7th December 2022

Parish of St Killian's Bendigo
Attention: Michelle Verbeek
C/- C+M Build Group
Attention: Matthew House
C/-mathew@cmbuildgroup.com.au

C+S Consult Group Reference No.: CS22136

Attention: Michelle Verbeek

Dear Michelle,
ENGINEER'S REPORT ON DAMAGE TO WHITE HOUSE BUILDING, ST KILLIAN'S PARISH
161 MCCRAE ST STREET, BENDIGO, VIC, 3550

Introduction:

1 C+S Consult Group have been engaged by St Killian's Parish Bendigo, C/- C+M Build Group Bendigo, to provide consulting engineering expertise in relation to property damage at the above address.

2 Refer to Engineering Report request from St Killian's Parish Bendigo (Michelle Verbeek) to C+S Consult Group Pty Ltd dated 27th September 2022.

3 Site inspections at the above address were completed by Ashley Sim of C+S Consult Group on the 22nd November, 23rd November and 25th November 2022. Leigh Crapper of C+S Consult Group also inspected the site on the 23rd November 2022.

A representative from St Killian's Parish, Michelle Verbeek, was present for the site inspections carried out on the 22nd and 23rd November.

Instructions:

4 As per St Killian's Parish Bendigo verbal instruction of the 22nd of November 2022, C+S Consult Group was requested to:

- *Carry out an inspection of a sink hole that had opened up beneath the North-East wall of the White House Building.*
- *Provide engineering advice regarding any required make safe works to the impacted areas including:*
  - White House Building (**subject building**);
  - St Killian's Primary School grounds; and
  - Parish Carpark and other immediate surrounds.
- *Provide engineering advice regarding potential remedial works solutions for permanent repair of the impacted building.*

Preamble:

5 It is understood that St Killian's Parish Bendigo staff noticed several sink holes (approximately 3No. in total) following a period of substantial rainfall occurring in the Bendigo area.

6 It is understood that 2No. of the sink holes when inspected by St Killian's Parish Bendigo staff appeared to be relative minor and were backfilled with crushed rock and filling material.

These sink holes were located adjacent to the Southernmost corner of the White House Building (**subject building**). Refer Figure 1 below for photo showing the location of the backfilled sink holes.

Assessment of the backfilling to these 2No. sink holes was not included in the scope of this Engineer's Report.

Figure 1 – NearMap aerial photograph of the property and garage (dated 22nd July 2022).

7 The remaining sink hole was found to be substantially larger, in both footprint and depth, and had undermined the foundations to a section of the North-Eastern wall of the White House Building (**subject building**).

Refer Figure 2 below for photo of the subject sink hole.

8 The North-Eastern wall of the White House building forms part of the property boundary shared by St Killian's Parish Bendigo and St Killian's Primary School.

9 Following concerns regarding the structural integrity of the impacted wall C+S Consult were requested to attend site and carry out an engineering assessment of the walls structural condition.

10 Following our inspections on the 22nd and 23rd of November, C+S Consult Group recommended immediate make safe works be completed to restrict access to the affected area.

Refer emails to St Killian's Parish Bendigo (Michelle Verbeek) and C+M Build Group (Mathew House) dated 22nd and 23rd of November.

11 The scope of the inspections and associated engineer's report is limited to the undermined section of the North-Eastern wall of the White house Building only.

A detailed inspection of the remainder of other areas of the building are excluded from the C+S Consult Group scope.

Figure 2 – NearMap aerial photograph of the property and garage (dated 22nd July 2022).

Building Description:

12 The White House Building (**subject building**) is a two-storey mixed use building.

13 It is understood that the subject building was originally a single storey building estimated to have been constructed approximately 120 years ago.

A second storey was added to the original building approximately 20 years ago.

14 The typical construction of the subject building is as follows:

- Roof – Corrugated metal roof sheeting, assumed supported by either timber roof trusses or conventional timber roof framing.
- Ceiling – Plasterboard ceiling assumed fixed to metal ceiling battens fixed to the underside of roof trusses or ceiling joists.
- External walls – Double brick cavity walls to ground floor. Assumed brick veneer or double brick to upper floor (to be confirmed).
- Internal walls – Assumed double and single skin brick walls to ground floor lined with hard plaster and timber stud walls lined with plasterboard to upper floor.
- Footings – Brick spread footing on cemented combination of broken bricks, rubble and cement.
- Floor – Timber subfloor to ground floor, assumed hardwood timber joists and bearers on either timber stumps or brick piers. Timber floor joists (or proprietary timber trusses) to upper floor.
- Refer photos attached as Appendix A for details;

15 Some existing defects were noted to the subject building at the time of inspection which generally appeared to be historical damage and unrelated to the occurrence of the sink hole to the North-East wall.

16 The existing structural condition of the building is generally considered consistent with buildings of similar age and construction, except for some more notable defect as outlined in the Discussions and Observations section of the report.

17 The site generally has slight falls from the front of the property (McCrae Street) to towards the Bendigo Creek to the rear of the property.

18 Landscaping surrounding the subject building consists of the following:

- Asphalt pavement to the South-East and South-West sides of the building.
- Asphalt pavement and sand pit area against the North-East side of the building.

  There is also a poly water tank on a compacted sand bed on ground in immediate proximity to the sink hole location.

  Further beyond there are some existing building structures within the grounds of St Killian's Primary School, including:

  - Toilet block;
  - Covered roof structure.
- The North-Western side of the building is abutted by single storey buildings believed to have originally been used as stables. Outside the buildings is asphalt pavement.

19 There is one medium sized paper bark tree located in close proximity to the North-East wall of the building.

Given the size and proximity of the tree, it is considered likely that this tree may contribute to abnormal soil moisture conditions (drying effects) to some soils beneath the North-East wall of the building.

20 The subject property is located within an area with known historical gold mining activity.

21 Such mining activities are unlikely to have consisted of substantial excavations of shafts.

Rather, given the close proximity to the Bendigo Creek mining activity to this property was likely limited to shallow excavation and sluicing type gold mining.

22 Such mining activities and the natural geological composition of soils near waterways typically results in a soil profile consisting of worked alluvial fill materials.

Such soils are particularly susceptible to experiencing a loss of shear strength and bearing capacity in saturated conditions and are also susceptible to erosion.

In general, such soils are typically considered as being unsuitable for supporting shallow foundations.

23 A search of historical mine mapping data from Earth Resources Victoria did not return any known mines of significance located within or in immediate proximity to the subject property.

However, this does not mean that there are no unmapped shafts present on this site.

Major shafts and mining operations were known to exist nearby namely Hustlers Royal Reserve and Royal Hustlers.

Figure 2 – Historical mine mapping data for the subject site shown by area enclosed by red rectangle. No known historical mines to this site.
(Earth Resources – Geovic Explore Victoria Online mapping data).

Observations and Discussion:

24 There has been significant ground subsidence, in the form of a sink hole, in immediate proximity to the North-East wall of the building.

Refer Figures 3 & 4 below for photos of the sink hole.

Figure 3 – Sink hole to North-East wall of building located within St Killian's Primary School site.

Figure 4 – Sink hole to North-East wall of building after hydro excavation.

25 The ground subsidence has resulted in the footings to this area being undermined.

26 There is a risk that the structural stability of the substantial brick walls to the North-East and South-East walls of the building could be impacted by the footings being undermined.

27 Some *Moderate** stepped cracking was also noted to the North-East wall and South-East wall towards the Eastern corner of the building.

The cracking is likely to have been caused by historical differential foundation movements.

It appears that this Eastern corner has settled downwards relative to the points away from this corner on the North-East and South-East walls.

* Refer Table C1, Appendix C – Classification of Damage Due to Foundation Movements, AS2870

28 Significant out-of-plane rotations were also noted to the small blade wall to the Eastern corner along North-East side of the building.

Refer Figure 5 below.

Figure 5: Blade wall significantly out-of-plumb.

29 The blade wall was found to be at least 60-70mm out of plumb over a 2400mm long spirit level.

30 This well exceeds normally accepted tolerance limits for outwards deflection.

31 Section 12 of AS3700 sets out tolerance requirements for masonry construction, which are tabulated in Figure 6 below. Whilst the tolerances are applicable to new construction, this still highlights the structural significance of the observed rotations.

TOLERANCES IN MASONRY CONSTRUCTION

	Item	Tolerance
(a)	Horizontal position of any masonry element specified or shown in plan at its base or at each storey level	±15 mm
(b)	Relative displacement between loadbearing walls in adjacent storeys intended to be in vertical alignment	±10 mm
(c)	Maximum deviation from plumb within a storey from a vertical line through the base of the member	The lesser of ±10 mm per 3 m of height or 0.05 times the thickness of the leaf
(d)	Maximum deviation from plumb in the total height of the building (from the base)	±25 mm
(e)	Maximum horizontal or vertical deviation of a surface from a plane surface (bow) when measured as described in Clause 12.5.2	±5 mm
(f)	Deviation of bed joint from horizontal, or from the level specified or shown in elevation	±10 mm in any 10 m length, ±15 mm in total
(g)	Deviation from specified thickness of bed joint	±3 mm
(h)	Minimum perpend thickness	5 mm
(i)	Deviation from specified thickness of perpend	±10 mm max.
(j)	Deviation from specified width of cavity	±15 mm

Figure 6: Table 12.1 of AS3700 -Tolerances in masonry construction.

32 Such lateral displacements place the centroid of the wall outside the middle third of the wall.

This induces permanent tensile stresses in the wall due to bending caused by eccentric loading.

Per AS3700, the flexural tensile strength of unreinforced masonry structures shall be taken as zero under permanent loading conditions. This suggests that the wall may be at risk of structural failure.

33 It is our opinion that this wall must be demolished due to the inherent risk of structural collapse.

34 Following consideration of the above existing conditions, C+S Consult Group recommended that a suitable exclusion zone be implemented for the affected area.

