Steven Winter Associates, Inc.
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BRANFORD MANOR MOISTURE CONDITIONS INVESTIGATION

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William Zoeller, RA — REPORT BY
22 July 2022 — REPORT DATE
RELA101A_Branford Manor — SWA PROJECT
13 July 2022 — DATE OF VISIT
9:30 AM – 12:00PM — TIME

WEATHER: *sunny* | *partly* | *sunny* | *cloudy* | *rain* | *snow* — HUMIDITY: *dry* | *comfortable* | *humid*

TEMP. °F: *-10 0 10 20 30 40 50 60 70 80 90 100* — WIND: *calm* | *breezy* | *gusty* | *windy*

ARCHITECT Buchanan Architects LLC

CONTRACTOR NA

PRESENT William Zoeller, RA, SWA; Lauryn Tacoronte, Assistant Project Manager, Related Affordable; Martin Brousseau, Maintenance Supervisor, Related Affordable.

INTRODUCTION

1. SWA has contacted by Related Affordable concerning chronic elevated moisture conditions observed within the basements and crawlspaces of the two-story townhome-style frame dwellings comprising most of the Branford Manors development.
2. Branford Manors, located in the city of Groton, CT is an affordable housing rental property containing 46 “EL” shaped two story structures; 16 constructed with full basement foundations, and 30 constructed with vented crawlspace foundations.
3. All buildings are served by sloped gable roof and rafter-framed vented attics. Floors are standard dimensional lumber joists and walls are 2 x 4 framed at 16” on-center.
4. The buildings were reported to be originally constructed in approximately 1970. This was not verified, and the construction and design appear more consistent with the 1960’s.
5. The buildings were renovated in 2017 receiving new windows; a new water-resistive barrier / air-barrier (house-wrap) over the existing plywood sheathing; 1” continuous exterior rigid insulation; and new fiber-cement siding. Window trims, flashing and associated accessories were also replaced.
6. A probe was not conducted to determine the exact house-wrap and rigid insulation products, and that information was not available in the construction documents reviewed.
7. Building foundations (basements and crawlspaces) were not altered / upgraded during these renovations and are generally as originally constructed.

Basements are approximately 7’ in height with poured-in-place concrete walls and a poured concrete slab. Except where altered, the basement access is available directly from the dwelling unit above via stair from kitchen space. The full building basements are subdivided by fire-rated rated frame partitions forming approximately 24’ x 16’ spaces.

8. Kraft faced fiberglass insulation is in place within the floor joists overhead.
9. Each crawlspace building has a separate crawlspace under each wing. The foundation walls are poured concrete and the floor is unimproved soil with a marginal polyethylene vapor retarder covering (most of) the soil.
10. Headroom in the crawlspaces is approximately 4’. Crawlspaces are accessed via areaways at the end of each wing.
11. The crawlspaces are passively vented with small sidewall vents placed at the gable ends of the crawlspaces.

Image 1: General view of inside gable ends at typical “EL” configured townhome building.

OBSERVATIONS

12. Most of the reported high levels of moisture and relative humidity are specific to the basements and crawlspaces of the buildings. Although the site drainage for the most part appears adequate, there were some noted typical practices occurring throughout the property which will tend to exacerbate below grade moisture conditions.
13. As is shown in image 1 above, rainwater collected from the roofs of the building via the gutter system collect and deposit the rainwater directly adjacent to the foundation. This has the effect of concentrating storm water directly at foundation potentially overwhelming whatever foundation damp-proofing may exist.
14. The site does have a storm drainage system in place, but only a few rain leaders are directly tied into it.

