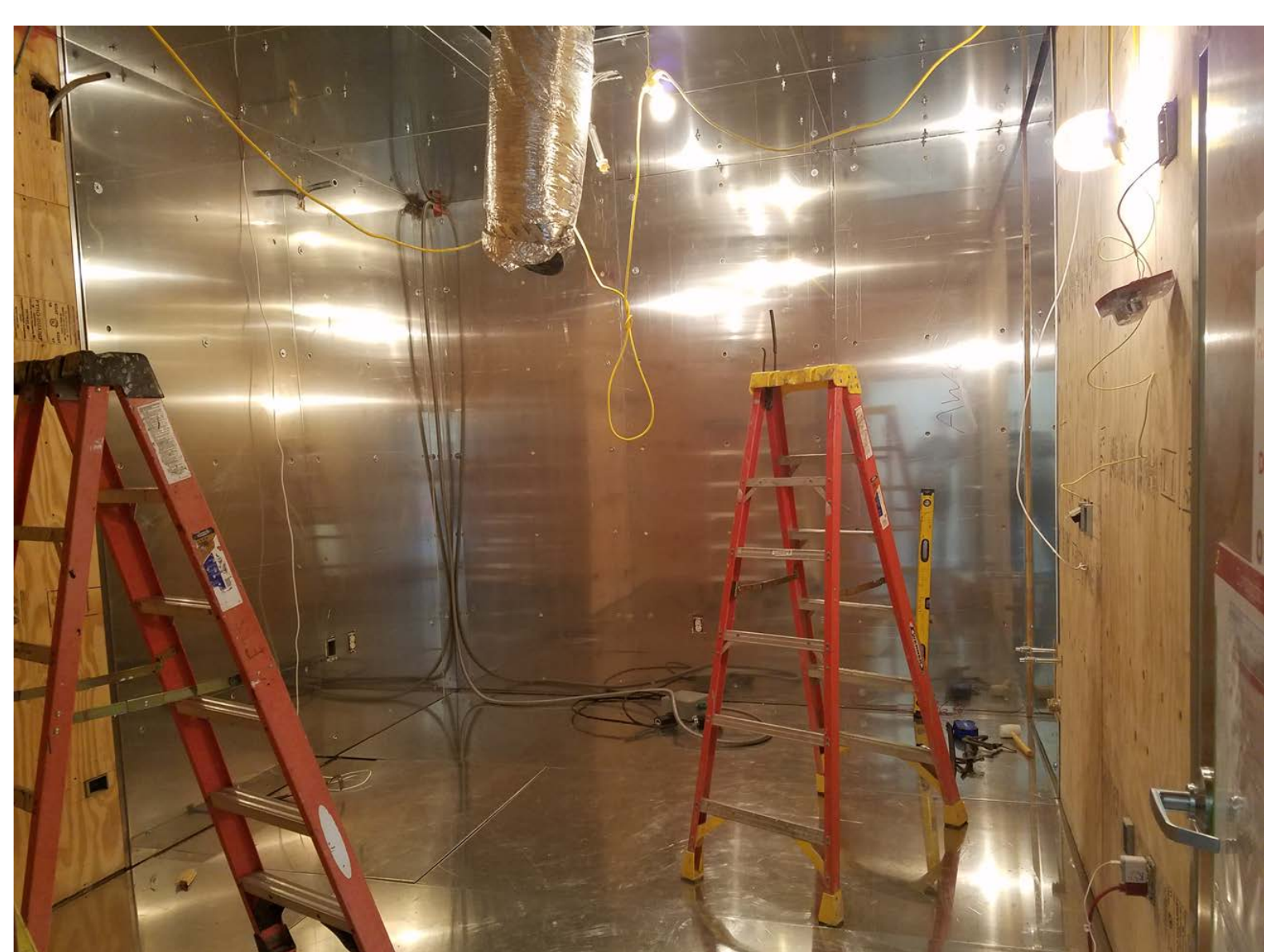
- Two major mammography system vendors evaluated test detectors in the proposed mammography room in its original configuration.
- Both vendors observed artifacts in the test data.
- Measurements were made to map of the rms magnitude of the 60 Hz magnetic fields<sup>2</sup>.
- Continuous measurements of the 60 Hz magnetic fields were made to evaluate dynamic variations of the fields.
- EMI shielding was designed and installed.
- Post-shielding evaluation of AC magnetic fields included both mapping of the field throughout the room and continuous measurements of the temporal variations.