Refer email correspondence to St Killian's Parish Bendigo on 22nd and 23rd of November.

35 It was not possible to determine the cause of the sink hole based on visual inspection alone, noting that there are many potential causes including but not limited to:

- Development of a sink hole from erosion of existing soil possibly caused by a plumbing leak.
- Development of a sink hole from erosion of existing soil possibly due to ground water seepage occurring with the significant rainfall received by the area of the past 12 months (particularly the past 3 months).
- Potential collapse of historical mine shafts or associated ventilation shafts.
- A combination of all the above.

36 However, several observations were made during the inspection that are considered relevant to potential causal affects.

Such observations are discussed below.

37 Surface drainage to the carpark area surrounding the building is extremely poor.

There is a distinct lack of stormwater drainage pits to collect surface runoff into a suitably design inground stormwater network or retention system.

The site is also lacking defined surface grading and drainage such as spoon drains to direct overland flows to collection points within a stormwater drainage system.

The poor drainage to the area is likely to be significantly contributing to the ongoing subsidence issues noted by St Killian's Parish Bendigo staff during the inspection.

38 Further, surface drainage to the sandpit area against the North-East wall of the building is also very poor.

The sand pit constructed against the North-East wall, as shown in Figure 5 below, provides opportunity for rainwater to pond and collect in this area eventually seeping into the soil below.

This will create opportunities for variable moisture contents to develop along the length of the foundations to this wall which will cause differential foundation movement.

This has likely had some contribution to the observed subsidence along the North-East wall.

Figure 5 – Sand pit constructed against North-East wall of building allowing for rainfall to seep into soils against building.

39 At the time of inspection, the rainwater tank adjacent the North-East wall, in immediate proximity to the sink hole, was found not to be full and the outlet tap at the base of this tank was not fully shut.

Given the significant amount of recent rainfall received to the Bendigo area it is unusual for this tank not to be full which could indicate a potential leak or ongoing discharge that may have contributed to the observed ground subsidence.

40 It is strongly recommended that a plumbing investigation is completed including the following:

- Stormwater drainage pipes. This should include:
    - o Roof drainage, down pipes and associated stormwater collection serving the subject building.
    - o Roof drainage, down pipes and associated stormwater collection serving the adjacent buildings within St Killian's Primary School buildings (toilet block, covered outdoor learning area, school hall and storage buildings).
    - o Roof drainage, down pipes and associated stormwater collection serving the surrounding parish buildings.
- Stormwater drainage to the carpark area.

- Water supply lines.
- Rainwater tank and associated plumbing
- Sewer.

41 C+S Consult Group request that copies of any plumbing investigation reports be provided to our office for review and completeness of the Engineering investigation.

42 It is also noted that the Bendigo area has recorded rainfalls significantly above average throughout this year.

Such rainfall will have contributed to abnormally high and potentially saturated soil moisture conditions at this site and may have impacted the stability of some soils and contributed to the observed damage.

Further commentary regarding the impact of such high levels of soil moisture content to the soils of this site is provided later in this report.

43 A number of previous geotechnical investigation reports have been completed at and around this site which provide a good level of detail regarding existing soil conditions beneath the building.

44 The following geotechnical reports have been provided to C+S Consult Group at the time of writing:

- Geotechnical report No. 114090, prepared by AS James, dated 23rd March 2012.

  Prepared for the subject building following historical building damaged from subsidence.
- Geotechnical report No. 107988, prepared by AS James, dated 16th October 2006.

  Prepared for the adjacent property St Killian's Primary School.
- Geotechnical report No. 19C 0989, prepared by GTS, dated 3rd December 2019.

  Prepared for the adjacent property St Killian's Primary School.

A copy of each of the geotechnical investigation reports has been provided in the appendices of the report.

45 The above report dated 23rd March 2012 is considered particularly relevant to this engineering assessment with the purpose of the investigation as per the except below:

- "Visible movement has occurred on the southern corner of the "White House" building at St Killian's Church, McCrae St, Bendigo. Herein, it was required to determine the probable causes of movement, together with appropriate remedial action."

46 The following causations were provided in the report:

- "The actual footing of the "White House" structure consists of a continuation of the brickwork which terminates at 0.45m below the existing surface level. At the base of the brickwork is a cemented combination of broken bricks, rubble, and cement. This rough "blinding" footing is founded in clayey silt at a depth of 0.9m below the existing surface level and has become weakened and easily broken. Based on the log of the nearby borehole 1, the underlying soil profile changes to silty sand from 0.9m."
- "The variation in underlying soil profiles between borehole 1 and borehole 2 may cause for inconsistent seasonal volume change of the soils over the length of the building.

  The underlying silty clay indicated in borehole 2 from a depth of 0.3m is more susceptible to volume change due to seasonal variations in moisture content than the clayey silt and silty sand encountered in borehole 1 and footing probe 1.

  This variable profile is typical of the area, especially given the close proximity to the nearby Bendigo Creek to the north of the site."

47 The following recommendation were also provided with respect to remedial underpinning:

- "It is our recommendation that consideration should be given to reconstruction and deepening of the rough cemented "blinding footings" which underpin the existing brick footing. It must be appreciated, however that if underpinning of isolated problem areas only is undertaken, this in itself may lead to cracking of section which are currently in relatively good repair, due to "propping" of the affected area.

  This should, however, be minimal if the entire structure is underpinned or a progressive program introduced.

  It is recommended that the proposed underpins for the existing structures footings should extend to stiff clay or dense silty sand at a minimum depth of 1.8m and such underpins should be designed using a maximum bearing pressure of 150kPa.

  It is essential to prevent the ingress of moisture down to the base of the underpins by ensuring that the backfill to the front of the underpins comprises clean clay fill compacted in layers not greater than 150 millimetres when loose and to a dry density not less than 95% of the maximum dry density value determined by the Standard Compaction Test, in accordance with Australian Standard AS 1289 5.1.1. – 1993, using appropriate compaction equipment.

  During compaction the clay fill material should have a moisture content within the range of 85%-115% of the optimum moisture content as determined by the Standard Compaction Test in accordance with AS 1289 5.1.1. – 1993.

  In order to prevent future cracking of the structure at the transition points it is recommended that full height articulation be introduced into the brickwork at all points where the underpinning is terminated.

  It is thought that in the refurbishment works adequate detailing and partial demolition may articulate the structure to accommodate minor movements."

48 It is important to note that the above recommendations make specific mention that it is "essential" to prevent the ingress of moisture to the base of footings.

49 The other geotechnical investigation reports, namely the AS James October 2006 and GTS December 2019, documented soil profiles with significant depths of fill and worked alluvial material prior to reaching suitable founding material.

Mixed fill depths (with some silt-based soils) between 2.5m – 4.3m were documented by the AS James report.

Up to 3.6m of worked alluvial was also documented by the GTS report.

50 Such worked alluvial and silty fill materials are particularly susceptible to geotechnical instabilities if saturated as the soils experience a loss of shear strength.

This can result in bearing failures and erosion where there is flowing ground water or continual seepage.

51 Because of this, such soils are generally considered to be unsuitable founding material for building foundations.

52 Given the highly variable soil profiles that exist for sites close to the Bendigo Creek it is possible that some of the subject building's footings may be founded in such material.

53 Based on the above, it is considered that the sinkhole is most likely not the result of a collapsed mineshaft.

54 Following the March 2012 AS James report a technical memorandum was prepared by Osborne Consulting Group in relation to possible underpinning solutions.

Refer technical memorandum reference number SD11-09039, dated 20th April 2012, attached within the appendices of the report.

55 The technical memorandum explores possible alternatives to conventional underpinning as recommended within the AS James geotechnical report dated March 2012.

56 Specialist advice was sought by Osborne Consulting Group from Uretek Ground Engineering regarding a non-intrusive proprietary deep injection resin/compaction grout system, as an alternative to a conventional intrusive underpinning solution.

57 The Uretek system works as follows:

- The soils or footing to the impacted area a drilled to allow injection of a resin/compaction grout into the soil profile.
- The resin/compaction grout is then pumped under pressure into the soil to fill and close voids within the existing soil matrix.
- Once the voids have been filled this reinstates the support/contact between the footing and subgrade.

58 The Uretek system does have some limitations including but not limited to the following:

- The injected resin will only find, and fill voids present at the time of inspection.
- The injected resin does not facilitate transfer of load through to deeper levels of the soil strata where different founding material may exist.

  Thus, the injected resin simply reinstates contact with the original subgrade irrespective of the subgrades suitability to provide adequate bearing support to the existing footing.

  In other words, if the subgrade supporting the original footing was poor there is not necessarily improvement to this subgrade.
- The injected resin does not change the geotechnical properties of the surrounding soils, i.e., silty soils remain as is.

  Thus, problem soils retain the same geotechnical problems with respect to moisture ingress, reactivity, strength etc.

59 Given the above, serviceable performance of the Uretek system is heavily dependent on the following:

- Good protection against moisture ingress into the soils;
- The absence of a high-water table or ground water; and
- The original subgrade material being suitable for the long-term support of the building's footings.

60 It is our opinion, that all or some of above provisions have not been achieved and that this has contributed to new issues.

61 Unless it could be guaranteed that the above provisions can be suitably address for the remaining service life of the building C+S Consult Group would not recommend that such an underpinning system is used for any new remedial works.

62 In our opinion, such guarantees will likely not be possible and should not be used in preference to a conventional underpinning solution for the required eventual permanent remedial works.

63 As part of immediate make safe works C+S Consult Group recommended for the sink hole to the North-East wall to be excavated or "scratched out" and filled with stabilized sand or similar to prevent further ingress of stormwater runoff entering the hole and causing further erosion in the immediate-short term.

