

FORENSIC ENGINEERING REPORT

Vivid Civil Engineers

Structural and Civil Engineering Consultancy

Vivid Civil Engineers is an experienced team based in Melbourne. We provide optimal civil and structural engineering solutions and first-class service to architects, builders, insurance companies, developers, government departments, councils, and private organisations, to meet time and budget expectations and streamline construction.

Vivid Civil Engineers are committed to long-standing relationships, and we enjoy involving our clients in the project process to achieve better developments.



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Prepared for Ambrose Construct Group


CAUSATION REPORT & SOW

Scope: Distressed Dwelling Assessment

Address: 16 Aaran Close, Endeavour Hills VIC 3802

Date: 3 November 2023

DOCUMENT STATUS

Rev No.	Author	Reviewer	Approved for Issue		
			Name	Signature	Date
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1. Executive Summary and Conclusion

Ambrose Construct Group has engaged Vivid Civil Engineering (VCE) to undertake an engineering investigation of the damaged structure at 16 Aaran Close, Endeavour Hills VIC 3802.

A site inspection was carried out by Wenze Shao and David Ong, Forensic Engineers at VCE, on October 19, 2023, and the owner of the property was in attendance.

The primary focus of this investigation was to evaluate the existing timber verandah & patio below, as requested by Ambrose Construct Group. The damage assessment is categorized as follows:

Damage to the patio & verandah:

Our inspection identified poor workmanship as the primary cause to the patio/verandah damage. The damage includes:

- **Lack of lateral bracing -**
 - Despite the timber posts being generally in good condition, we observed deficiencies in installation, such as the use of stirrups to support each post on the footing without adequate roof/knee bracing.
- **Other structural issues to verandah -**
 - Additional concerns in the patio area includes poor splice connections in the perimeter beam, undersized and splitting battens, insecurely fixed roof sheeting and inadequate gutter fall.
- **Drainage Issues -**
 - In addition to structural concerns, the patio has surface drainage issues. The paving bricks are uneven and slope towards the dwelling (approx. 2° fall). The strip drain appears to be undersized and installed with inadequate fall, impeding proper drainage to the stormwater system, and raising the risk of overflow.

Other Structural issues (outside of the scope of this investigation):

Apart from the specified patio & verandah issues, we note the following additional structural concerns:

- Damage to subfloor joists and bearers near the bathroom suggests possible leakage. Further investigation is required to determine the leak source and the extent of damage to this area.
- A hole has been excavated in the southwestern corner of the dwelling subfloor, potentially compromising the foundations. This situation requires further investigation.
- Site levels collected indicate that the differential movements of the footing system are acceptable, with no significant foundation movement observed. However, numerous significant cracks were observed throughout the inside and outside of the dwelling, suggesting ongoing foundation movement. It could be the case that the dwelling floor was levelled as part of relatively recent restumping & floor relevening.
- The insured reported roof space leakage, which was not accessed during the visit. This issue may be related to the observed cracking and detachment. A roof report should be undertaken as a matter of urgency.

Thank you for engaging our services in this instance, and I trust the above report has addressed all your concerns. However, should you have any further queries, please do not hesitate to contact our office on 03 9070 8290.

2. Project Brief and History

2.1 General Information about the structure

The subject structure is a single-storey house, and its general construction comprises the following:

- Roof - Tiled roof with timber framing
- External Walls - Brick Veneer
- Internal Post - Timber framed stud walls with plasterboard linings
- Floor/Foundation - Timber floor supported on concrete stumps/pad footing and perimeter wall supported on brick/strip footing
- Attached Patio - Timber roof framing with timber posts to stirrup

We understand that the structure was constructed more than 20 years ago.

This report contains observations, findings, and recommendations arising from this visit.

Architectural drawing (general floor plan) was provided by the insured during the site visit.

This office has been provided with a copy of reports, these reports have been reviewed and summarised as follows:

- Building Inspection Report by “8 Point Building Inspections” dated 9th August 2023. The key findings are as follows:
 - Defects and non-complaint work in the patio, signalling poor workmanship.
 - Poor site drainage in external areas.
 - Evidence of mould growth throughout the property, likely attributed to previous water leaks.
 - Leakage in the shower area.
 - Blocked roof gutters.
 - General cracks in the overall dwelling, indicating potential foundation movement or poor workmanship.
 - Inadequate coverage of insulation batts in the roof space.

2.2 Scope of the Inspection

Ambrose Construct Group engaged VCE to prepare an engineering report to assess the cause of damage to the subject structure including the following:

1. Confirmation if a make safe is required.
2. Cause of Damage (any commentary around whether the event may have contributed to the damage)
3. Scope of Works for Rectification.

VCE received the following instructions from Ambrose Construct group:

“We kindly request ... for an engineer to arrange for attendance...the required methodology to fix the timber post issue and also to provide to us whether it would have been damaged from works completed by previous builder or is due to long term maintenance.”

During the visit, we performed visual and tactile inspection of the areas of the existing structure surrounding the damaged areas only. Wall and floor linings had not been removed, and no invasive inspection was conducted.

