DRAFT

REPORT

STRUCTURAL EVALUATION

SINGLE FAMILY RESIDENCE

1 SILVERTHORNE LANE
BELLE MEAD, NEW JERSEY

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OVERVIEW

This report concerns an investigation of the condition of the single family residence at 1 Silverthorne Lane, Belle Mead, New Jersey. The owner has concerns with respect to some of the existing conditions of the house.

This was a visual inspection. There was no removal of material for testing purposes. There was no removal of building finishes to inspect the substrate. A photographic record was prepared which is included with this report. Included with this evaluation is a review of the following documents:

1. Construction plans prepared for Toll Brothers, Inc., entitled, “Madison Estates at Rivers Edge, Lot 45".

2. Letter type report prepared by U.S. Laboratories, Inc., dated April 21, 2004, prepared for Ms. Ellen Nevins, signed by Malcolm L. Rahat, P.E.

3. Test results for concrete core samples.

4. Letter type report dated, June 24, 2004, prepared by James B. Huffman, P.E.

5. Testing and inspection report prepared by U.S. Laboratories, Inc., dated August 2, 2004, presenting results of Ferroscan of the concrete wall.

6. Letter type report prepared by Criterium Lockatong Engineers, dated August 24, 2006, prepared by Robert N. Roop, P.E.

7. Undated report prepared by J. Anthony Dowling listing deficiencies within the residence with a cost estimate for repair.

It is the finding of this investigation that there are various deficiencies within the house. These deficiencies are the result of the detail of design, the detail of construction and the quality of the workmanship involved in the process of the design and construction of the house. Although at this time, these deficiencies do not render the house non-habitable, they do represent deficiencies which, if left uncared for, will cause a deterioration of the condition of the house which may render it not habitable. Other conditions are aesthetic in nature and affect the appearance and use of the house.

DESCRIPTION

This description is based upon a review of the construction plans and a site visit.

The construction plans are a set of stock construction plans prepared for Toll Brothers. The name of the architect is not shown on the plans. The set of plans is one style house, which is used by Toll Brothers in various locations. It is probably one of several sets of stock plans presented

to prospective home buyers when the site was developed.

One peculiarity of the plans is that the construction plans show a particular layout of the house with the garage at the right front corner and the conservatory at the left end of the house. The house which was constructed at 1 Silverthorne Lane is a mirror image of the house shown on the construction plans. On the one hand, this is a common experience in the construction of single family residences within a large development. A set number of standard drawings are available. The house can be either built in the orientation shown on the plans or in the mirror image. There is a challenge for the contractor to be alert to reversing the dimensions and the layout.

The other noticeable characteristic of the plans is that the plans have limited information with respect to the details of construction, in particular, the details of the connections. It was noticed during the inspection that the as-built condition of the house does not match the information shown on the plans in certain areas. For example, the construction plans show that there is a crawl space below the conservatory. In actuality, the basement extends under the conservatory. There is no crawl space.

Another example is the layout of the foundation wall along the rear of the house. There is an extension to the wall. This extends under the family room. There was to be an extension of the basement wall to form an alcove. The W8 x 18 structural steel beam was to be set in beam pockets on the two corners. This was to support the floor of the family room. A triple 2 x 10 drop beam was then to extend between the beam pockets on the two walls. This was to support the rear portion of the breakfast area. As constructed, the wall extension was eliminated. A circular steel column was set in place to support a continuous structural steel beam. The wood beam was not installed.

There were some changes to the roof layout. Toward the left end of the house, as built, or right end, as shown on the plans, there is a tray ceiling over the master bedroom. The plans do not show any skylights. As constructed, there is a skylight over the master bath. This results in a modification of the roof framing. Instead of continuous roof trusses, extending from front to rear, set at 2' on center, the trusses were spread apart so there were double trusses on either side of the skylight. Dimensional lumber was then used to frame across the opening between the top chords of the double trusses. See photographs

The construction plans show that the roof framing, from left to right, across the house, was to be pre-manufactured wood trusses. Then the sheathing was to be applied. Dimensional lumber was to be used to over frame the base roof to form the gable end treatments at the front of the house. The roof was not constructed in this manner.