64 Localised hydro excavation of the sink hole was commissioned by C+M Build Group on the 25th of November 2022 to clean out the subsided area to sufficient extent to allow access for a concrete pump to pour stabilised sand into the hole.

65 C+S Consult Group attended site during the above hydro excavation to carry out monitoring of the works.

66 The intent of the hydro excavation was only to complete a basic clean out of the sink hole.

It was not intended for the excavation to achieve complete removal of loose materials or to excavate the impacted area to sound founding material.

Such works would likely have required significant excavation depths, further undermining footings in proximity to the impacted area.

67 **It is important to acknowledge that the backfilling of the sink hole will not provide adequate bearing support to the undermined footings and should in no way be considered equivalent to an engineered designed underpinning solution.**

68 Whilst on site, C+S Consult Group made the following observations:

- The soils appeared to be loose and appeared to be more silty than clayey or sandy.

  Sound founding materials were not reached at the terminated depth of excavation which was estimated to be more than 2.5m.
- Some Uretek resin was found to the excavated area.
- The Uretek did not appear to be in any substantial quantity to this area and could be easily removed with the hydro excavation.
- The sink hole has resulted in undermining of a significant portion of the footings to the North-East.

69 In addition to the undermining of footings, other pre-existing defects and damages were identified to the undermined section of wall and to sections immediately outside the undermined area.

Such defects are discussed below.

70 Rising damp problems were noted to some areas along the North-East including some efflorescence and deterioration of the mortar joints.

However, it was also noted that there appears to have been a post-installed chemical injection damp proofing system provided to the North-East wall. C+S Consult Group have not been able to confirm when this system was installed at the time of writing.

71 Rising damp is a result of moisture and salt being absorbed by the clay masonry and mortar through capillary action which result in deterioration of the masonry.

72 This can be attributed to the poor surface drainage to the landscaping surrounding the wall and the lack of an adequate roof drainage and collection system to the carpark roof structure.

73 Some out-of-plane bowing was also noted along the North-East wall of the building.

Such bowing is typically caused by brick growth occurring due to moisture absorption of clay bricks and their subsequent expansion in unarticulated brickwork.

74 Whilst the rising damp and bowing have not been caused by the undermining of the footings to this building such issues are reflective of problems with moisture ingress into the soil profile.

75 An engineered design of a suitable underpinning solution will be required to ensure that the foundations of the building are adequately supported.

76 C+S Consult Group have prepared high-level schematic design sketches detailing a possible methodology for such underpinning works.

77 There are some existing constraints that need to be acknowledged and other design considerations that need to be addressed by the final underpinning solution including:

- The impacted wall is understood to be located immediately against the title boundary between the St Killian's Parish site and the St Killian's Primary School site.

As such, the proposed underpinning solution will need to ensure that any new permanent structures and/or footings are located within the St Killian's Parish site and do not foul or cross the title boundary.

- The existing geotechnical conditions may not be wholly reflective of the previous findings of the AS James 2012 geotechnical report.

  Thus, a conservative approach to ensuring suitable founding depths should be considered at this point in time.
- Access for plant and equipment as required to complete the remedial works will need to be considered.
- Requirements for temporary support of the structure. Can this be achieved both practically and economically.
- Temporary support requirements for adjoining structures and eventual reinstatement of the existing support conditions.

78 Given the above, it is our opinion that conventional underpinning with concrete underpins, whilst possible, will not be practical or economical.

79 Noting that such a solution would require:

- Intrusive temporary propping works;
- Deep excavations to reach suitable founding depths. This would further undermine other sections of wall potentially causing more damage and carries a higher risk of collapse occurring to the brickwork during such works.
- Due to the deep excavations and existing soil type the excavation will likely be significantly oversized and will encroach over the title boundary unless suitable formwork can be introduced.

80 Some pre-existing defects were also noted to the interior of the subject building including but not limited to the following.

- There appeared to be a noticeable grade hallway flooring along the North-East wall of the building, with the floor along the North-East wall noticeably lower than that to the interior.
- Some *Moderate** cracking damage was noted to the hard plaster finish to the internal walls.

  This damage is reflective of damage caused by differential movement of building foundations.

  * Refer Table C1, Appendix C – Classification of Damage Due to Foundation Movements, AS2870

81 It is also understood that the second storey of the building was added within the last 20 years.

82 The addition of the second storey would have an immediate and long-term impact on the consolidation of the soils supporting the external walls which may have contributed to some of the observed damages.

83 It is also important to recognise that the original footings have been founded in reactive soils.

84 The impacts of abnormal moisture conditions on footings in reactive clay soils is known to cause significant damage to structures.

Reactive clay soils have potential for significant movement (both shrinkage and swelling) as a result of a changes in soil moisture content.

The extent of movement is dependent upon the clay type (i.e., reactivity).

Localised settlement of footings in wetted (saturated) soils, due to a reduced shear strength of soil is also a potential problem associated with excessive moisture in reactive clay soils (i.e., a saturated soil has a reduced load carrying capacity, potentially causing settlement of footings into such wetted soils).

85 Moderately reactive clays are typical of the Bendigo area.

Moderately to highly reactive clays have a potential for characteristic surface movement in the range of 20-40mm, such movements can be of significant detriment to a dwelling.

86 Attention is drawn to the following VBA & CSRIO publications:

- "VBA - Minimising Foundation Movement and Damage to your House";
- "CSRIO BTS 18 – Foundation maintenance and Footing Performance – A Homeowners Guide";

87 These two publications both highlight a homeowner's responsibilities for foundation maintenance, including drainage, landscaping and plumbing maintenance.
A copy of both publications is attached as Appendix B.

88 The abovementioned references all have the same intent of achieving and maintaining good foundation maintenance, and prevention of abnormal moisture conditions from developing, as such abnormal moisture conditions can cause building damage &/or distress, via foundation movement.

89 It was noted that there were no articulation joints (AJ's) or control joints (CJ's), to the brick walls of the subject building.

90 AJ's break up larger brickwork panels into smaller sections and allow such brickwork panel sections to deflect with the curvature of the foundations when differential settlement occurs.

CJ's again break up the larger brickwork panels into smaller panels to limit the total volumetric expansion of brickwork panels.

Control joints are filled with compressible construction materials that allow the brickwork to expand into the control joint which alleviates a build-up of compressive stress that would otherwise only be relieved by cracking occurring the brickwork.

91 For class M & M-D sites, Table 13.1 of AS4773.1 requires AJ's at:

- 4.2m maximum centres in straight runs of brickwork;
- at large window/door openings;
- within 4.5m of corners;

92 The absence of AJ's and CJ's to the perimeter brickwork would have increased the risk of damage to such brickwork panels.

Recommendations for intermediate remedial works:

93 The following recommendations are made with respect to intermediate remedial works:

- Retain the existing exclusion zone and temporary fencing until remedial works have been completed.
- Demolish the existing blade wall to the Southern corner of the building.
- Complete all recommended plumbing investigation works and carry out any repairs to existing defects identified and any other recommendations from such investigations.
- Install tie-rods at upper floor level to assist mitigating the risk of disengagement occurring between the upper floor structure and North-East wall.

  Refer attached sketch SK1 prepared by C+S Consult Group within Appendix C.

Recommendations for permanent remedial works:

94 The following recommendations are made with respect to intermediate remedial works:

- Complete temporary works as suggested by attached sketches SK2 & SK3.
- Complete demolition works as suggested by attached sketches SK4
- Complete underpinning (foundation rebuild) works as suggested by attached sketches SK5
- Complete rebuild works as suggest by attached sketches SK5 – SK8

Refer attached sketches prepared by C+S Consult Group within Appendix C

95 The rebuild works depicted in the above sketches do not show any provision for underpinning of the existing internal walls.

96 Such underpinning works would be cost prohibitive and would favour complete demolition.

97 The AS James March 2012 geotechnical investigation report states:

- "In order to prevent future cracking of the structure at the transition points it is recommended that full height articulation be introduced into the brickwork at all points where the underpinning is terminated.

  It is thought that in the refurbishment works adequate detailing and partial demolition may articulate the structure to accommodate minor movements."

98 Such an approach is depicted in the preliminary sketches above.

99 It is important to note that partial underpinning may leave the structure susceptible to new damage in the event of differential foundation movement that exceeds the movement tolerances of any new articulation joints.

100 Further advice must be sought from a suitably qualified geotechnical, familiar with the site conditions, to provide guidance on expected levels of differential movement that may occur in relation to the proposed permanent remedial works before progressing further with a detailed structural design.

101 Alternatively, consideration should be given to complete demolition and rebuilding of the structure or new building.

Such an approach will likely require town planning approval from the City of Greater Bendigo.

102 It is strongly recommended that preliminary costings be sought for both of the above options.

Conclusion:

103 There has been significant ground subsidence in the form of a sink hole which has caused undermining to some sections of the North-East wall of the White House building.

104 The cause of the sink hole could not be established by visual inspection alone.

105 Further plumbing investigations have been recommended that may assist in establishing the cause of the sink hole.

106 Any plumbing defects identified from such plumbing investigations must be immediately rectified.

107 The surface drainage to this site is considered to be extremely poor and is likely to be contributing to the ongoing occurrence of ground subsidence to this site.

It is strongly recommended that a Civil Engineer is engaged to provide further advice regarding the implementation of a suitable site wide stormwater management plan and associated capital works improvements.

108 Recommendations were made by C+S Consult Group regarding the implementation of immediate make-safe works.

It is understood that all such recommendations have been implemented at the time of writing.

109 Recommendations have been made for intermediate remedial works as outlined within the report.

110 Recommendations have been made for permanent medial works as outlined within the report.

111 Further advice must be sought from a suitably qualified geotechnical, familiar with the site conditions, to provide guidance on expected levels of differential movement that may occur in relation to the proposed permanent remedial works before progressing further with a detailed structural design.