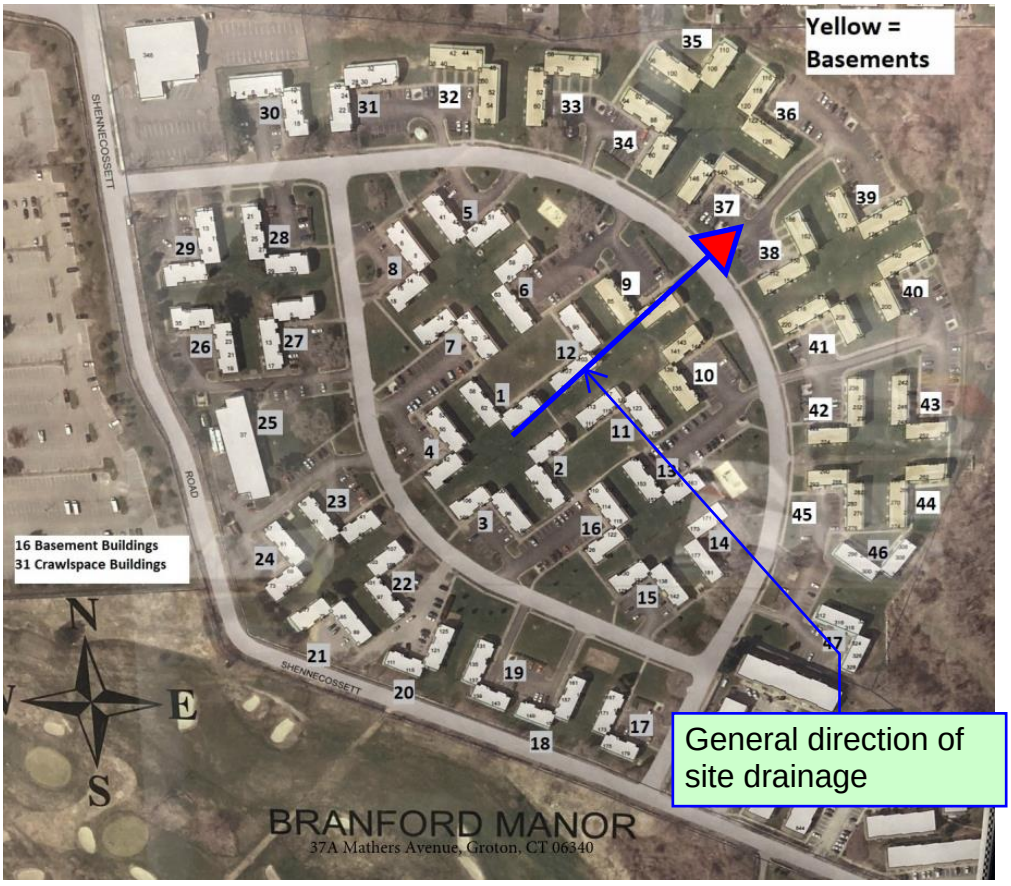


Image 2: Branford Manor site plan. Topography is generally lightly sloped with primary drainage to the northeast.

Images 3, 4: Typical storm area drain; rain leader terminating below grade.

15. The general topography is rolling / lightly sloped with the major drainage direction to the northeast. Appropriate surface swales for drainage management exist, but there are a few instances where basement window wells and crawlspace vents are close to grade and are potentially breached during substantial rainfall events.

Images 5, 6: Basement window well and crawlspace vent level with existing grade and subject to water infiltration.

Images 7, 8: Grades slope to the northeast generally. Drainage swales exist between buildings but are marginal in some cases. Positive drainage away from foundations should ideally extend for 10' minimum away from each building.

16. As noted above, 16 building have basements, and 30 have vented crawl spaces. The full building poured concrete basements are subdivided with frame partitions aligning with the tenant separation walls of the apartments above. The crawlspaces are not subdivided but are fully open encompassing one wing of the two wing buildings, each building having two non-connected crawlspace volumes.

17. Crawlspaces are accessed via removable surface grates and larger sized vertical openings in the crawlspace end walls. Basements are accessed through interior stairs from the dwelling kitchens.