A Zip-Level was used to obtain relative floor levels to assist in quantifying floor movement.

2.3 Site Safety and Make Safe

In its current state, the dwelling does not present a safety concern structurally and no structural make-safe works are required.

2.4 Survey of structural loading

Loading as experienced by the structure is not expected to exceed the design limits as outlined in AS1170. No additional loading was observed, mentioned by the client, or anticipated for the use of this building, either past or current.

No recent additions are known to have been undertaken on the structure.

2.5 Reported Damage/Discussion with Insured

The insured describes the incident as follows:

- In November 2019, a storm caused roof leakage in the insured property and inflicted damage to the verandah/patio.
- Subsequently, in February 2020, another storm exacerbated the existing issues.
- Builder engaged by the insurance company came to rectify the patio, but they abandoned the job halfway, leaving the patio pavement uneven and sloping towards the dwelling.
- The insured also noted that construction materials were left scattered and contributed to the blockage in the strip drain outlet over time.
- Complaints were filed with AFCA, however, the replacement builder provided by the insurance company proved ineffective once again.
- In August 2023, the insured engaged an independent inspection, reveals extensive problems as summarised in Section 2.1.
- The patio was left in disarray, and ongoing leaks persist, marking a four-year span of unresolved issues despite assurances.

3. Structural Findings

3.1 Signs of Structural Issues

VCE made the following observations during the site visit. We note that this is a general description of the observations that VCE deems relevant to this investigation and is not intended to be a complete list of all defects:

Area of Observation

Verandah/Patio

- Paving was uneven and sloped towards the dwelling, which promotes water flow into subfloor area (approx. 2° fall).
- Patio posts were slightly out of plumb.
- Patio posts fixed to stirrup without adequate roof/knee bracing.
- Splitting observed in the roof battens.
- Roof battens (70x25) were determined to be undersized.
- Roof sheeting inadequately secured to battens, with screws exposed in the air.
- Non-compliant splice connections identified in the perimeter beam.
- Strip drain was not installed correctly and was undersized.
- The outlet pipe was not located at the lowest point of the strip drain.



Photo 1

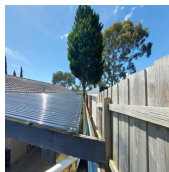


Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7

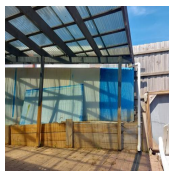


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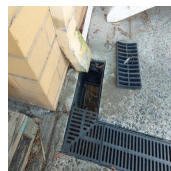


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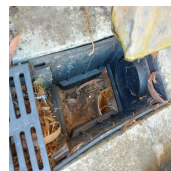


Photo 10



Photo 11

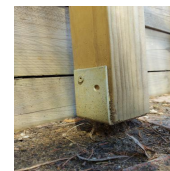


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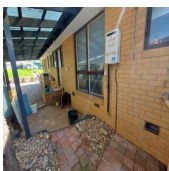


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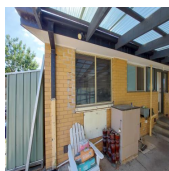


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Photo 15



Photo 16

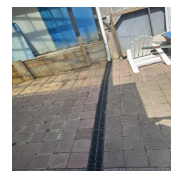


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Photo 18

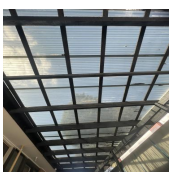


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Photo 20

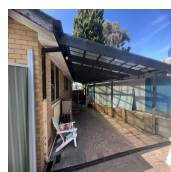


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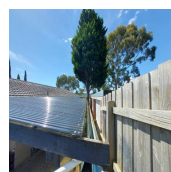


Photo 22

Area of Observation

Subfloor

- Water stains present on multiple timber subfloor members.
- Several joists under the laundry/bathroom area showing signs of rot.
- Section of bearer under the bathroom/laundry area showing signs of rot.
- The concentration of observed rot near the laundry/bathroom area, coupled with the significant clearance from the ground, suggests the presence of a leakage issue.
- A hole has been excavated near the southwestern corner of the subfloor and requires backfilling. It is not clear as to the purpose of this hole (possibly for service installation). Additionally, it seems that the footings have been partially demolished in this area.
- The subfloor consistently showed overall dampness during the inspection, attributed to runoff from the patio and leakage.

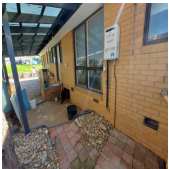


Photo 23



Photo 24



Photo 25



Photo 26



Photo 27



Photo 28



Photo 29



Photo 30

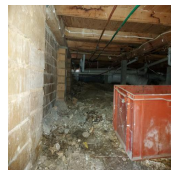


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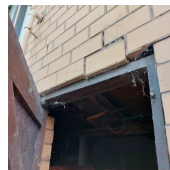


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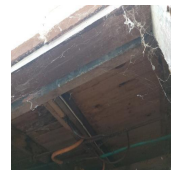


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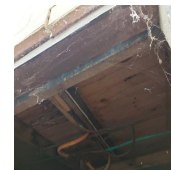