The construction plans do not show any skylights in the roof above the family room. The as-built condition has the skylights. The detail of the framing is not known.

The house is supported on concrete spread footings. There are strip footings for the perimeter walls of the basement and individual footings for the columns.

The construction plans show that the perimeter walls for the basement and for the garage are 8" thick cast in place concrete walls supported on an 8" thick by 16" wide concrete footing.

There is a note that the condition varies with the veneers. The particular variation is not shown. The footings to support the piers vary. In general, the piers are 12" thick by 30" by 30". The pier is 12" thick by 24" by 24" within the garage. The floor slab in the basement is reported to be a 3½" thick concrete slab on a 6 mil poly vapor barrier, lapped 6" at edges, on a 4" crushed stone. The slab in the garage is a 4" thick concrete slab with WWF10-6/6.

The construction plans do not show any reinforcing in the spread footings for the walls and the individual footings for the columns. The construction plans do not show reinforcing in the basement walls.

On August 2, 2004, U.S. Laboratories, Inc. observed testing by Applied Engineering Technology. The testing was to use a Hilti FS10 Ferroscan instrument to locate reinforcing steel within the wall. Two of the walls were scanned, the front wall and the right side wall. At both locations, only two horizontal reinforcing bars were found. These are estimated to be a #4 bar. The first bar is located 10" above the concrete slab. The other is located 4'-10" above the concrete floor slab. No vertical reinforcing was found. With this limited amount of reinforcing, the walls are considered unreinforced.

The basement is one large room. There are two means of access. One is an interior wood frame stair, from the first floor down to the basement. The other means of access is an exterior access at the left rear corner of the basement. There is a 6' wide double door through the basement wall. At the exterior, there is a set of concrete stairs bounded by concrete retaining walls.

The first floor consists of the main portion of the house and the three car attached garage. The three car attached garage is located at the left front corner of the first floor. The garage is a concrete slab on grade. There is no basement below the garage. Above the ceiling of the garage is a walk-in closet for the master bedroom suite.

The main entrance is at the front of the house. It provides access into a foyer. To the left of the foyer is the dining room. To the right of the foyer is the living room. Behind the living room is a study. To the right of the study and living room is the conservatory. This foyer also has the set of wood frame stairs to provide access to the second floor. Behind the wood frame stairs, there is the family room. This has a vaulted ceiling. To the left of the family room, there is the breakfast area and the kitchen with the laundry.

The conservatory is a single story structure. The basement extends below the conservatory. The hip roof of the conservatory is set at the elevation of the second floor.

There is a masonry fireplace in the living room. This is on the common wall with the conservatory. There is a separate concrete masonry unit wall and footing in the basement below this fireplace. There is another fireplace at the rear wall of the family room. The rear foundation wall supports the fireplace.

The floor framing consists of 2 x 10 floor joists, spaced at 16" on center. The first floor framing below the kitchen consists of double 2 x 10's at 16" on center. At various locations throughout the first floor framing, there are double 2 x 10's to support interior non-load bearing and load baring walls that separate the various rooms. The orientation of the floor joists below the

kitchen and below the main portion of the house is from front to rear with support on the front basement wall, two interior steel beams, W8 x 18 in size, supported on steel columns, and at the rear basement wall. At the extension of the rear basement wall under the breakfast area and family room, there is an additional row of W8 x 18 beams to support the floor joists. At the conservatory, the 2 x 10 floor joists are supported on the front basement wall, a single interior beam and the rear basement wall.

It should be noted that the span lengths of the 2 x 12 floor joists vary depending upon the location in the house. Across the front of the house, below the foyer and the front portion of the living room and the dining room, the floor joists are 15'-1¼" long. At the center portion, which would be under the stairs, the span length is 5'-6". At the rear portion of the first floor, the span length is 15'-10¾". At the conservatory, the span length of the floor joists to the rear is 15'. The length of the floor joists in the front is 15'-4".