112 Continued monitoring of the building's existing condition must also be undertaken.

Should any noticeable changes in condition be identified by St Killian's Parish Bendigo staff this office must be notified for further assessment.

Recommendations and Scope of Works for Repair:

1 In addition to the remedial works depicted by the attached structural sketches, the following must be included within the broader scope of works for the repairs:

- Implement all repairs to the existing plumbing defects as identified and recommended within the plumbing investigation reports.
- Liaise with City of Greater Bendigo to confirm any requirements for planning permit applications for the proposed remedial works.
- Engage a land surveyor to confirm title boundaries.
- Engage a specialist contractor to carry out a survey to locate all existing inground services that may be impacted by the proposed underpinning works.
- Engage contractors to divert and/or isolate any impacted services.
- Engage a suitably qualified structural engineer to completed detailed design of an underpinning system.
- Engage a qualified building surveyor to obtain relevant building permits.
- Engage a building contractor to complete the rebuild works.

2 Any building works shall consider and incorporate all appropriate building elements as required, including but not limited to the following:

- Asbestos audit of existing dwelling to allow appropriate removal & disposal of any asbestos as required;
- Electrical & communications disconnect & temporary make safe;
- Plumbing (including gas where applicable) disconnect & temporary make safe;
- Temporary fencing to isolate work site from public access;
- Fully detailed architectural drawings of proposed re-build;
- Site classification in accordance with AS2870;
- Engineering of proposed re-build, including footings, lintels, beams, bracing, tie downs & connections;
- Energy rating;
- BAL assessment;
- Planning permit (if required by local Council);
- Building Permit from Relevant Building Surveyor;
- Other statutory applications, approvals &/or permits as required;
- Demolition works permit;
- New build works shall be completed by a suitably qualified and experienced builder.
  Building works shall be completed by suitably qualified and experienced tradespersons, to a high level of workmanship in accordance with industry best practice.

Note:

1 Any construction and/or repair works shall be completed in accordance with NCC and relevant Australian Standard requirements;

2 Any construction and/or repair works shall be completed with any necessary design, permits and/or approvals required (eg. engineering design, Building and/or Planning Permits);

3 Any construction and/or repair works shall be completed by suitably qualified and experienced tradespersons, to a high level of workmanship in accordance with industry best practice;

4 This engineers report is limited to assessing the damage to the White House Building as a result of subsidence/erosion.
This report does not constitute;

- Structural certification of the dwelling, including any associated design and/or construction;
- A detailed assessment of the dwelling's compliance with current NCC Regulations or Australian Standards;
- A detailed assessment of the required maintenance to the dwelling;

If you wish to discuss the above or require any additional information please contact the undersigned.

Yours faithfully

ASHLEY SIM
Director
Structural + Forensic Engineer
PE0003453 (VIC)
MIEAust CPEng NER

REVISION	DATE	ENGINEER & AUTHOR	ENGINEER & REVIEWER
A	07/12/2022	Ashley Sim	Leigh Crapper

Appendix A

Select Site Inspection Photos 22/11/2022 & 23/11/2022

Photo 1 – Location of sink hole.

Photo 2 – Existing condition of brick wall in proximity to sink hole. Note cracking.

Photo 3 – Existing sand pit and tree in proximity to sink hole. Note also trench in sandpit against wall.

Photo 4 – Sink hole condition at first inspection.

Photo 5 – Sink hole prior to excavation.

Photo 6 – Sink hole following hydro excavation.

Photo 7 – Existing conditions to South-East wall of building.

Photo 8 – Blade wall to Southern corner of building with significant out-of-plane rotations.

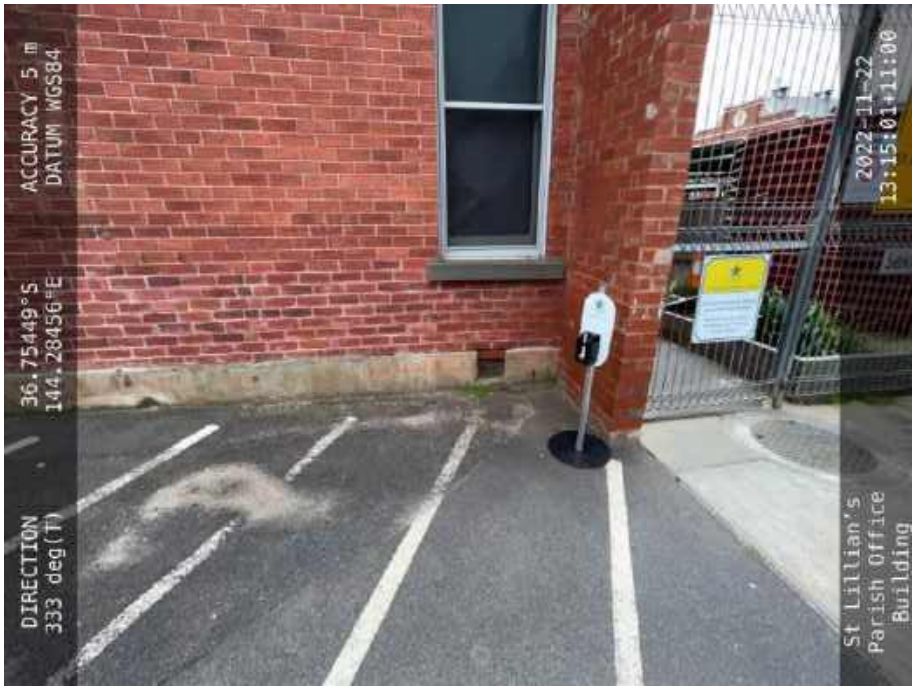


Photo 9 – Existing condition along South-East wall of building near sink hole. Note rising damp to base of wall and brickwork cracking.

Photo 10 – Existing condition along North-East wall of building near sink hole. Note rising damp to base of wall and brickwork cracking.

Photo 11 – Stepped cracking damage to Southern corner of White House building.

Photo 12 – Rainwater tank found not to be full at the time of inspection. Outlet valve to base of tank also found not to be fully shut.

Photo 13 – Damp soil was found to the base of the tank outlet.

Photo 14 – Overview of existing carpark to St Killian's Parish. Note no surface drainage.

Photo 15 – Typical cracking to hard plaster to interior of White House building.

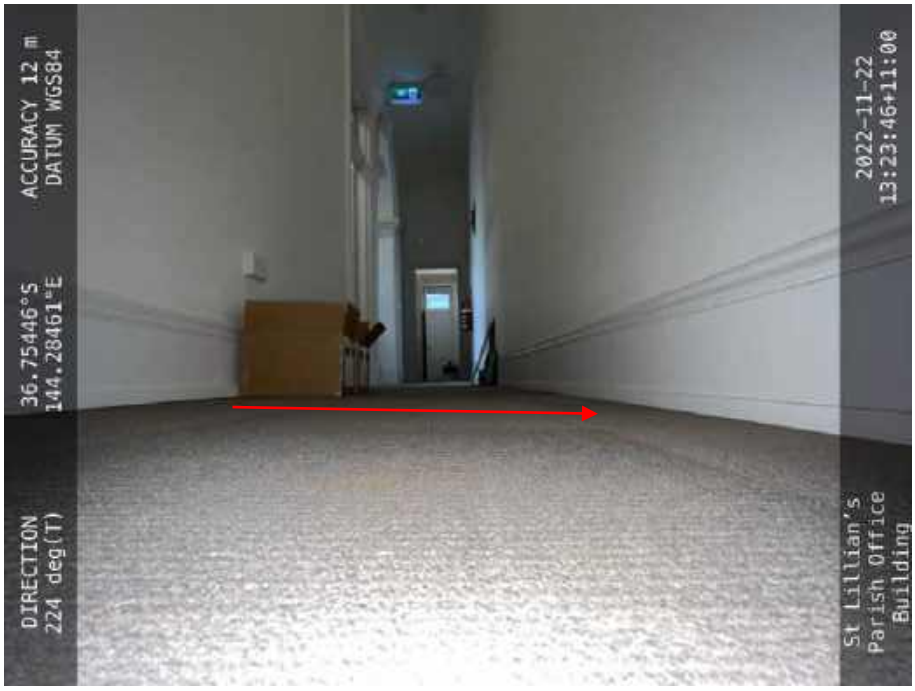


Photo 16 – Local grade in floor against North-East wall of White House building.

Photo 17 – Existing St Killian's Primary School, school hall building. Note possible defective down pipe noted to circled location.

Photo 18 – Typical cracking to other walls of the subject building caused by historical foundation movements.

Photo 19 – Existing link bridge between original presbytery building and White House.

Appendix B

VBA publication "Minimising Foundation Movement and Damage to your House"

CSRIO Publication BTS 18 – "Foundation maintenance and Footing Performance – A Homeowners Guide"

Minimising foundation movement and damage to your house

Once you have taken ownership of your new home, there are several things you should do to help protect it from cracks and associated damage caused by excessive foundation movement. This guide provides you with advice about maintaining your home to reduce the risk of damage caused by foundation movement.

Understanding soil conditions

Before building your new home, your builder, draftsperson or architect would have arranged for a soil test to classify your soil type and determine how 'reactive' it is. The reactivity of the soil determines to what extent the soil shrinks and swells with changes in moisture content. Excessive changes in moisture conditions around the perimeter of your home can cause the footings to move, potentially causing damage to your home.

The soil test will classify the reactivity of your soil from:

A – Non-reactive
S – Slight
M, M-D – Moderate
H1, H1-D – High
H2, H2-D – Very High
E, E-D – Extreme.

Reactivity levels

The greater the reactivity, the greater the possibility of excessive movement. If you do not have a copy of the soil report for your property, ask your builder for a copy or contact your local council.