Images 9, 10: Typical crawlspace access; typical crawlspace vent

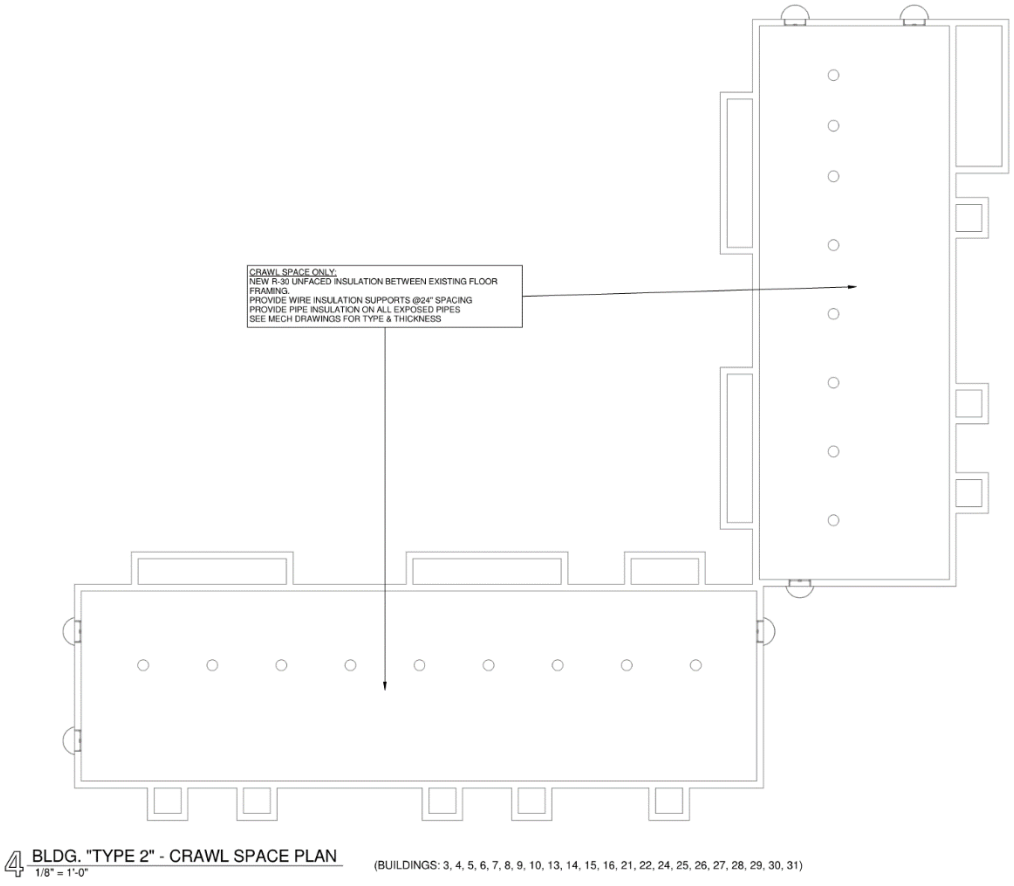
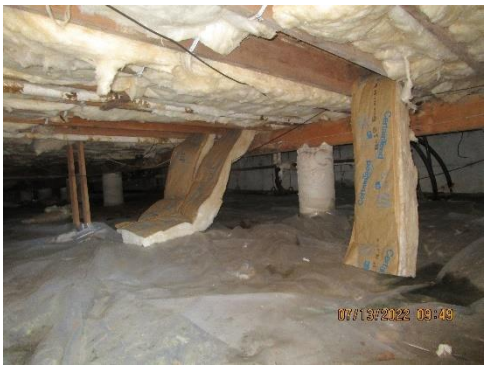


Image 11: Typical crawlspace plan showing vent locations

18. Multiple crawlspaces were accessed and viewed. Observed conditions were consistent across buildings. Interior headroom is approximately 4' in height between floor and floor framing above.
19. Floors are unimproved soil with an unreinforced polyethylene vapor barrier covering. The vapor barrier is not secured in place and displaced and non-continuous at areas. Seams are not taped/sealed, etc.
20. Fiberglass insulation batts are in place above within the floor joist cavities. The 2017 renovation drawings call out as new unfaced R-30 batts. The insulation observed is kraft-faced R-19 batts and in overall poor condition. The material is not secured, falling out of position and only marginally effective.