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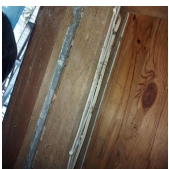


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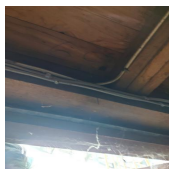


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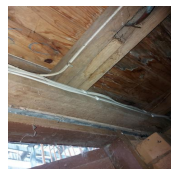


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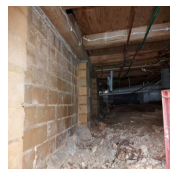


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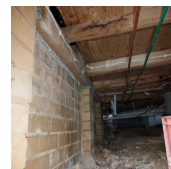


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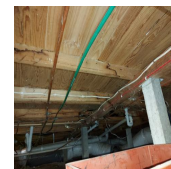


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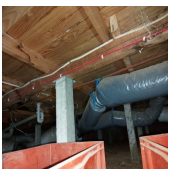


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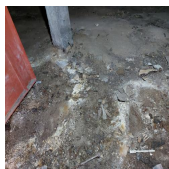


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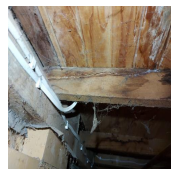


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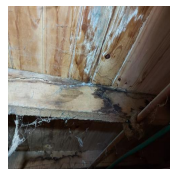


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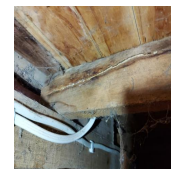


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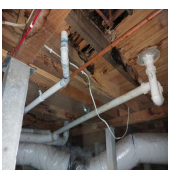


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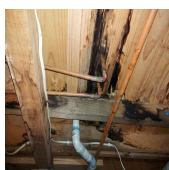


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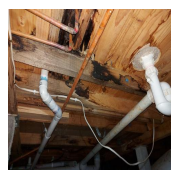


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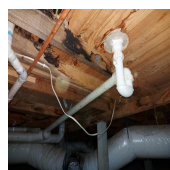


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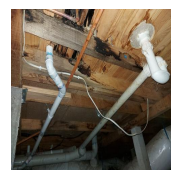


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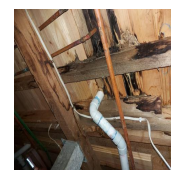


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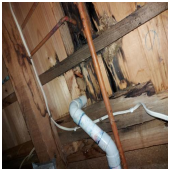


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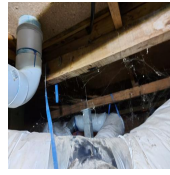


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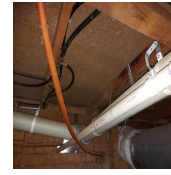


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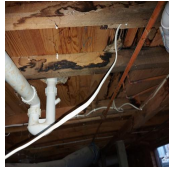


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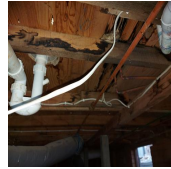


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Photo 65



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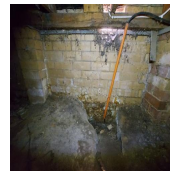


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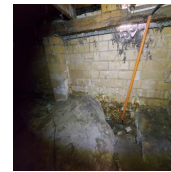


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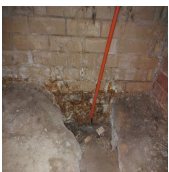


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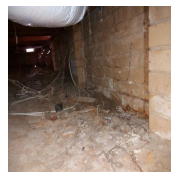


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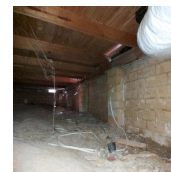


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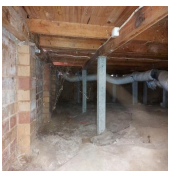


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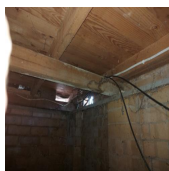


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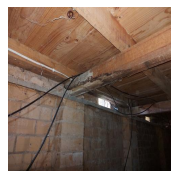


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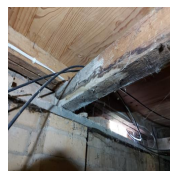


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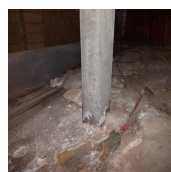


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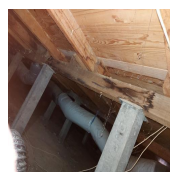


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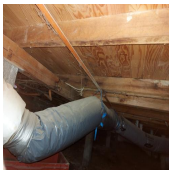


Photo 95



Photo 96

Area of Observation

External (General)

- The backyard slopes towards the rear of the dwelling.
- Site drainage around the property was generally poor, allowing water to flow into the subfloor during rainfall.
- Vertical and stepped cracking to the brickwork with signs of previous patching at the southeastern side of the dwelling (outside of 'Bedroom 3').
- Step cracking to brick cladding stemming from the top of the subfloor access door to the 'Laundry' window.