Once the soil has been classified, the designer and/or engineer will design your house footings to ensure they can cope with the classification of the soil and likely movement. The builder will then build your home on footings designed under engineering principals to suit the soil on your land.

Responsibilities of the builder

When building your house, the builder must comply with the relevant building legislation and Australian Standards, and they must build your home's footings according to the engineer's designs and specifications approved by the building surveyor when they issued the building permit. This will mean that your home and its footings are designed and built to suit the soil condition and will minimise movement of the footings, as long as the soil condition doesn't change. For more details of the builders responsibilities refer to page 4.

Movement of footings

Some movement of footings is normal and within design tolerances. When your footing lifts excessively (i.e. heaves) in one section of your house and not another, your walls will usually develop cracks.

Cracks in walls less than 1mm wide that are caused by movement of the footings are generally considered part of the normal movement that a house may experience and within the accepted range. This movement and consequential wall damage may not be due to a serious problem with your house footings. As the owner, you are responsible for any repairs you wish to undertake.

If your home is showing signs of significant damage, the potential cause and extent of excessive footing movement should be investigated. If your home is less than 10 years old you should contact your builder for advice in the first instance.

For cracks in walls between 1mm and 5mm wide, the cracking should be monitored during all weather conditions over a 12-month period. If the cracks are attributed to the actions of the builder, they may be considered defective.

In moderate or severe cases, the cracking can be more significant and require substantial repair work. Cracks more than 5mm wide are considered significant and outside the tolerances for footing movement. This could also appear as noticeable bulging of walls, and windows and doors that stick and/or distort. The cause of this excessive movement should be further investigated by a registered civil/structural engineer. If defective work is determined and it can be attributed to the actions of your builder, then they will be responsible for any necessary remedial works and repairs.

For more information about what is considered to be within the acceptable standards of building, visit the Victorian Building Authority's website at www.vba.vic.gov.au to download the *Guide to Standards and Tolerances*. Please note that there are different versions of the guide and the guide that is applicable for your home will depend on the date you entered into your domestic building contract with your builder.

You can also find more information about your rights from Building Advice and Conciliation Victoria at www.consumer.vic.gov.au

Responsibilities of the homeowner

Once your home has been built and you have taken possession of it, you will need to ensure that the foundation soil is not subject to significant moisture changes.

If the conditions of the foundation are not properly maintained, it can cause or contribute to the cracking of walls and floors due to movement. If the damage is attributed to the actions taken by you as the owner, it can diminish the builder's liability, potentially leaving you responsible for some or all of the repair costs.

Maintaining your home

When carrying out work around your home and garden, you need to make sure you don't change the moisture conditions of the foundation. It is also important that the foundation that supports the edges of your footing is not exposed to excess moisture, such as water ponding against footings or walls.

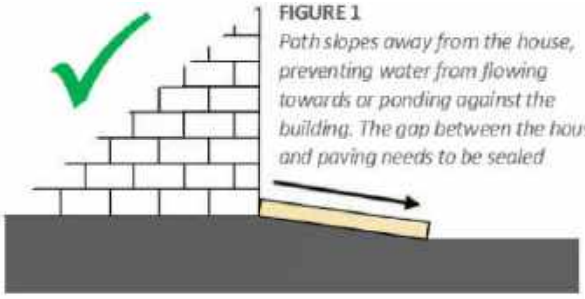


FIGURE 1
Path slopes away from the house, preventing water from flowing towards or ponding against the building. The gap between the house and paving needs to be sealed

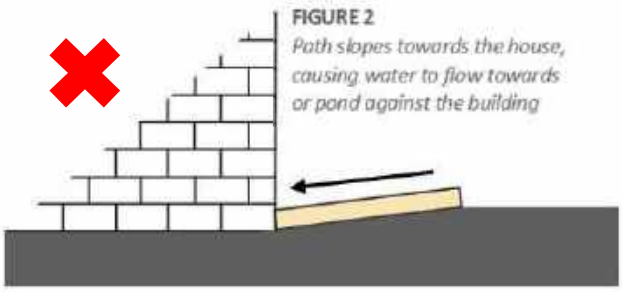


FIGURE 2
Path slopes towards the house, causing water to flow towards or pond against the building

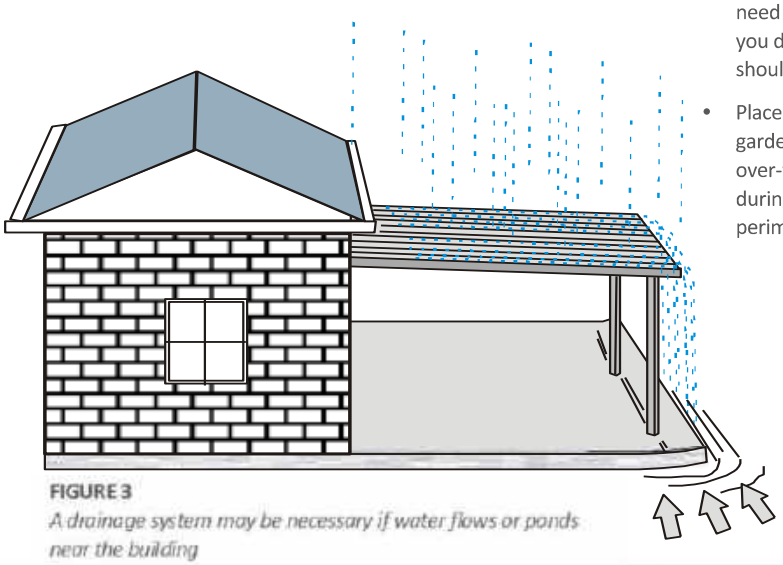


FIGURE 3
A drainage system may be necessary if water flows or ponds near the building

Below are some useful tips to help you protect your home from damage caused by excessive movement of the footings.

DO

- Prevent water flowing towards your home's foundations by sloping the soil, paths and garden beds away from the building (Figure 1). As a rule, the more reactive the soil, the steeper the slope needs to be.
- If it is not possible for the surfaces surrounding your home to drain away from the building, you will need to install garden drainage systems or drains against your external walls to remove excess moisture to your stormwater system. You should seek professional advice about any drainage work.
- Ensure you properly maintain any drainage installed by your builder.
- Make sure the roof of any garden shed adjacent to your home has gutters draining to your stormwater system.
- Ensure there is a minimum slope of 70mm for the first metre away from the house in very reactive soils.

DON'T

- Install sheds or outdoor roofed areas without connecting the roof drainage to stormwater systems.
- Lay paving around the building without sufficient slope away from the building (Figure 2). In large paved areas a drain and stormwater collection pit may be necessary.
- Run machinery over shallow drain pipes. This may break or squash the pipes, which can cause leaks and subsequent movement of the foundation.
- Excavate close to building footings, where possible. If you do need to carry out excavations next to your house, make sure you don't excavate deeper than the base of the footing. You should ensure you don't undermine the footing.
- Place garden beds alongside the house, where possible. If garden beds must be next to the house, make sure not to over-water them. Footings constructed in reactive soil during dry conditions may experience damage if the perimeter of the house is watered unevenly or excessively.

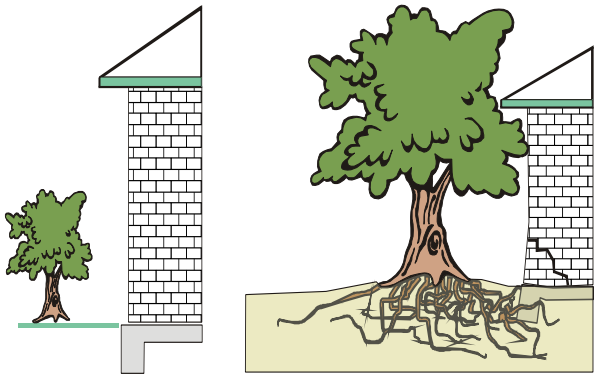


FIGURE 4
Plant trees away from your house to allow for tree and root growth

Landscaping and trees

Trees can significantly impact the house's foundation and damage can occur even months after a tree has been removed. If trees do not receive sufficient water while alive, their roots will dry the soil near buildings or under pavements. Generally, the larger the root system of the tree the more it will dry the soil.

If you want to grow, keep or remove trees near your house, you should let your builder know before you sign the building contract. The builder will then advise the engineer, who will take this into account when designing your home's footings.

The type and grouping of trees or shrubs have varying impacts on their surrounding soil moisture conditions. After your house is built, you should seek professional advice before planting to ensure that the trees or shrubs chosen, as well as their distance from the house, will not damage or affect the footings in the future.

If you plan to remove nearby trees after your house is built, you should consult an expert arboriculturist or a registered civil/structural engineer who is familiar with footing movement.

Most modern allotments with clay-type soils are too small to safely grow large trees without special footings.

Foundation problems in clay sites may also be caused by:

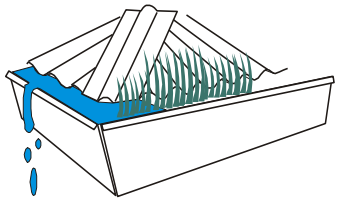
- excessive watering of gardens
- watering systems that are overused or discharge water too close to building walls
- constructing waterproof decks, verandahs and retaining walls without appropriate drainage.

Tree roots in sandy areas are less likely to cause damage to your home. Sand does not shrink or swell with changes in moisture, however, if the root ball or large root is very close to a building it can grow and lift the footings of a structure causing damage.

Poor site maintenance

The greatest cause of building damage by far is an excessive change of moisture in foundation soil around the perimeter of a house. Changes to drainage or watering of gardens in adjoining properties can also create problems.