Images 12, 13: Crawlspaces with dislodged insulation, and unsealed poly vapor barrier

21. Elevated levels of atmospheric moisture were evident within the crawlspaces. Based on site storm water management presently in place, the soils surrounding the buildings, adjacent to the foundations, and below the vapor retarder layer are highly likely to become saturated, or at a minimum contain high levels of moisture.
22. Crawlspace passive ventilation is marginal, although close to consistent with present code requirements of 1 sf per 1500 sf of floor area if a class 1 vapor retarder is in place. The additional soil moisture loading is causing the area ratios to be overwhelmed resulting in higher moisture levels than can be passively vented.
23. Several representative basements were entered and observed. The basement interior volumes differ significantly from the crawlspaces. Clear headroom is approximately 7' – 6" and the floors are covered by substantial concrete slabs. Various types of tenant-installed finishes were observed.
24. The exposed concrete basement walls observed were typically coated with a white "Thoroseal" type coating. (Exact product was not identified).

25. The basement spaces are not intended to be used as occupiable space, but management reports many are. Use as an additional bedroom was also reported although no required second means of access exists. The basements are not equipped with heating or cooling.

Images 14, 15: Typical basement space with framed partition to right of image; spalling coating indicating presence of moisture in concrete wall.

26. Like the crawlspaces, levels of elevated atmospheric moisture were evident within the basements. Evidence of moisture vapor migration through he concrete walls and slabs were observed. Image 15 above shows the interior surface coating spalling off exposing the concrete below. The most typical cause of this is high levels of soil moisture, permeating the concrete, and seeking to dry to the (relatively) dryer interior space. The coating is not highly permeable, so as the moisture exists the wall, it forces the coating off the surface causing the coating to spall.

27. The type or presence of damp-proofing / waterproofing on the exterior of the foundation walls could not be determined. True waterproofing is unlikely, but some sort of damp-proofing coating would have been considered good-practice at the time of original construction. Damp-proofing, like most all building materials have finite useful lives and can be prone to failure after decades of performance.

28. The soils in this region (although variable) would generally be categorized as “well-draining”. Well-draining soils can be used without water management membranes and products, thus the soils here may have allowed for the elimination of damp proofing. It was reported that the site utilizes a significant amount of fill. This will on average drain better than virgin grade.

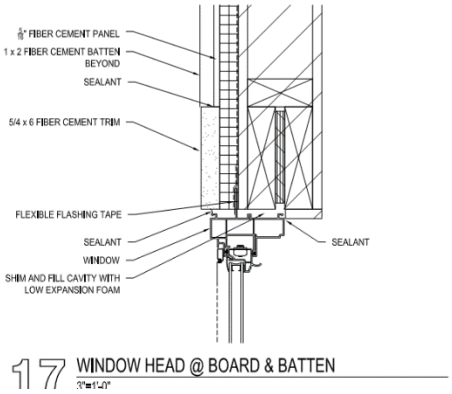
29. The concrete floor slabs similarly exhibit signs of vertical moisture migration through the concrete into the basement space. Standard practice at the time of original construction was to basement slabs onto a sand drainage layer without the use of a vapor retarder membrane. That is likely the case here but was not confirmed with a probe.