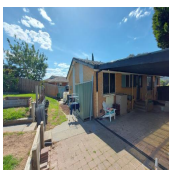


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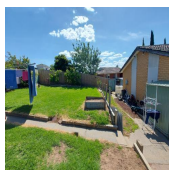


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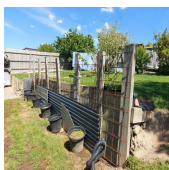


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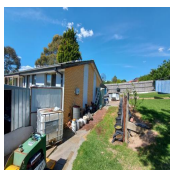


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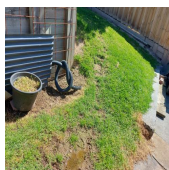


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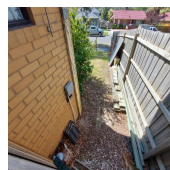


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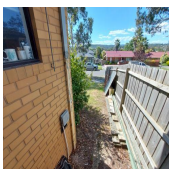


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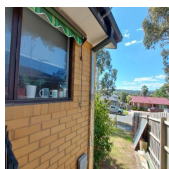


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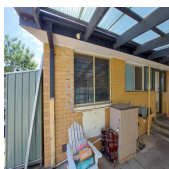


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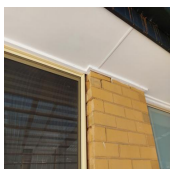


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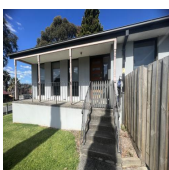


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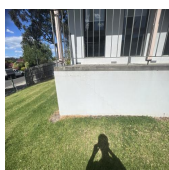


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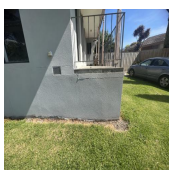


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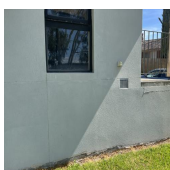


Photo 112



Photo 113



Photo 114

Area of Observation

Internal (General)

- Very slight-slight cracks to the walls and ceiling throughout the property.
- The wardrobe was observed to be leaning from the wall in Bedroom 2.
- Cracking to the bathroom area tiles was observed, which encourages moisture ingress into the underlying timber framing.



Photo 115

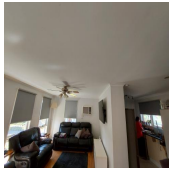


Photo 116



Photo 117

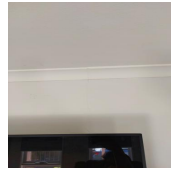


Photo 118



Photo 119

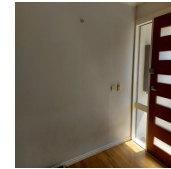


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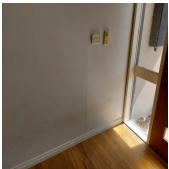


Photo 121

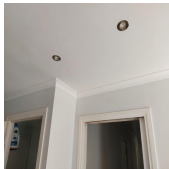


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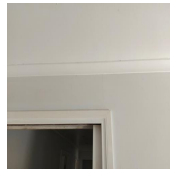


Photo 123

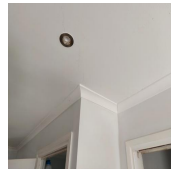


Photo 124

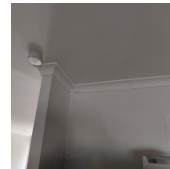


Photo 125



Photo 126

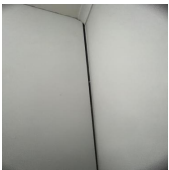


Photo 127

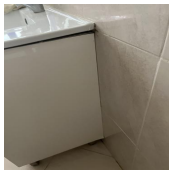


Photo 128

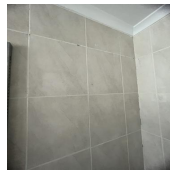


Photo 129

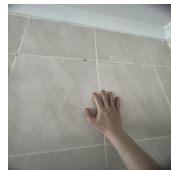


Photo 130



Photo 131

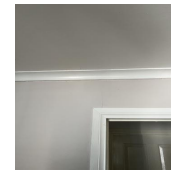


Photo 132

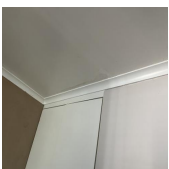


Photo 133

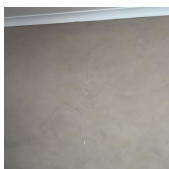


Photo 134



Photo 135

3.2 Discussion

3.2.1 Identified poor workmanship in the Patio

The patio exhibits a general lack of workmanship. Although the timber posts are generally in good condition, there are deficiencies in the installation, such as the use of stirrups to support each post on the footing but without adequate roof/knee bracing. This oversight could be contributing to the slight misalignment of the posts, as they lack the necessary resistance to lateral loads.