At the second floor, the area above the family room is open to the underside of the attic. The area above the entrance foyer is also open to the underside of the attic. The portion of the second floor at the interior is a bridge between the left and right sides of the house. Access to this bridge is from the foyer stairs.

To the right side of the house, there are two bedrooms with a shared bath. Beyond the bedrooms, there is the attic and roof area above the conservatory.

To the left side of the house, there is the master bedroom suite and a separate bedroom. On the plans, the separate bedroom is described as the "Princess Suite". This has an attached bath. The master bedroom suite is located above the kitchen and the garage. The master den and the "Princess Suite" are located above the dining room and the breakfast area. There is a second set of stairs providing access from the second floor down to the first floor.

The framing for the second floor consists of 2 x 10 floor joists. There are variations in the orientation. On the right side of the house, above the living room and the study, the floor joists are from side to side with support on the wall between the living room/study and the conservatory and on the interior on the wall separating the study from the family room and the living room from the entrance lobby.

The framing on the left side of the house, above the dining room, is also side to side with support on the interior wall between the foyer and the dining room and the wall between the dining room and the garage. Some double 2 x 10's have been set in the first floor framing to support the interior load bearing walls.

At the left rear corner of the house, at the support for the "Princess Suite" and the main portion of the master bedroom, the floor joists span front to rear with support on the interior load bearing walls and engineered wood, in particular, paralams of various sizes. The floor joists under the master bathroom have been doubled to support the extra weight of the tub.

The roof framing is shown on two different drawings, Sheets A4B and A4C. On A4B, the general layout of the house is shown. It is indicated as engineered roof trusses over the main floor, dimensional lumber above the conservatory and trusses above the walk-in closet for the master bedroom suite. The plan also indicates the area of over framing of the basic frame to form

the dormers at the front of the house. The second sheet shows details of the layout of the roof trusses. The configuration of the roof is a hip roof with three dormers at the front, two minor dormers and a large dormer over the three car garage, facing the front.

In general, the roof trusses span from front to rear on the house with support on the front and the rear exterior wall at the great room. There is a paralam which spans across the ceiling to support the roof trusses. Beyond the paralam, the roof framing is dimensional lumber using 2 x 12's at 24" on center. At the right end of the house, the hip is framed with a two ply truss girder with jack rafters extending down toward the eave of the right side of the house. There is one jack rafter extending from the two ply girder to provide the support of the hip. The line of the hip continues across the top chords of the trusses to the center ridge. The construction plans show a similar configuration for the hip at the left end of the house. There is a change in direction of the roof trusses over the garage. The roof trusses are from side to side rather than from front to rear.

There is a variation in the actual construction of the roof. Over the master bathroom, there is a skylight through the trusses. The trusses have been rearranged as two pairs of double trusses set approximately 4' apart. Dimensional lumber framing was used as roof rafters. These are supported at the top chords of the double trusses. See photographs

Above the first floor deck, all of the interior walls, whether load bearing or non-load bearing, are wood frame construction, using 2 x 4 studs. The exterior walls are also wood frame construction with 2 x 4 studs. The exterior is a plywood sheathing. The finish at the front of the house is a brick veneer applied over the wood frame walls. At the left, right and rear elevations, the finish is a vinyl siding.

There is an exception to this configuration at the rear wall of the family room. Due to the extra height of the family room wall, the exterior wall was framed with 2 x 6 framing studs rather than with 2 x 4 studs.

The interior finishes consist of ½" sheetrock applied to the walls and to the underside of the ceiling. The floors consist of ¾" thick tongue and groove plywood sheathing as a subfloor with various floor finishes, including wood and tile.

The Cover Sheet shows the standard details for radon mitigation and waterproofing. The details indicate that the exterior surface of the concrete basement walls were to receive a bituminous damproofing. This is not the waterproof membrane. Damproofing is permitted by the code in areas where there is no high ground water table.