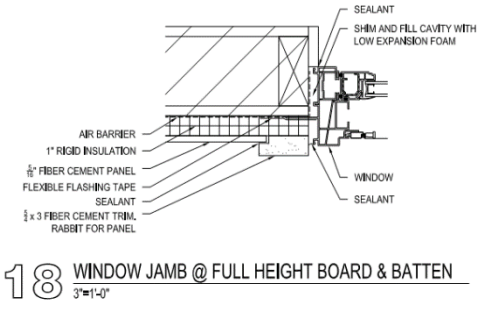
Images 16, 17: Surface spalling on concrete basement slab; staining and potential mold growth at base of concrete foundation wall.

30. Areas of rough slab surfaces (image 16) are indications of moisture drive through the slab. Relative high levels of moisture in sub-slab soils will cause the moisture to migrate upwards into the (relatively) drier basement. Surface spalling of the concrete is a result of this action.
31. Property management reports that except for rare occasions of basement window wells and crawlspaces vents being water-infiltrated by extreme surface run-of events, the basements are not subjected to chronic flooding, or active water penetration. The main problem is one of elevated interior humidity, and a lack of drying capability creating unconformable interior environmental conditions.
32. The townhomes have a very limited capability for moisture removal. Passive drying is through natural infiltration and through the vented attics

Images 18, 19: Attic ventilation is limited to gable vents at the gable end of each building "block", and shingle-over ridge vents.

33. Attic ventilation is very limited. A gable vent exists at the gable end of each townhouse block and a shingle-over ridge vent is in place. There is no soffit and therefore, no room to place soffit vents.
34. Attic access was not available at the time of the site visit, so representative attic spaces were not accessed. SWA was not able to determine if the gable vents are operable/open, or if the roof decking was cut back from the ridge beam as needed for the ridge vents to be functional. Even if these vents are functional, the clear vent area is marginal, and the passive ventilation will be limited. It should be noted that the purpose of attic venting is moisture removal, not heat removal, so inadequate attic ventilation will contribute to inadequate moisture removal.
35. SWA had requested that management provide photos of the attic interiors. Images have not been provided to date.
36. The 2017 renovations were generally well-considered and executed, however a reduction in natural infiltration drying capability resulted. The renovations included new vinyl windows and continuous exterior insulation over the existing sheathing. The new windows will be more air sealed that the originals; and the new (XPS or polyiso) continuous insulation will improve air-sealing and is moisture impermeable. The exterior walls should not provide a mechanism for interior moisture removal, but prior to the renovations they did, so normally proper improvements had the net effect of reducing interior moisture removal.





Images 20; 21: Window head and jamb details from the 2017 renovation architectural set showing continuous "rigid" exterior insulation over the existing sheathing.

37. Active (mechanical) moisture removal is also very limited. Each dwelling possesses a single bathroom fan on a manual switch. When not in operation, no mechanical moisture removal occurs. The fans are, however, vented directly to the exterior through vertical ducts and roof mounted exhaust ports. Kitchen vent hood are recirculation type, and not vented.

CONCLUSIONS

38. Branford Manor was originally constructed in a manner consistent with typical residential construction designs, materials, and methods of the late 1950's and early 1960's. The building envelopes were generally leaky with regards to air movement, and building waterproofing was applied only if hydrostatic water conditions were present. Damp proofing was marginal, and moisture vapor control was considered only for extreme environments or uses such as refrigerated containers, etc.
39. The buildings as presently configured are now more air-sealed than they originally were, but no less prone to interior moisture loading.
40. There are no mechanical systems in place to remove moisture.
41. Site drainage patterns are marginal at several down-slope buildings with inadequate swales in place to drain water away from the foundation.
42. Storm water management on site is marginal as it relates to collecting and discharging water away from the buildings. As a result, the generally porous soils at the buildings become regularly charged with moisture and maintain a high moisture content.
43. The building foundations, especially the crawlspaces, are not constructed to thwart moisture vapor flow through the assemblies.
44. Moisture travels through the foundation via capillary action and exits into the relatively drier basement are.
45. The soil crawlspace floors will be constantly moisture charged, with moisture in vapor form constantly being released into the crawlspace volume.
46. The lack of internal air-sealing between living spaces and basement / foundation allows highly moisture laden air to travel up through the building causing elevated relative humidity in the occupied spaces.
47. Vented attics are intended as a means of excess moisture removal. Attic ventilation is presently marginal (and unverified).