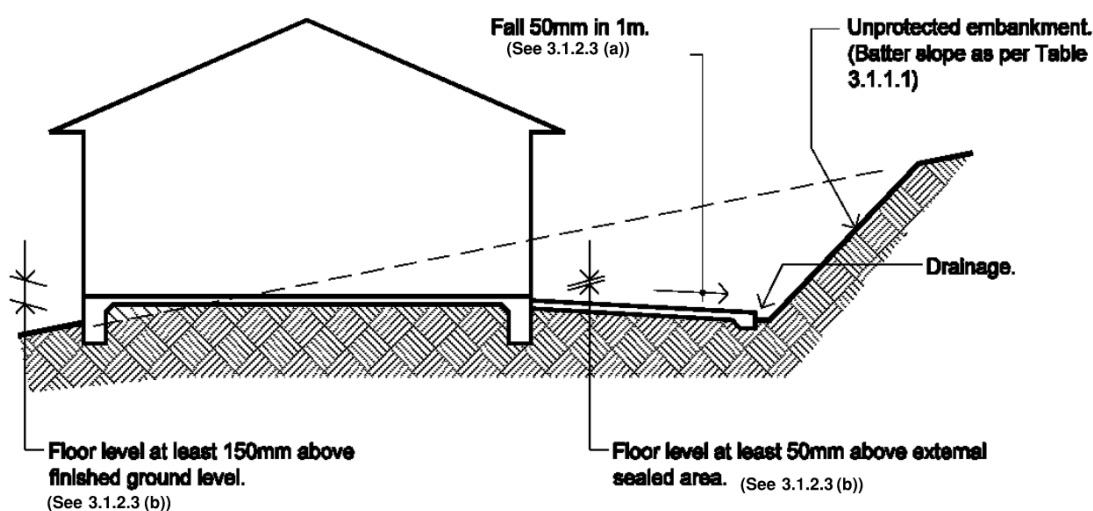
Further evidence of subpar workmanship is found in the patio roof structure, including the poor splice connections in the perimeter beam, undersized and splitting roof battens, and improperly secured roof sheeting where some screws do not penetrate the battens at all. Moreover, the patio gutters lack adequate fall.

3.2.2 Site surface drainage

According to the Building Code of Australia—3.1.3.3 regarding surface water drainage, the following applies. First, the external finished surface surrounding the slab must be drained to move surface water away from the building and graded to give a slope of not less than 50 mm over the first 1m from the building (see Figure below).

In this instance upon inspection of the property it was noted that the site drainage around the premises was generally inadequate, allowing surface runoff to flow into the subfloor during rainfall. Notably, the patio paving slopes towards the dwelling, and issues with the patio strip drain was incorrectly installed and undersized. Moreover, the outlet pipe was not positioned at the lowest point of the strip drain. External surfaces adjacent to the dwelling, including permeable materials like paving or garden areas, also allow moisture ingress into the foundational soil, posing a potential risk for foundation problems.

Additionally, the insured mentioned that the patio strip drain outlet became blocked over time due to construction materials being left disarrayed near the patio. While VCE was unable to verify this on-site, a plumbing report is recommended to better understand the blockage in the existing drainage system.



3.2.3 Plumbing/Drainage

If a leak or surface runoff encourages excess moisture to accumulate in reactive soils, then localised expansion/settlement can occur. It is not unreasonable to expect a certain level of heave experienced at the location of the reactive clay soil experienced a high saturation event (e.g., from a pipe leak). The CSIRO Foundation Maintenance and Footing Performance: A Homeowner's Guide states "the swelling of soil creates an upward force on the footings of the building" after exposure to water and moisture from a pipe leak incident. Additionally, if moisture levels are excessive, then the bearing strength of the soil can reduce, which causes settlement of the footings.

A leak in reactive soils can be damaging to house foundations and is generally limited to a localised influence zone depending on the amount of water released, duration of the leak, the site topography, and the drying conditions at the time of the leak. It is important to note that for soil characteristics to stabilise a drying out period must be undertaken, and further movement and damage may occur.

There appears to have been a leak emanating from the bathroom area. Given the floor levels are well within expected tolerances, this office does not believe that the foundations have been impacted by either the patio runoff or the bathroom leak.

Regardless of this, signs of rot were identified in several joists and bearers near the Laundry/Bathroom area. Given the elevated clearance from the ground and the concentration of rot in this area, VCE suspects a leakage issue within the bathroom rather than damage from the previous storms or runoff from the patio. A plumbing report is recommended to gain a comprehensive understanding of the leakage source and enable repairs. With respect to the sub-floor damage, linings will need to be removed to enable a thorough inspection of the wall and floor framing and to determine optimal reinstatement solution. Given the damaged elements are likely to be structural, a building permit will most likely be required before reinstatement to this area can occur.

3.2.4 Site Levels

Internal Floor Levels

We utilised a hydraulic level device to collect levels throughout the dwelling, which are recorded with an accuracy of +/- 2mm. The floor levels survey results of the ground are summarised as follows (refer to level plan for measurements as recorded):

Dwelling

- An arbitrary datum point was selected adjacent to the entry to the 'Living Room'.
- A maximum floor level differential of 16 mm (+11, -5) was recorded across the ground floor of the building, considered to be of moderate magnitude.
- Differential movement of the footing system is discernible. The pattern of footing movement is widespread and extends over the entire building footprint.
- Floor surface levels exhibit a pattern of widespread fall towards the North side of the building.
- Floor surface levels do not exhibit a pattern of localised movement.
- The floor levels of the dwelling present as relatively level and within expected tolerances.