To help prevent damage, all possible water leaks and sources of excessive water should be repaired immediately, such as:



- leaking or blocked roof gutters, which cause water to overflow near the external walls of a building (right)
- hot water system relief valve pipes (Figure 5). If the discharge changes the moisture of the soil, the pipes should be connected to the stormwater drainage system
- air conditioners and heat pumps to hot water systems. These should not discharge water near the building footings, as it may change the soil moisture conditions. They should be connected to a stormwater drainage system
- leaking or overflowing water tanks near building footings
- land or paving that slopes towards the house, causing rain water to flow or pond near the building
- plumbing leaks, leaky taps or hoses
- water from regularly washing cars near the house
- water flowing near the house (even from neighbouring properties), which must be diverted away from the footings or collected via a drainage system.

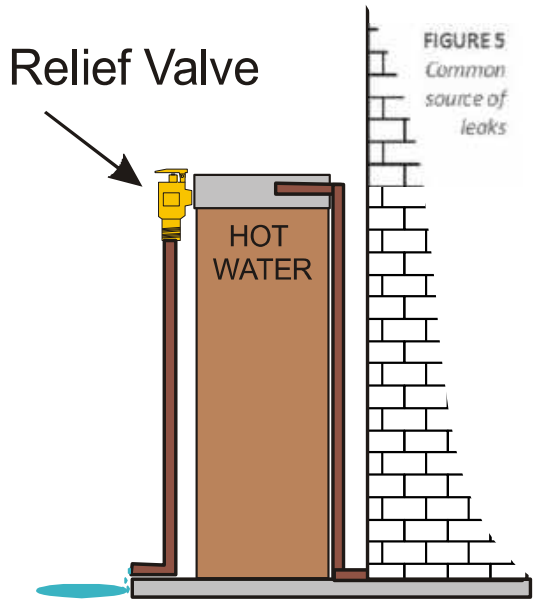


FIGURE 5
Common source of leaks

Responsibilities of the builder

When building your house, the builder needs to comply with the Building Code of Australia, relevant Australian Standards, approved designs, specifications and contract documents.

Builders need to address the following important aspects:

- Make sure there are well-drained foundation conditions which will create 'normal' soil moisture and maintain adequate bearing capacity of the footings as soon as work begins at the site.
- Where abnormal moisture conditions exist or are anticipated, the footings will need to be designed by a structural engineer to suit these conditions.
- Ensure that the floor level allows for proper drainage around the outside of the house, and that the property is protected from any adjoining water flows (Figure 8).
- Slope the soil and paths away from the building by the minimum amount required by the Building Code of Australia to prevent water flowing towards the house's foundations.
- Special considerations may be needed if any excavations are to be dug near adjoining structures (i.e. when installing a swimming pool).
- Construct subsoil drains or moisture barriers on sloping sites to your engineer's requirements, in order to prevent stormwater affecting the building's foundations.

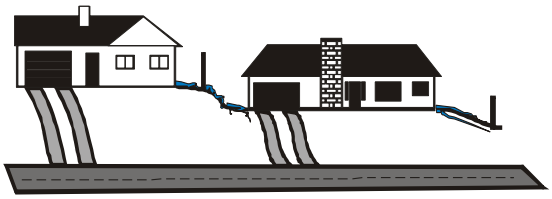


FIGURE 6
Ensure that the property is protected from water flowing from adjoining properties

- In sites with highly or extremely reactive soil, *AS 2870 – Residential slabs and footings* requires mechanical flexible couplings for sub-surface drainage pipes and for above-ground connections from the downpipe to the stormwater and sewerage drains (Figure 7). These allow for the movement of the soil and minimise the risk of pipe joints breaking and leaking.
- Ensure owners understand that failure to maintain adequate drainage may result in damage to the structure.

Builders are also encouraged to provide owners with a plan showing the location of all 'as installed' sewer pipes, stormwater drains, water and gas lines. This will help with any future modifications or repairs.

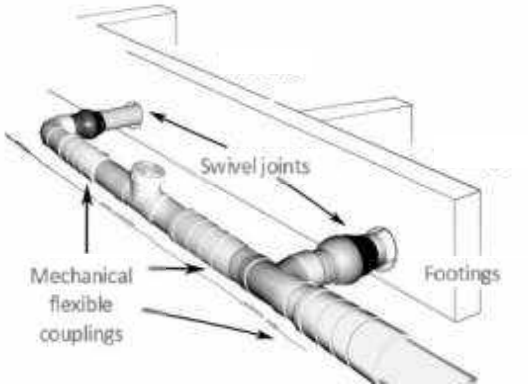


FIGURE 7
Mechanical flexible couplings reduce the potential of broken pipes in highly or extremely reactive soil

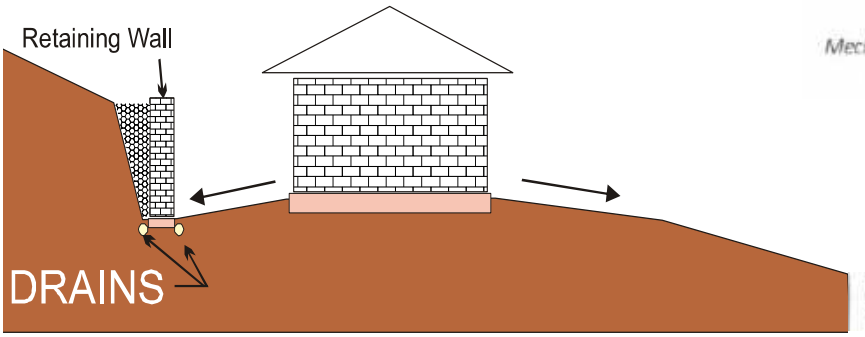


FIGURE 8
A well-drained site

Explanations

Footings (often incorrectly called foundations) are usually constructed of reinforced concrete that supports the building. They are commonly comprised of concrete strips, stumps with pads, stiffened raft or waffle slabs (Figures 9, 10 and 11).

Foundation is the soil or rock supporting the footings.

Reactive clay foundations are those that shrink and swell with changing moisture and cause the building and paving to sink or lift.

Reverse slope is one that slopes towards the building.

Sand foundations do not shrink or swell but if they are loose they can cause the building to move.

The Australian Standard for building footing construction permits minor wall and floor movements. If the foundation conditions are changed after construction, the floor and walls may move more than these standards allow for. The designs for building footings in *Australian Standard 2870 – Residential slabs and footings* will perform adequately, provided the building site and surrounds have 'normal' foundation conditions that are maintained. If the building site and surrounds have 'abnormal' moisture conditions, special provisions must be followed by the design engineer, builder and owners (refer to AS 2870 for a description and examples of 'abnormal' moisture conditions).

Typical footing system used for dwellings

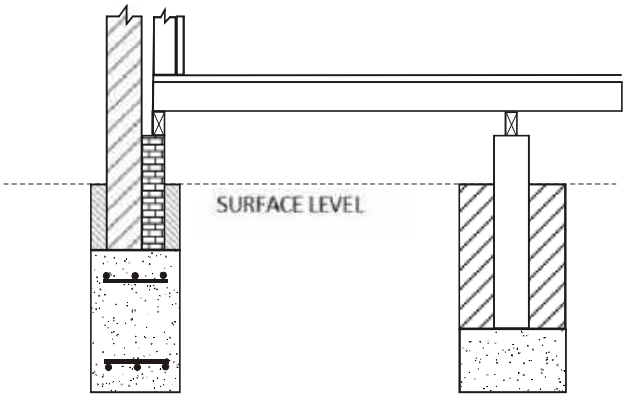


FIGURE 9
Strip and stump footing system

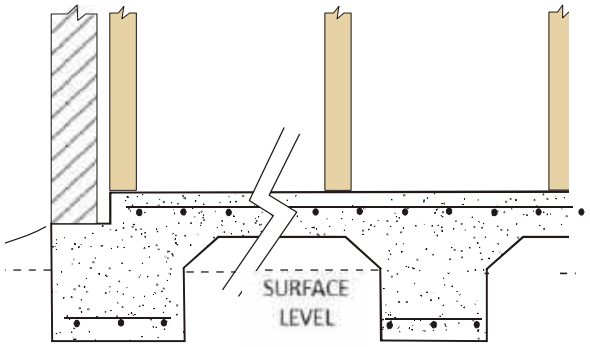


FIGURE 10
Stiffened raft

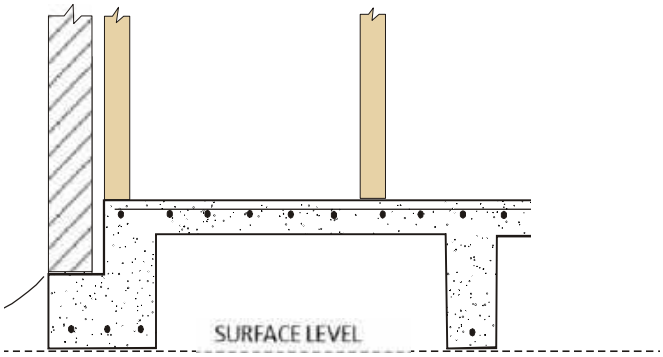


FIGURE 11
Waffle slab

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

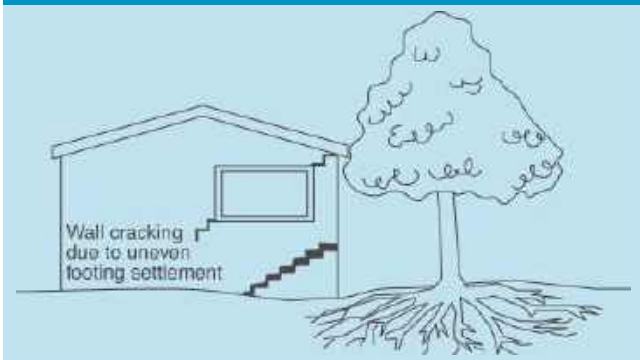
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