## Shielding Plan & Installation

All interior surfaces of the room were shielded with 6.25 mm (1/4") plate aluminum (walls, ceiling and floor)<sup>2</sup>.

The floor incorporated an additional 6.25 mm (1/4") Si-Steel

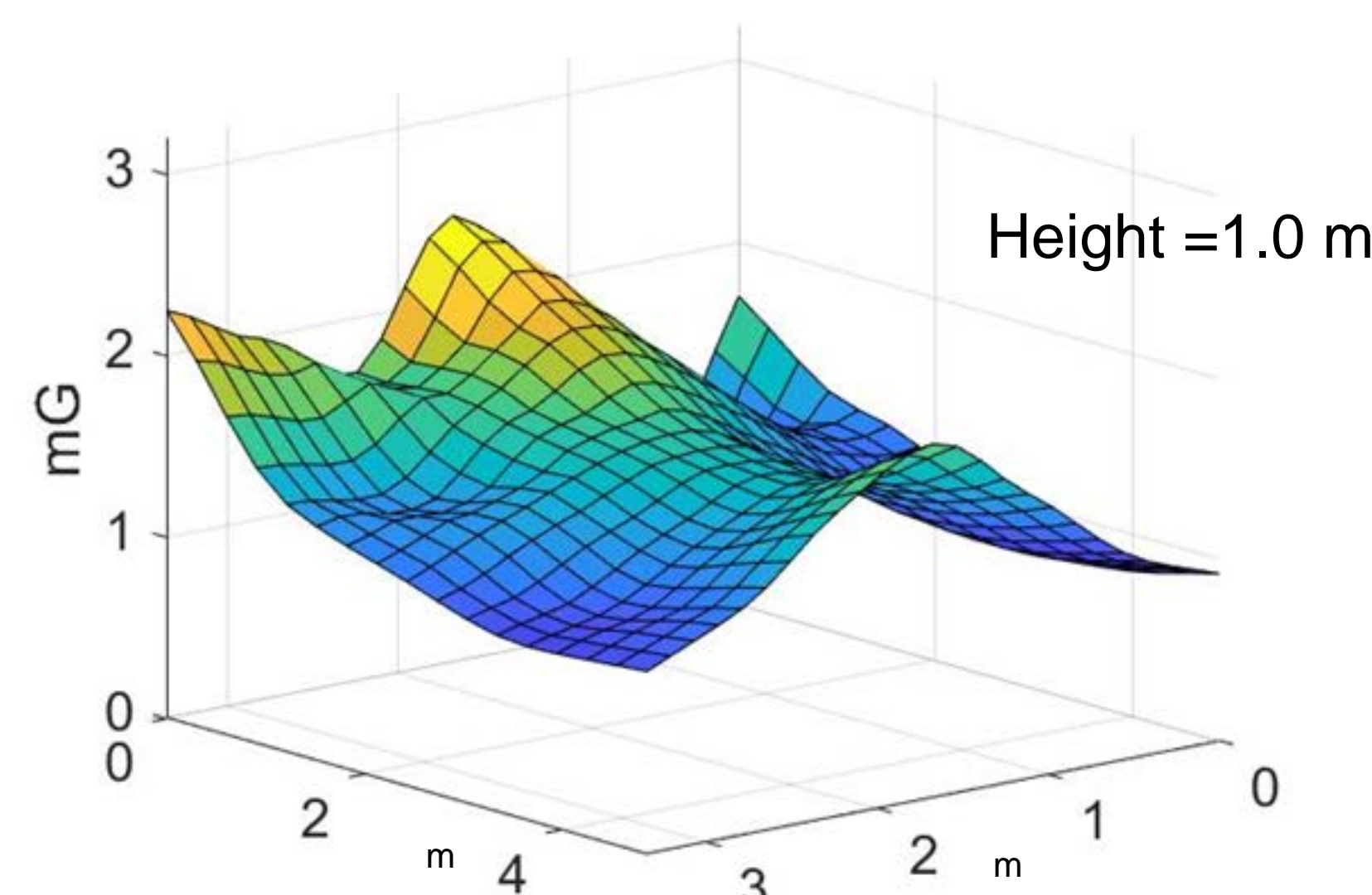
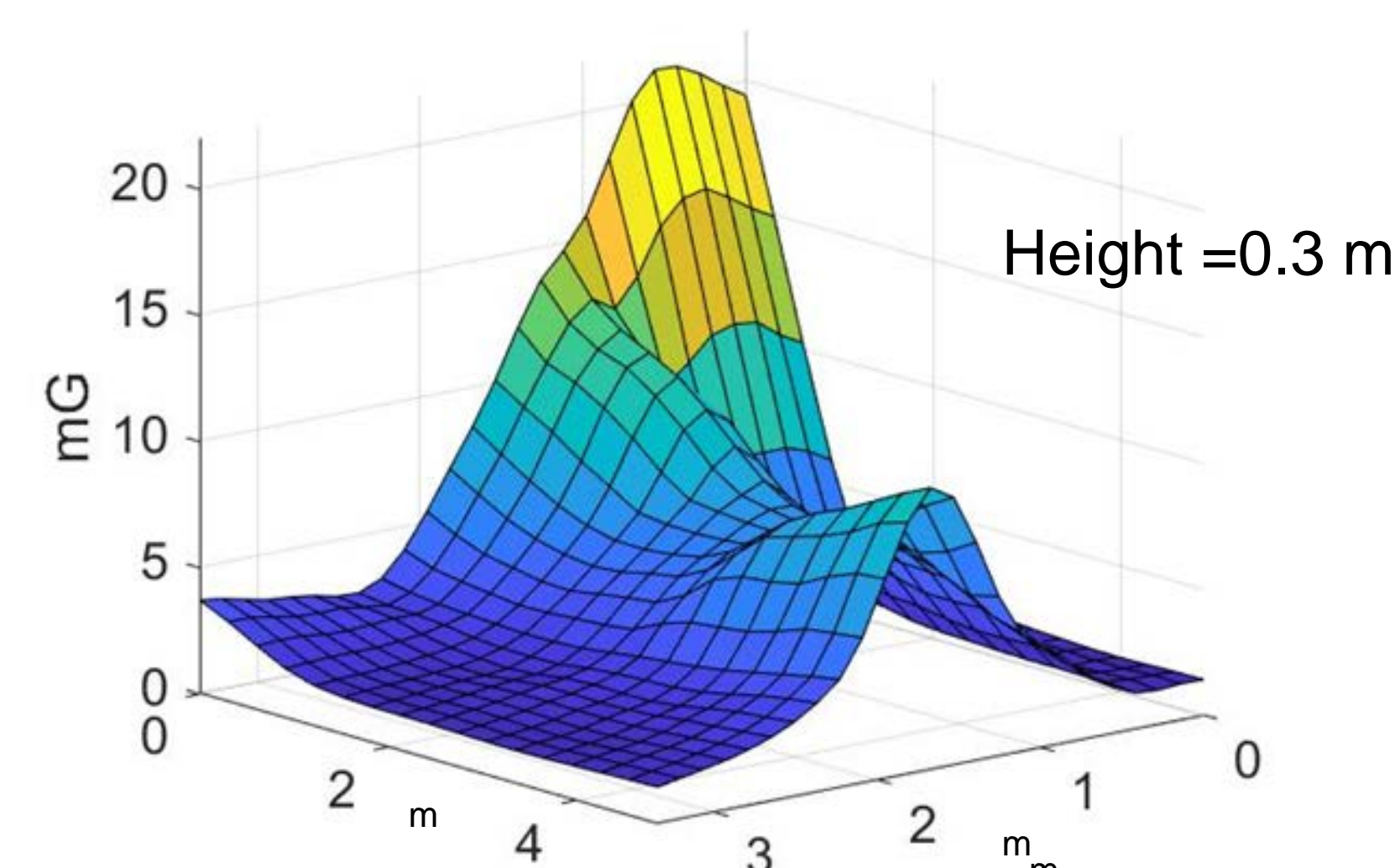
The existing wooden doors were not shielded