Patio

The patio was observed to be sloping towards the dwelling at approximately 2° fall. This inclination encourages moisture ingress into the subfloor. Coupled with the undersized strip drain and blocked roof gutter, this could lead to moisture accumulation within the founding soils of the footings and lead to damage / poor foundation performance.

While it is deemed improbable that the observed cracks are a result of general or widespread differential movement, it is essential to acknowledge the potential for localized differential movement that may not have been initially detected and further investigation is recommended.

3.3 Recommended Actions/Scope of Works

3.3.1 Patio/Verandah

The following works should be broadly undertaken to the patio / verandah area:

Structural Works:

- Demolish and reconstruct the entire patio to standard, ensuring proper flashing at the dwelling attachment interface, and incorporating adequate roof and gutter fall. Timber posts can be retained, subject to confirmation that the existing footings are adequate. The new verandah will need to be designed by qualified structural engineer as part of building permit process.
- Obtain Soil report to confirm the size of the existing footings is adequate for hold down purposes and the footing founding depth is adequate.

Drainage Works:

- Engaged a qualified plumber to conduct a CCTV survey and inspect the stormwater system to check for any blockages and repair as required.
- Upgrade the patio strip drain & pavement generally to ensure adequacy, This should be designed by a qualified civil engineer. It is likely that the strip drain requires upgrade, and the patio paving requires relaying to improve grade. All subject to civil engineer design.

3.3.2 Other Recommendations (out of the scope of this investigation)

The following works are recommended to address other structural issues uncovered:

- Engage a qualified plumber to check for any leakage near the bathroom area.
- Conduct a thorough inspection of the roof (plumbing report) to confirm any leakage or water damage.
- Engage a qualified structural engineer to design the rectification work for the rotten subfloor and any identified water damage in the roof space. This is likely to require building permit (subject to advice from building surveyor and findings from inspections).