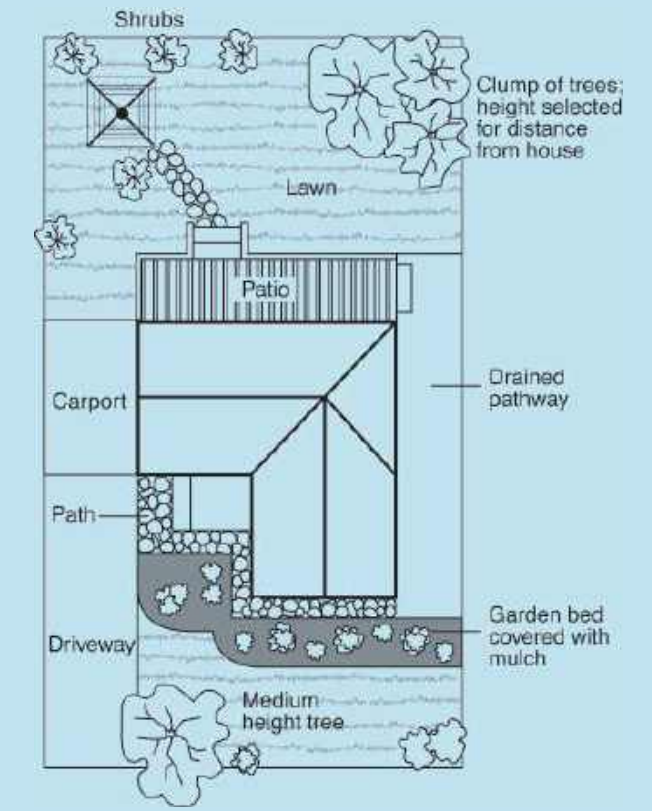
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

Distributed by

CSIRO PUBLISHING PO Box 1139, Collingwood 3066, Australia

Freecall 1800 645 051 Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au

Email: publishing.sales@csiro.au

Appendix C

Preliminary Sketches for Intermediate Remedial Repair Options
&
Preliminary Sketches for Permanent Remedial Repair Options.

35 Willls Street
Bendigo VIC 3550
www.csconsultgroup.com.au
ABN: 61 623 885 751

ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP

INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS

SCHEMATIC DESIGN SKETCHES

DRAWING INDEX		
DRAWING NUMBER	**DRAWING TITLE**	**REVISION**
SK1	FACE SHEET	P1
SK2	FOOTINGS PLAN & DEMOLITION PLAN UPPER FLOOR GENERAL ARRANAGEMENT PLAN	P1
SK3	ELEVATIONS	P1
SK4	DEMOLITION PLAN	P1
SK5	FOOTINGS PLAN	P1
SK6	UPPER FLOOR REBUILD WORKS PLAN	P1
SK7	GROUND FLOOR REBUILD WORKS PLAN	P1
SK8	ROOF REBUILD WORKS PLAN	P1

NOTE:
1. ALL DESIGNS SHOWN ARE PRELIMINARY ONLY AND HAVE BEEN PRODUCED AS 'HIGH LEVEL' DRAWINGS FOR THE PURPOSE OF PROCURING APPROXIMATE BUDGET ESTIMATES FOR THE REQUIRED WORKS ONLY. THE DESIGNS SHOWN ARE SUBJECT TO CHANGE AND MUST NOT BE CONSIDERED AS FINAL DESIGNS OR USED FOR CONSTRUCTION.
2. ALL SKETCHES SHALL BE READ IN CONJUNCTION WITH ENGINEER'S REPORT PREPARED BY C+S CONSULT GROUP REFERENCE No. CS22136 DATED 07/12/2022

REV.	DESCRIPTION	DESIGNER	CHECKED	APPROVED	DATE
P1	ISSUED FOR INFORMATION ONLY	A.S	A.S		29/11/22

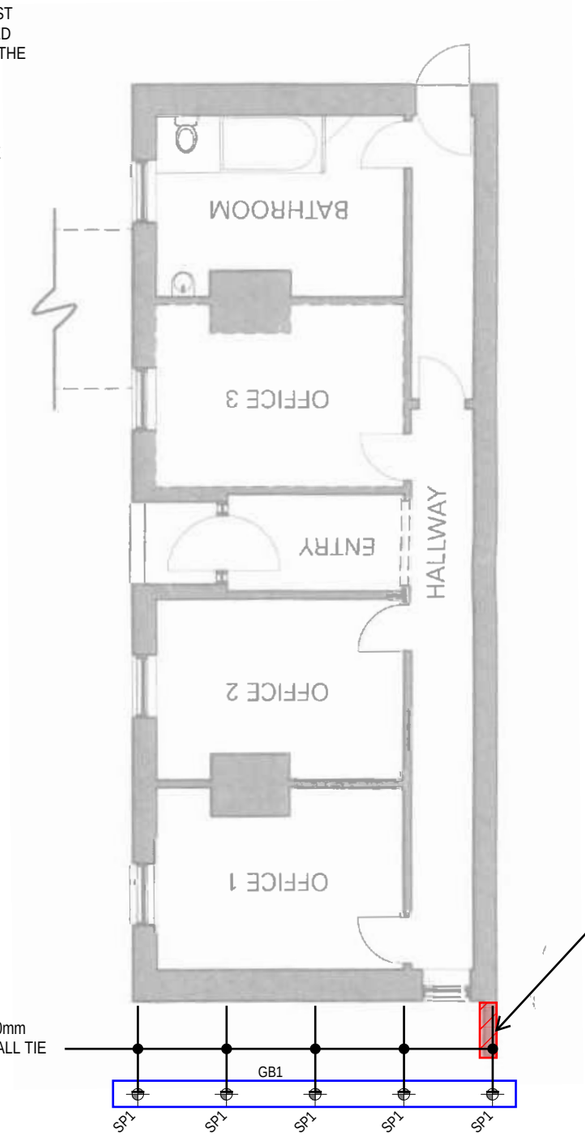
ASSOCIATED CONSULTANTS:

CLIENT / PROJECT:
ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP
INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS
TO WHITE HOUSE BUILDING,
ST KILLIAN'S PARISH BENDIGO

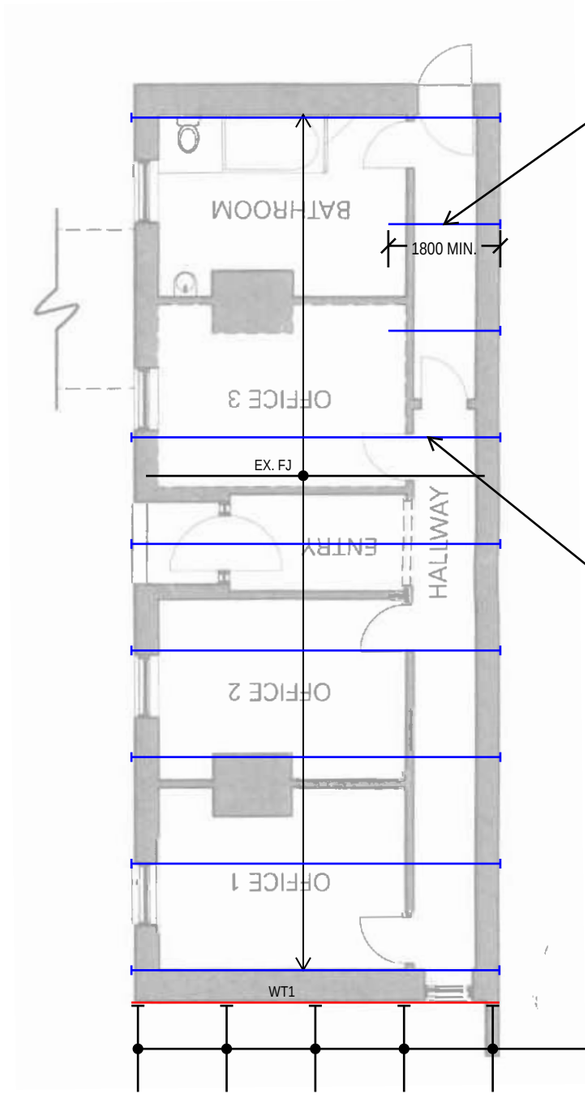
DESIGNED: A.S.
DRAWN: A.S.
PROJECT No. CS22104
SCALE: AS SHOWN
TITLE: FACE SHEET
A3 FULL SIZE
DRAWING No. SK1
REVISION P1

NOTE:
1. CONTRACTOR TO ALLOW TO ENGAGE SUBCONTRACTOR TO CARRY OUT LOCATION SURVEY OF ALL EXISTING UNDERGROUND SERVICES TO THE AREA OF WORKS.
2. ANY SERVICES IMPACTED BY THE PROPOSED WORKS MUST BE RE-DIVERTED OR TEMPORARILY ISOLATED BY LICENSED SUBCONTRACTORS AS REQUIRED TO SAFELY COMPLETE THE WORKS.
3. ALL EXISTING TEMPORARY FENCING AND ASSOCIATED EXCLUSION ZONES MUST BE REMAIN IN PLACE UNTIL PERMANENT REMEDIAL WORKS HAVE BEEN COMPLETED NOTING THAT THE WORKS SHOWN ON THIS DRAWING ARE INTERMEDIARY ONLY AND MUST NOT A SUITABLE SUBSTITUTION FOR PERMANENT REMEDIAL WORKS.

NOTES:
1. SCREW PILES TO BE INSTALLED BY AN APPROVED CONTRACTOR. SCREW PILES ARE TO BE DESIGNED AND CERTIFIED BY THE PILING CONTRACTOR.
2. MACHINERY TO BE CALIBRATED THROUGH EITHER DRIVING RESISTANCE OR PREDETERMINED SET TO ENSURE PILES WILL BE ACHIEVE THEIR NOMINATED SAFE WORKING CAPACITY. PILING LOGS TO BE RETAINED AND COPIES FORWARDED TO THE STRUCTURAL ENGINEER.
3. PROVIDE ADDITIONAL SCREW PILE UNDER CONCENTRATED COLUMN LOCATIONS AS SHOWN ON PLAN.
4. DURABILITY DESIGN OF SCREW PILES MUST ACHIEVE A MINIMUM SERVICE LIFE OF 50 YEARS.