## Results

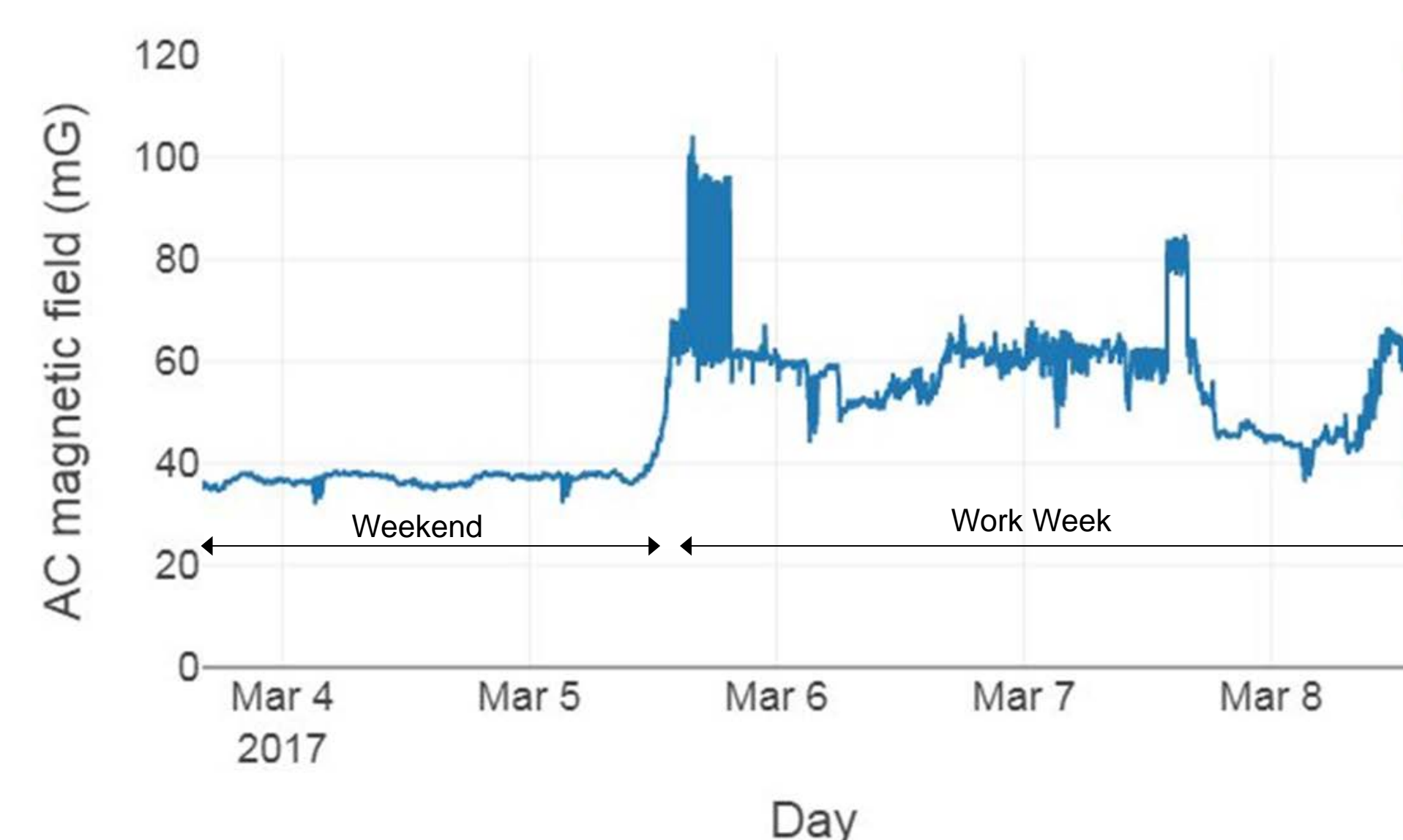
### Pre-Shielding

- AC Magnetic fields were mapped across the room at four different heights<sup>2</sup>: 0.3 m, 1m (detector position) 1.5 m and 2.4 m.
- The intensity decreased with distance from a neighboring electrical supply room and the floor, where a sub-slab electrical conduit is located.