4. Building Photos: Site Visit 19/10/2023



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7

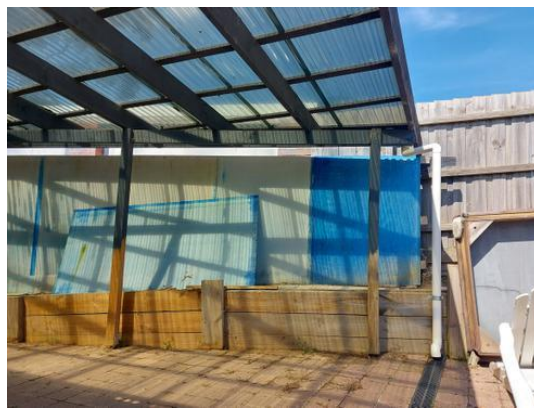


Photo 8



Photo 9



Photo 10



Photo 11



Photo 12



Photo 13



Photo 14



Photo 15



Photo 16



Photo 17



Photo 18

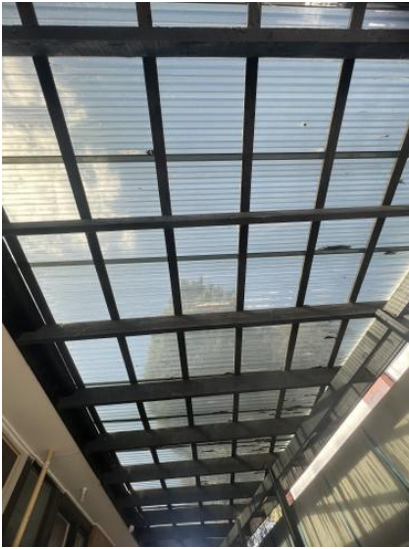


Photo 19



Photo 20



Photo 21



Photo 22

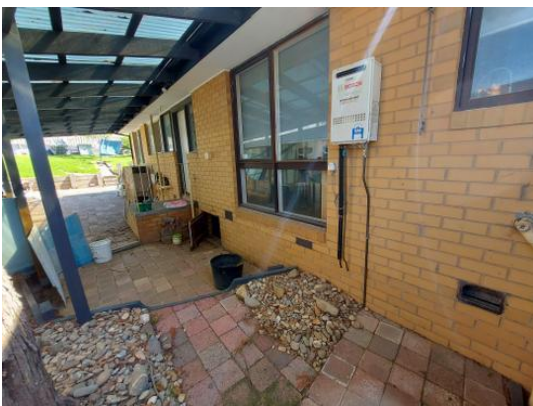


Photo 23



Photo 24



Photo 25



Photo 26



Photo 27



Photo 28



Photo 29



Photo 30



Photo 31



Photo 32



Photo 33



Photo 34



Photo 35



Photo 36



Photo 37



Photo 38



Photo 39



Photo 40



Photo 41



Photo 42



Photo 43



Photo 44



Photo 45



Photo 46



Photo 47

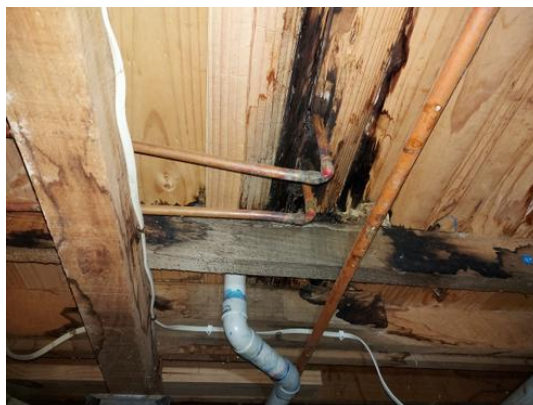


Photo 48



Photo 49



Photo 50



Photo 51



Photo 52

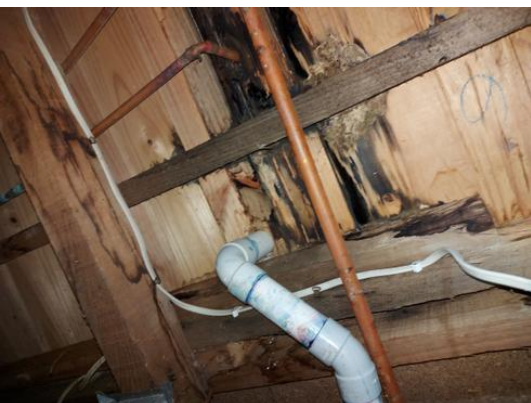


Photo 53



Photo 54



Photo 55



Photo 56



Photo 57



Photo 58



Photo 59

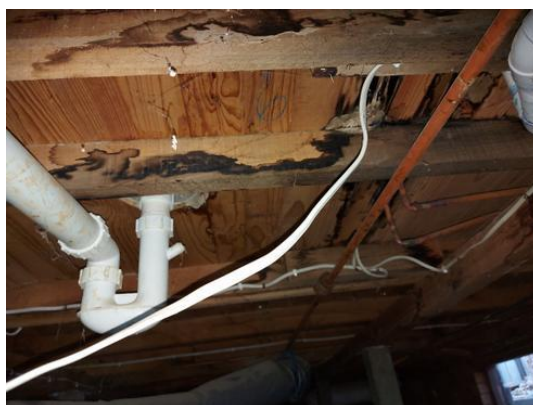


Photo 60



Photo 61



Photo 62



Photo 63



Photo 64



Photo 65



Photo 66



Photo 67



Photo 68



Photo 69



Photo 70

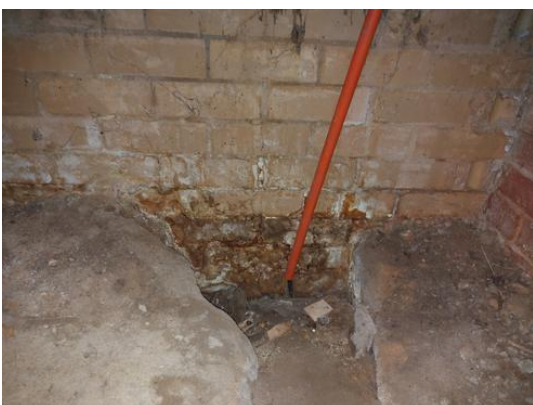


Photo 71



Photo 72



Photo 73



Photo 74



Photo 75



Photo 76



Photo 77



Photo 78



Photo 79



Photo 80



Photo 81



Photo 82



Photo 83



Photo 84



Photo 85



Photo 86



Photo 87



Photo 88



Photo 89



Photo 90



Photo 91



Photo 92



Photo 93



Photo 94



Photo 95



Photo 96



Photo 97



Photo 98



Photo 99



Photo 100

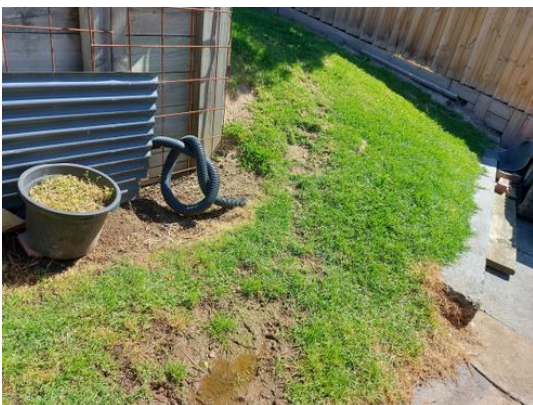


Photo 101

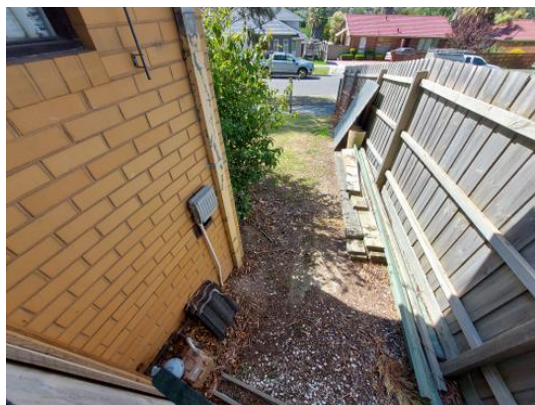


Photo 102



Photo 103



Photo 104



Photo 105



Photo 106



Photo 107



Photo 108



Photo 109



Photo 110



Photo 111



Photo 112



Photo 113



Photo 114



Photo 115



Photo 116



Photo 117



Photo 118



Photo 119



Photo 120

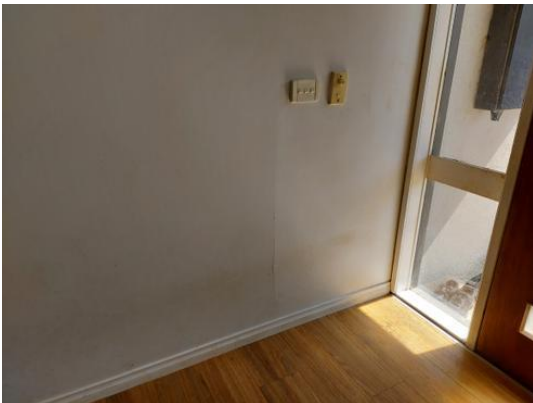


Photo 121



Photo 122



Photo 123



Photo 124



Photo 125



Photo 126



Photo 127

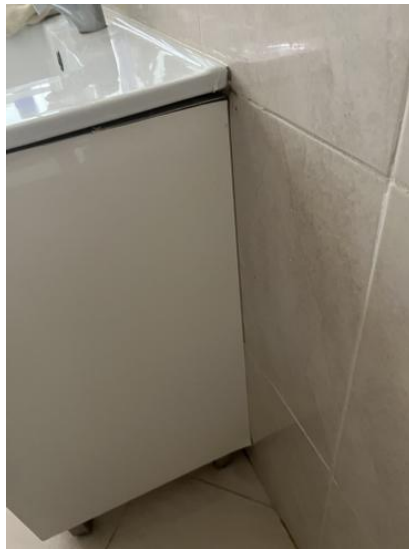


Photo 128



Photo 129

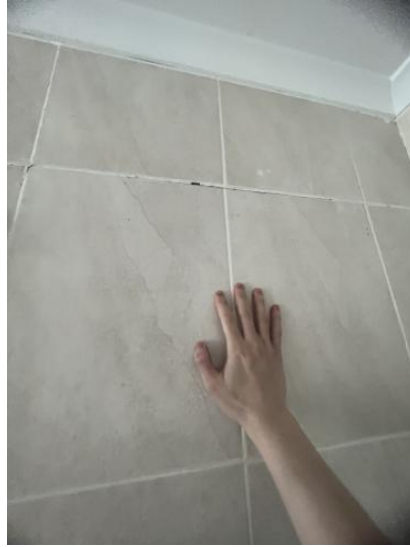


Photo 130



Photo 131



Photo 132



Photo 133



Photo 134



Photo 135

5. Limitations of this Report

1. The report is limited to the information acquired on the inspection date(s) noted, and the Scope of Works.
2. Due to the limitations of visual inspections (i.e. obstructions, concealed defects, etc.), Vivid does not guarantee that all defects within the structure have been identified.
3. The report does not cover distresses which are located in areas not reasonably accessible at the time of inspection.