CONDITION

The basement floor is not level. A laser level was set up on the basement floor. Measurements were taken from the laser level down to the floor and from the same laser level to the underside of the first floor framing. It was found that there is a variation in the finished surface of the basement floor slab. The greatest difference in magnitude is 2". The lowest elevation of the floor is at the extension of the basement below the family room. The highest point appears to be toward the middle section of the house. It was not possible to obtain accurate

measurements across the front of the house, due to material stored in the basement.

In a similar manner, the laser beam was used to measure the height from the laser beam to the underside of the first floor structure. In general, the elevations found were consistent with some minor variation of a few 16's of an inch. This would be characteristic of a flexible wood frame floor.

Around the basement wall, there are various hairline cracks. Some are vertical and some are diagonal. The diagonal ones tend to radiate from the lower corner of the penetration for windows. In some of the cracks there is evidence of moisture penetration through the crack. See photographs Along the rear wall, elevations were taken to determine the top of wall elevation. It was found that the top of the beam is set ⅜" higher than the top of wall elevation. This will effect the elevation of the first floor in the family room. An inspection of the family room floor shows that there is a high point, referred to in one of the earlier reports as a tent action in the floor.

At the rear wall, it was found that the beam pocket to receive the steel beams were set deeper than was necessary. They were probably set to accommodate the 10" deep built-up beam rather than the 8" deep structural steel beam. As a result, it was necessary to stack various plies of steel plates, as shims, to make up the difference. See photographs At the one end, the bearing length of the beam is short. There is a diagonal crack radiating from the bearing. See photographs

Along the right side basement wall, there is a bow in the surface of the concrete wall. This appears to be due to movement of the form during the placement of the concrete. Further investigation is required.

The masonry opening at the left rear corner of the basement to accommodate the access door, does not match the size of the door. Modifications were made in the framing which are inadequate. The header over the door was not properly framed and supported.

There is no separate header over the openings for the basement windows. In normal construction the framer will set a double sill plate around the perimeter. This will provide additional stiffness to frame across the windows. For this house, there is a single sill plate. A steel angle was set in place as a header across the window. This interferes with the operation of the window.

An inspection around the perimeter of the house shows that, in general, the height of the backfill is approximately 7'-0" above the elevation of the basement floor slab. At the front, the height of the backfill approaches 8'-0". This is due to the build-up of the planting bed for the landscaping and also the presence of the fill for the front porch.

The construction plans note that there is to be a variation in the basement wall, designed to accommodate the brick veneer. The detail is not shown on the construction plans. An inspection at the front of the house shows that the brick veneer over hangs the front face of the wall, raising to question the support of the veneer. In addition, it was noted that there are no weep holes through the front wall.

Concern has been expressed with respect to the method of attachment of the underlayment and subfloor to the floor joists. It is not possible for this writer to independently

verify this condition

The misalignment to the floor joists as seen from
conditions found at random points throughout the

There is hairline cracking of the ceramic tiles around the

Within the conservatory, the joint in the sheetrock ceiling, which coincides with the hip rafter, is offset from the corner joint. See photographs This is an indication of a problem with the roof framing. Usually, the hip rafter is set so that it is supported on the corner post. The joint in the ceiling would then be located on line with the rafter and intersect with the vertical joint at the corner. The fact that the hip rafter joint is offset at both the right front corner and the right rear corner indicates a potential problem with the framing of the roof. It was not possible to gain access into the attic above the conservatory.

Within the field of the first floor framing, there are some anomalies. At some locations, there is a vertical twist to the joist. There is some misalignment.

The construction plans show that the opening from the foyer into the dining room and the opening from the foyer into the living room were to be directly across from each other. In the as-built condition, these are offset. This is primarily an aesthetic concern. There may be some structural concern. These walls are load bearing walls. The triple 2 x 10 headers above the openings transfer the second floor load through the door jambs to the framing below. Further investigation needs to be undertaken to determine if the offset nature of the openings affects the first floor framing.