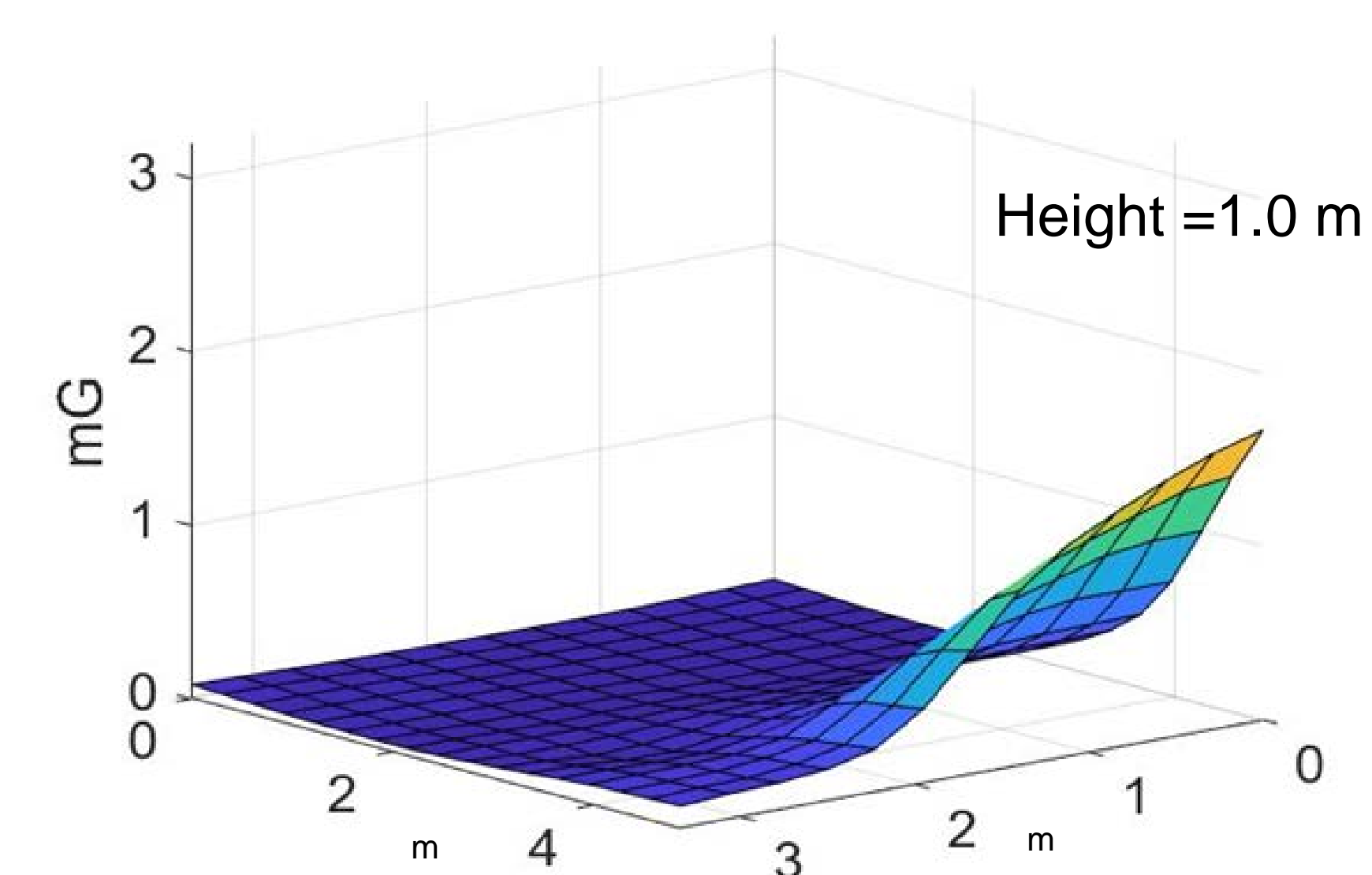
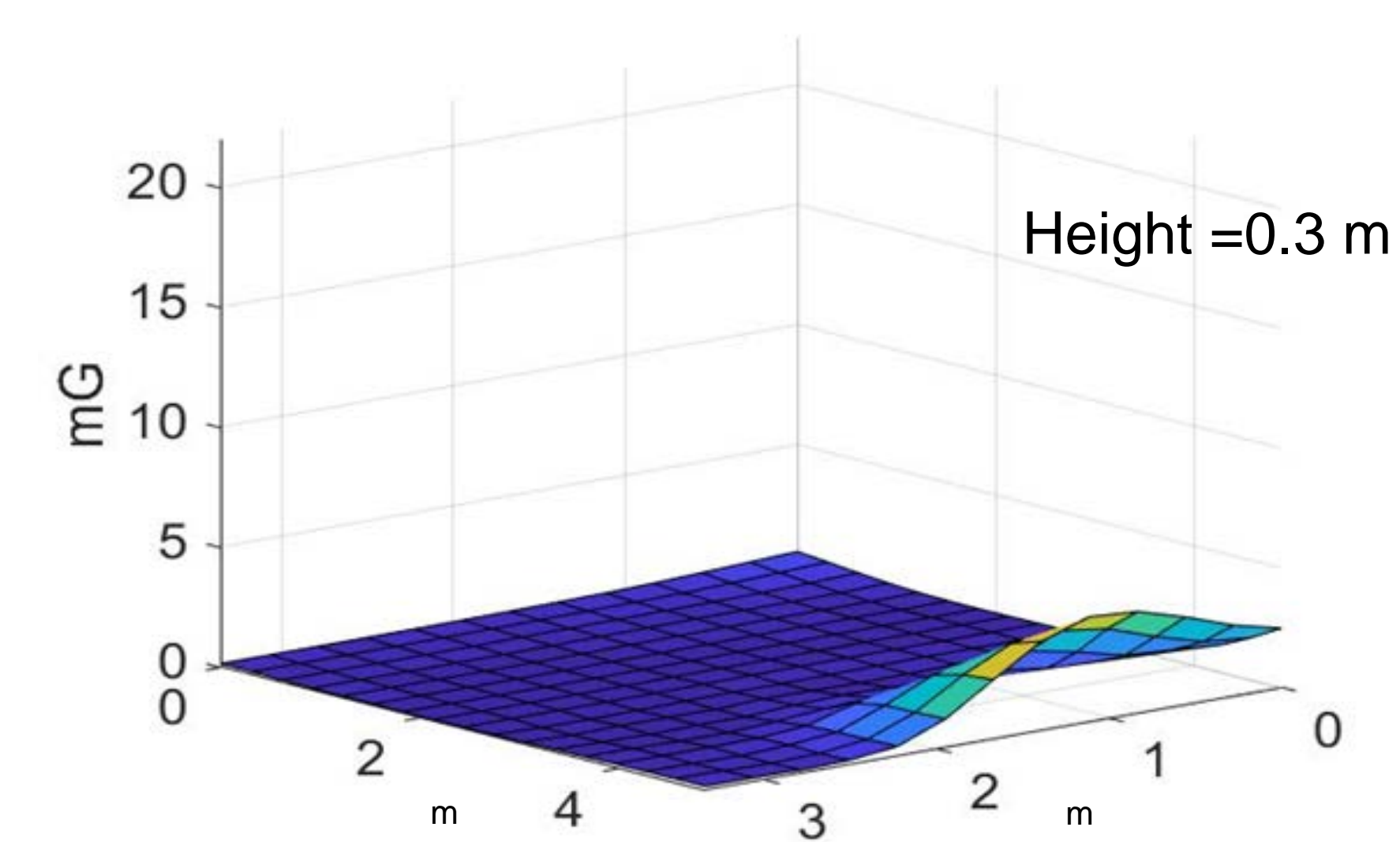
Continuous measurements showed large variations in the magnitudes of the AC magnetic field.