4. Vivid will not be liable for faults which are not reasonably foreseeable given the evidence acquired at the time of the inspection(s).
5. Additional follow-up inspections should be conducted as required (at additional cost) to assess areas which could not be accessed previously without disturbing the existing structure or its finishes.
6. Vivid is unbiased and impartial to the opinion of the Insurer, the Insured or outside influences. The report has been written without prejudice.
7. Vivid guarantees that the report was prepared by a suitably experienced person, an expert in their field.
8. All due care and consideration has been taken in the production of the report.
9. Vivid will not be held liable for distress that may occur at the property as a result of failure to comply with CSIRO BTF-18.
10. All recommended remedial work is to be carried out by qualified and experienced contractors in the correct order and to remedial engineering recommendations supplied on this report or separate remedial engineering specifications, as required. It is expected that all remedial action will be carried out without delay.
11. The report may need to be reviewed and amended if remedial action is not carried out within 6 months of the issue date.
12. The report is limited by the accuracy of additional reports (if any) such as plumbing or soil reports, not conducted by Vivid but supplied by the Insurer or a third party, which may influence the content of this report. All such additional reports have been interpreted in good faith. Should the information provided to Vivid be inaccurate, Vivid will not accept liability for arising damage correlated to undisclosed or inaccurate information.
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14. The exact elevation of the floor immediately post construction, its relation to surveyed levels or the Australian Height Datum is unknown. When floor levels are included in the report, they have been measured relative to an arbitrary datum point.
15. The as-built level of the floor is unknown. Floor levels supplied in the report have been adjusted for differential thickness of floor coverings (e.g. tiles or carpet).
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17. This report is not to be used as evidence in VCAT or in Court. VCAT and Court reports abide to a specific and different set of rules than the ones for producing normal reports, which requires additional work and an Expert Witness to compile the report. VCAT or Court reports services can be provided by Vivid at additional fees. Should you require a VCAT or Court compliant report, please do not hesitate to contact us for further advice.
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