RECOMMENDATIONS

48. The elevated moisture conditions present at Branford Manor are the result of multiple variables relating to soil moisture loading, minimally effective damp-proofing / moisture vapor flow control, a reduction in air-infiltration form prior renovations, and a lack of mechanical moisture removal.

49. Corrective actions will need to address each of these factors in combination in order to achieve a positive result (reduce interior moisture loading and improve moisture removal).

SITE

50. Improve positive surface drainage away from downslope buildings where presently deficient. Swales should direct surface runoff around buildings or to area drains.

51. Roof water storm water management is highly deficient and must be improved. Ideally the vertical rain leaders should terminate in below grade drains feeding into the present area drains. If this is not practical, alternate means to produce a similar result should be employed. Discharging the rainwater at the foundation is highly problematic for moisture loading.

BASEMENTS

52. Improving capillary moisture flow though the foundation walls from the exterior is largely impractical but reducing the soil moisture loading (as stated above) will reduce the through wall moisture flow.

53. The concrete slabs likely do not possess a vapor retarder between the slab and the soil. A core probe could be conducted to confirm. If no VR is found, a fluid applied product can be used to coat the top surface of the slab. One product is https://laticrete.com/en/resinous-and-decorative-finishes/vapor-reduction-coatings/vapor-ban-er This is not a product recommendation which would need to include a more exhaustive scope of work consideration, and compatibility testing. Similar coatings may also be appropriate for walls.

54. These coatings are not intended for trafficked areas without further protection, but could be left exposed if the basements were not accessed from the apartments as management is reported to be considering.

55. If tenant basic access is eliminated, the frame partition may be removed (confirm fire separation requirements with local building department) and install whole-basement dehumidification. The combination of the storm water control, interior vapor control, and dehumidification will solve the bulk of the present excess moisture conditions.

CRAWLSPACES

56. The crawlspaces represent fewer simple options to attain the same level of effectiveness as the basements. The crawlspaces are vented, and to get high-level moisture control, they would need to be converted to non-vented. (more below).

57. Primary action at the basements is to improve the vapor barrier covering the soil floor. The exist 6 mil poly VR should be removed, and be replaced with a reinforced 12 mil or greater VR.

58. The insulation at the crawlspace ceiling should be replaced. There are multiple options with varying attributes. The least costly highly effective solution would be to install new unfaced fiberglass batts in the joist cavities supported in strung wire (not wire clips) such that the fiberglass remains flush with the bottom of the joists. A 1" layer of foil faced polyisocyanurate is installed to cover the fiberglass and joists with all seams taped with foil tape. All penetrations and edges at the perimeter are sealed with close cell foam. This would effectively separate the crawlspace from the living space above.

59. A deeper intervention would involve creating an unvented crawlspace. This involves sealing the vents, installing a new vapor retarder layer on the ground, insulating the walls (instead of the floor above) with 2" minimum of foil-faced polyiso, taping/sealing all joists, and spraying the rim joist with 3" closed cell foam. This brings the crawlspace into condition space.

ATTIC

60. As noted above, access to the attics was not provided at the time of the site visit. The apparent lack of attic ventilation likely has a minimal effect on the interior moisture level, but it still should be confirmed to be functional by direct observation.

BATH FANS

61. The only mechanical ventilation is presently the bath fans. The manual controlled devices should be replaced with high-efficiency, low sone (quiet) 2-speed fans. Unique operator controls are available such that when manually switched off, the fans will remain in low-speed mode to provide continuous exhaust ventilation.

62. The present fans appear to be direct vented to the exterior via a vertical duct and roof boot. This is an effective arrangement and can possible be reused with the new fans.

End of report