- March 4-5: weekend days of low building electrical loads.
- March 6 begins work week with increased building electrical loads.

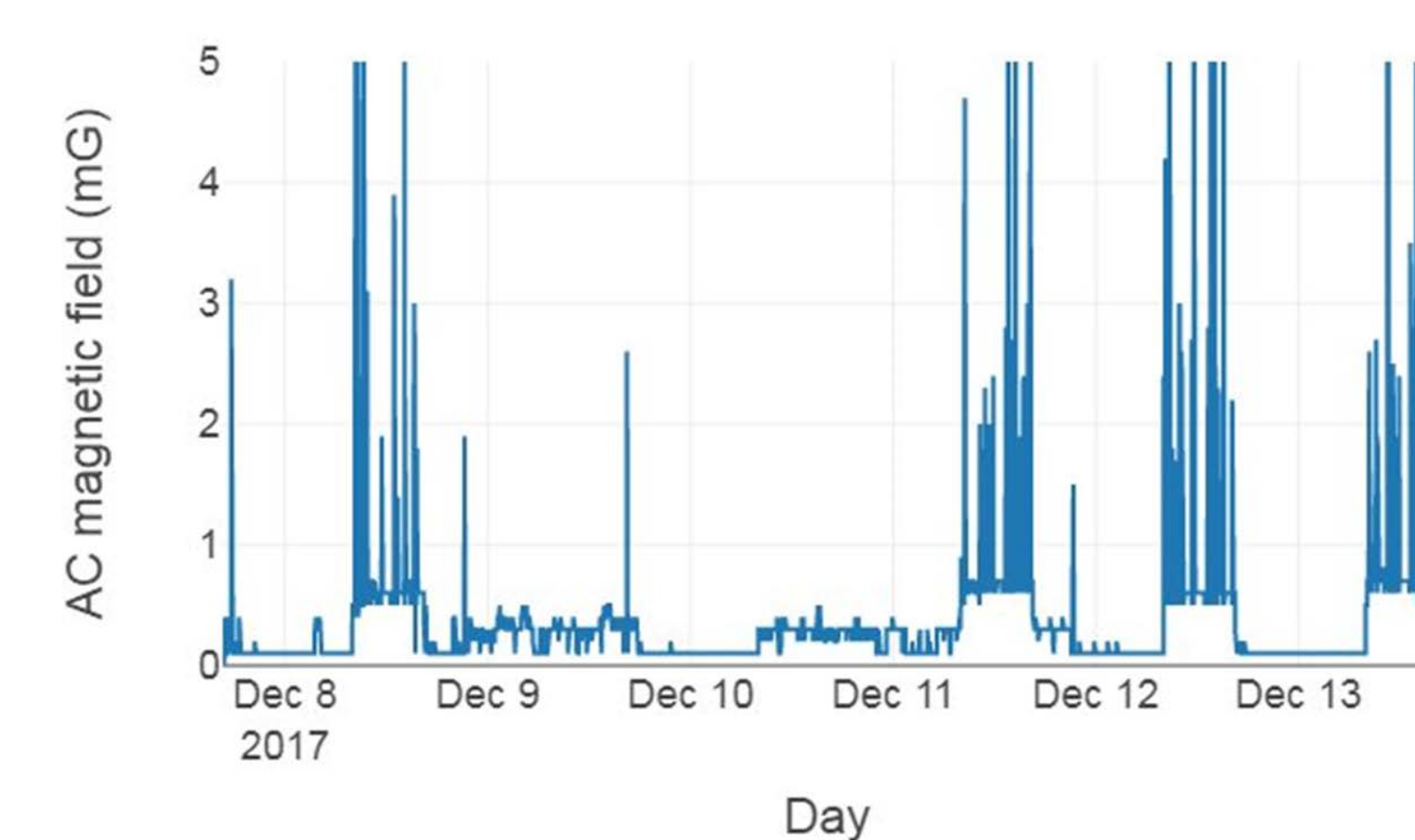


### Post-Shielding

- After the shielding was installed AC magnetic fields decreased to below the design goal of 0.5 mG at the detector location.
- The greatest residual fields are observed around the unshielded doorways.



- Continuous measurements showed the externally generated AC fields were attenuated below the design goal of 0.5 mG inside the room.
- Elevated baselines during the work-day correlate with operation of the mammography system
- The large spikes correlate with x-ray exposures by the mammography system and have not generated image artifacts.



## Conclusions

- Aluminum shielding can successfully attenuate 60 Hz AC magnetic fields
- No imaging artifacts have been observed during clinical use
- Any large surfaces that are not shielded may allow EMI leakage into an otherwise shielded area.

### References:

- [1] Hologic Customer Technical Bulletin: CTB-00130, 8/2015
- [2] Performed by ETS Lindgren, Inc.