In the rooms with the ceramic tile, there are hairline cracks. In the conservatory, the hairline crack is located in the floor directly above the center beam for the first floor framing. Within the kitchen, the cracks are located within the field of the first floor framing. This is an indication of a framing which is too flexible for the floor finish. It is also an indication of a possible deficiency in the preparation of the subfloor and the underlayment.

There are some reports of deviations in the method of attachment of the subfloor and the underlayment to the floor joists. It was not possible to verify this without removing some of the floor finishes. Throughout the first floor, there are some anomalies in the sheetrock finish of the walls. At some walls, there appears to be a bulge. At other places, the walls do not appear to be plumb. The corner joints are not plumb. This condition is found in the conservatory, the family room, the kitchen and at other rooms located throughout the first floor.

At the second floor, the landing for the main stairs is not level. It was not possible to directly inspect the second floor framing. This condition would indicate a problem with the detail of construction.

The as-built condition of the roof trusses does not match that which is shown on Sheet A-4C. At the master bedroom suite, rather than have a continuous run of trusses, there is a discontinuity. The roof trusses were set as double trusses on either side of the opening.

Dimensional lumber was set as roof purlins between the top chords. This was done to accommodate the framing for the skylight. It is not known whether this revision was designed by the architect or by a structural engineer or whether it was left to the skill of the framed to develop the detail. There are reports of leaks around the skylight. This may be a reflection of roof framing which was inadequately designed and is too flexible. Further investigation is required.

At some of the trusses, there is a 2 x 4 added to the web members. See photographs 12 and 13. These stiffeners are usually specified by the engineer who lays out the roof framing. Some of the web members are longer than permitted by the loads. They result in a flexible web. The additional 2 x 4 is a means of stiffening the web.

At the right end of the roof, the configuration is to be a hip. The layout of the trusses should accommodate this hip configuration. It appears that there was some variation in the layout of the trusses which required modification. The modification is seen as the addition of plywood plates at the intersection of the webs and the chord members. The history of this modification is not known. It is not known whether this was designed by the architect or structural engineer or whether it was left to the ingenuity of the framer. As a minimum, the history of this modification should be provided by the builder.

At the top of the stair, there is a misalignment between the nosing at the top tread and the landing surface. This leads to a trip hazard.

There are various deficiencies within the finishes. These have been documented in the reports. Due to the length of time since the construction of the house, the preparation of the prior reports and the preparation of this report, it is not possible for this writer to adequately separate those conditions which were present at the time of the initial construction of the house and those which may have been the result of normal wear and tear. Further investigation and testimony from the owner is required.

DISCUSSION

Although it is a common practice for developers to use a stock set of plans for a particular development, problems will arise. For example, if there are discussions between the buyer of the house and the developer with respect to additional features to be constructed in the house, they are not reflected on the plans. As a result, there is a potential for disputes to arise, due to improper documentation. In addition, since the information is not shown on the plans, the building inspector will not inspect the variation or know that a specific feature is missing. It is reported by the owner of the house that some of the added features, which had been requested, were not installed. It is beyond the scope of this report to review these features and resolve the discrepancies.

It is also a common practice with developers to reverse the orientation of a house on a particular lot. This in itself is not a problem, however, a set of drawings showing the reversed orientation should be produced. There is a potential for errors in the layout of the house for the foundation, the framing and the interior finishes when the contractor is left to interpreting a reversed, or mirror, set of drawings. Some of the deficiencies seen in the house, in particular the layout of some of the structural members, may be attributed to the use of the mirror image plans.

The construction plans are deficient in the detailing of the structure. Again, a developer looks for a simple drawing without attention to the site specific details. As a result, there are errors. As a result, there is limited information with respect to the header and the framing for the masonry opening at the double door entrance into the basement at the left rear corner. There was also no detailing of the variation in the front basement wall to support the brick veneer. The elevation view shown on Sheet A5B and the sections shown on Sheets A6 and A7 do not have sufficient detail to properly construct the house. As a result, there are various deficiencies. Some of these are aesthetic in nature. Some of these are structural in nature. Other deficiencies will affect the durability of the house.

