MDE Inc.

Forensic Engineering and Laboratories

The Science of Forensic Building Defect Evaluations

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Buildings are sometimes constructed in a way where construction defects, deficiencies, omissions, or incompatibilities (hereafter collectively referenced as defects) are present. The defects may include design deficiencies, material deficiencies, construction or installation defects, some of which lead to complete failures or a reduction in performance. Some outward signs that a defect may be present include (but are not limited to):

- *Cracks in walls*
- *Separations or gaps in materials*
- *Windows or doors that do not open or close properly*
- *Bulging, sagging, or shifting of surfaces*
- *Soil against untreated wood components*
- *Peeling or curling materials*
- *Loose materials, fittings, fixtures, that usually are tight in other parts of the building or similar buildings*
- *Water temperature problems*
- *Clogged sewage/drainage pipes*
- *Repeated water condensation in select locations*
- *Water leakages or water damage*
- *Water leakage or condensation on windows*
- *Undermined soil cavities below concrete slabs*
- *Flickering lights*
- *Circuit breakers that repeatedly trip, short-circuits*
- *Exhaust fans that do not function properly*

Building science investigations, conducted by experienced forensic engineers, scientists and technicians, such as those at MDE Inc. can evaluate conditions that may be associated with building defects. The investigations include identifying the presence of the defects, their presence, frequency (repetition), and degree of seriousness. If included in the scope of the work, recommendations can be made on the nature of needed repairs, and cost estimates for the work provided.

Evaluations typically begin by obtaining the history of the building. This may include reviewing plans and specifications, contract documents, governmental building inspection documents and placards, correspondence with builders, etc. Additionally the initial aspects of the evaluation include interviews or written documentation from owners, building operators, vendors (such as ventilation system maintenance company), and / or tenants to understand their perspective of the problems, and the history of the problems and repairs.

Forensic engineers or technical specialists will also conduct a visual assessment of the building. The objective is to be able to visualize the building, identify if visual evidence of reported problems are present, and, if within the scope of the work, to look for signs of additional defects or deficiencies. Photographic records, sketches, etc. are made of the building conditions that were observed.

Non-intrusive measurements, sampling or other assessments of affected building areas may be made during the visual assessment, or scheduled for another site visit. In general, non-intrusive evaluation components are generally considered those that do not deface the conditions inside or outside of the building during or following the evaluation, and do not require disturbance of the building surfaces to obtain the measurements. Non-intrusive measurements may include (but are not limited to), if pertinent to the scope of work:

- *Temperature and relative humidity*
- *Moisture measurements within walls, roofs, or concrete slabs (considered non-intrusive only if non-penetrating (pinless) moisture meters are used)*
- *Thermographic imaging*
- *Air sampling*
- *Ventilation flow measurements*
- *Dimensions of various components and areas*
- *Voltage/amperage measurements*
- *Water temperatures and/or water sampling*
- *Boroscope observations through existing penetrations, pipes, ducts, etc.*
- *Sampling of surface dusts or conditions using non-intrusive means*

Depending on the problem that is being evaluated, intrusive evaluations may also be necessary. These evaluations generally require detailed scheduling as tradespeople are typically utilized to open up (deconstruct) and then repair any openings that are required to evaluate components not readily visible without such means. Several examples of intrusive evaluations are the removal of exterior siding to evaluate window flashing details and opening an interior wall to evaluate drain pipe sloping.

Destructive sampling involves the physical removal of sections of building material for laboratory evaluation. Most samples collected are no longer functional after the analysis as the material is sectioned, stained to highlight material contrasts, or otherwise cut up. Some of the materials, such as carpet or drywall are physically collected by the forensic expert, and other materials, such as siding, flashings, or pipe sections are procured utilizing the services of tradespeople. Considerable forethought and planning is required prior to collection of these samples in occupied buildings as all affected parties are contacted, schedules determined, and replacement materials and labor needs to be obtained.

The forensic professional utilizes the evaluation findings to asses the nature and extent of the building defect. The defects identified are documented as to why the material or constructive practice is deficient, relative to:

- *Building code violations*
- *Violations in standards, consensus documents or written recommendations*
- *Violations of manufacturers requirements which affect the material warranties*
- *Defects in design or construction which affect the integrity, usability, or durability of the building*

MDE Inc. has experienced civil, mechanical, metallurgical and electrical engineers and technicians on staff that can provide building science evaluation consultations.