Wood trusses in their assembled configuration provide a structure which will have enough strength and stiffness to support the applied dead and snow load. As an individual member, the trusses are flimsy and a poor structural member. Therefore, it is critical that the design of the trusses, the layout of the trusses and the detailing of the installation of the trusses be undertaken by a licensed professional so that the complete assembly will carry the load. There is a significant risk of damage to the trusses if they are not properly fabricated, delivered to the site and installed.

Wood roof trusses shall not be modified in the field. The layout shall not be changed. The truss members shall not be cut or modified. All work associated with the trusses shall be referred back to the original design engineer for his review and comment.

For this particular house, there are variations from the original construction plan with respect to the layout of the trusses and with respect to modification of the trusses. There is no documentation to verify that the original design professional reviewed the changes and issued a supplemental document approving the changes. At this point in time, the most significant consequence of these variations is leaks through the roof at various locations, in particular, around the skylights.

The addition of the 2 x 4 stiffeners should only be undertaken at the direction of the design engineer who designed the truss assembly. These would have either been attached to the trusses at the fabrication shop or a direction would have been given to the framer to add them in the field. Documentation shall be provided by the developer to verify that the addition of the stiffeners was specified by the design professional and that the work was properly executed.

The developer shall be required to provide the necessary documentation indicating that the original design professional approved the changes. This would include a copy of any sketches or notations prepared by the original design professional. If this cannot be provided, it will be necessary for the developer to undertaken an analysis of the roof framing to verify its load carrying capacity. If this can’t be done, the roof shall be replaced.

With respect to the roof over the conservatory, there is a concern with respect to the quality of the workmanship and the layout of the roof. It appears that the front and rear hip rafters are not properly supported. It will be necessary to remove the sheetrock finish of the ceiling and the walls to inspect the support of the hip rafter. It may be necessary to remove the roof framing over the conservatory to reset the hip rafters and provide adequate support.

There was poor quality of workmanship with respect to the framing in the first floor. This resulted in out of level conditions, twisting of members and misalignment of members. The

immediate result is an inherent flexibility of the floor which results in cracking of the floor tiles and out of level conditions in the floor which may present a tripping hazard.

There are various anomalies in the finishes. On the one hand, these can be considered aesthetic concerns. However, they may be a reflection of deficiencies in the building structure. Considering the poor quality workmanship associated with the detailing of the construction in the areas where the framing is seen, there is a strong possibility that there are other deficiencies in the areas which are concealed. As a minimum, the interior sheetrock finishes shall be removed from the walls and ceilings to inspect the framing to determine the cause of the anomalies. All deficiencies should be corrected.

There are several questions with respect to the quality of workmanship of the basement walls. Hairline cracks have developed within the walls. These cracks are usually related to shrinkage of the concrete. They do not necessarily signify a structural deficiency. However, they do have a potential for providing a path for the infiltration of water into the basement. There is evidence of this occurring. Corrective action should be taken. Further investigation is required to develop a method of repair of the cracks.

There is further investigation required with respect to the nature of the exterior of the concrete walls. The architectural plans indicate that damproofing as a standard detail. However, the fact that water is penetrating through the wall indicates that there is a high ground water table which would have required a waterproof membrane. It may be necessary to excavate around the perimeter of the house to install a waterproof membrane and the necessary perforated pipe drainage system at the exterior of the house. A drainage system should not be installed at the interior.

SUMMARY

There are numerous deficiencies within this house. Some are related to the building structure. Others are related to aesthetics. Other deficiencies are related to the durability of the house.

These deficiencies are due to inadequately detailed architectural plans, the use of a mirror image plan and improper supervision of the various craftsmen on the site.

In particular, there are variations in the construction of the house from that which is shown on the construction plans. These variations affect the roof framing and have a potential for leaks and other damages.

The developer of the site and/or the contractor shall be required to review the various conditions found and undertake the necessary reports.

Respectfully submitted,

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