FOOTINGS PLAN & DEMOLITION PLAN
SCALE - 1:100 (APPROX)



UPPER FLOOR GENERAL ARRANGEMENT PLAN
SCALE - 1:100 (APPROX)

FOOTING SCHEDULE			
MARK	SIZE (WxD)	REINFORCEMENT	REMARKS
GB1	600 x 400	4N20 TOP & BOTTOM WITH N12 CLOSED LIGS AT 200 CTS	GROUND BEAM
GB2	600MIN. T.B.C. x 600D	4N20 TOP & BOTTOM WITH N12 CLOSED LIGS AT 200 CTS	GROUND BEAM

SCREW PILE SCHEDULE			
MARK	WORKING LOAD (DL + LL)	LOAD	REMARKS
SP1	T.B.C.	T.B.C.	TEMPORARY WORKS SCREW PILE (SCREW PILE DESIGN BY OTHERS)
SP2	T.B.C.	T.B.C.	PERMANENT WORKS SCREW PILE (SCREW PILE DESIGN BY OTHERS)

NOTE:
1. ALL DESIGNS SHOWN ARE PRELIMINARY ONLY AND HAVE BEEN PRODUCED AS 'HIGH LEVEL' DRAWINGS FOR THE PURPOSE OF PROCURING APPROXIMATE BUDGET ESTIMATES FOR THE REQUIRED WORKS ONLY. THE DESIGNS SHOWN ARE SUBJECT TO CHANGE AND MUST NOT BE CONSIDERED AS FINAL DESIGNS OR USED FOR CONSTRUCTION.

REV.	DESCRIPTION	DESIGNER	CHECKED	APPROVED	DATE
P1	ISSUED FOR INFORMATION ONLY	A.S	A.S		29/11/22

ASSOCIATED CONSULTANTS:

CLIENT / PROJECT:
ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP
INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS
TO WHITE HOUSE BUILDING,
ST KILLIAN'S PARISH BENDIGO

C+S CONSULTGROUP CIVIL + STRUCTURAL

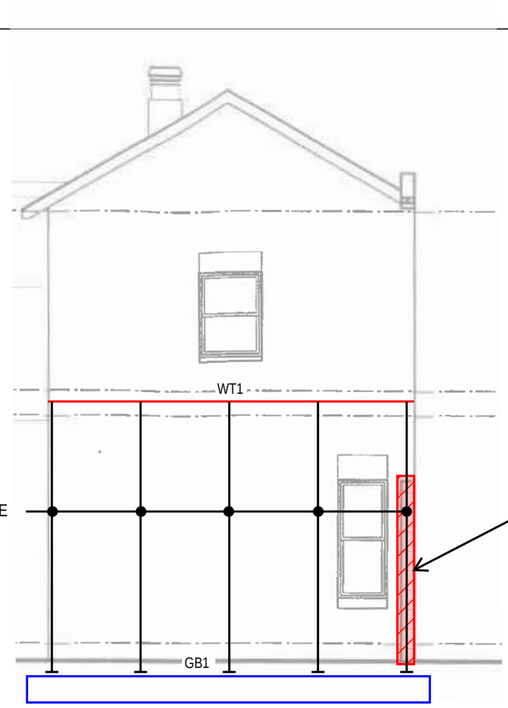
DESIGNED: A.S.
DRAWN: A.S.
PROJECT No. CS22104
SCALE: AS SHOWN

TITLE: INTERMEDIARY REMEDIAL WORKS - FOOTINGS PLAN & DEMOLITION PLAN GENERAL ARRANGEMENT PLAN

A3 FULL SIZE

DRAWING No. SK2

REVISION P1



PROVIDE TILT PROPS AT 1500mm MAX. CTS BETWEEN WT1 - WALL TIE AND GB1 - GROUND BEAM

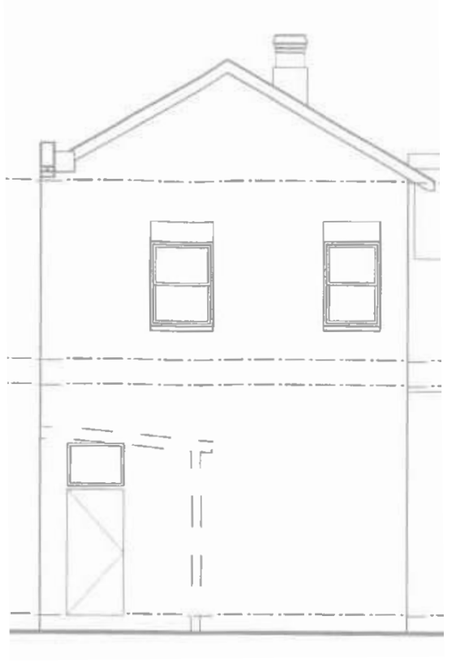
CAREFULLY DEMOLISH EXISTING BLADE WALL WITH EXCESSIVE OUT-OF-PLANE ROTATION. MAKE GOOD CONNECTED BRICKWORK AND PAVEMENT AS REQUIRED

SOUTH-EAST ELEVATION
SCALE - 1:100 (APPROX)

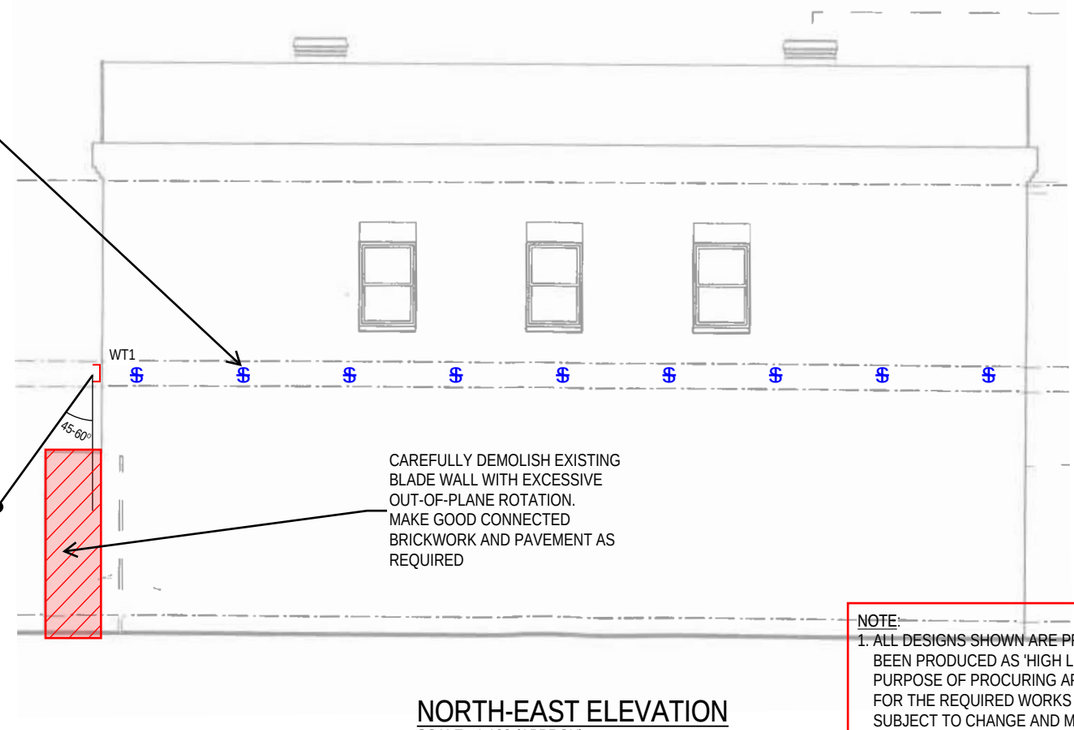
PROVIDE 20 DIA. M.S. GALVANISED TIE-RODS AT 1800mm MAX. CTS WITHIN DEPTH OF UPPER FLOOR SYSTEM. TIE RODS TO HAVE M.S. GALVANISED ORNATE HERITAGE BEARING PLATES WITH NUTS AND WASHERS EACH END TO THE EXPOSED FACE.
PROVIDE SUSPENSION HANGERS BETWEEN FLOOR JOISTS AND TIE RODS AS REQUIRED TO PREVENT EXCESSIVE SAG.

PROVIDE TILT PROPS AT 1500mm MAX. CTS BETWEEN WT1 - WALL TIE AND GB1 - GROUND BEAM

SOUTH-WEST ELEVATION
SCALE - 1:100 (APPROX)



PROVIDE 20 DIA. M.S. GALVANISED TIE-RODS AT 1800mm MAX. CTS WITHIN DEPTH OF UPPER FLOOR SYSTEM. TIE RODS TO HAVE M.S. GALVANISED ORNATE HERITAGE BEARING PLATES WITH NUTS AND WASHERS EACH END TO THE EXPOSED FACE.
PROVIDE SUSPENSION HANGERS BETWEEN FLOOR JOISTS AND TIE RODS AS REQUIRED TO PREVENT EXCESSIVE SAG.



PROVIDE TILT PROPS AT 1500mm MAX. CTS BETWEEN WT1 - WALL TIE AND GB1 - GROUND BEAM

CAREFULLY DEMOLISH EXISTING BLADE WALL WITH EXCESSIVE OUT-OF-PLANE ROTATION. MAKE GOOD CONNECTED BRICKWORK AND PAVEMENT AS REQUIRED

NORTH-WEST ELEVATION
SCALE - 1:100 (APPROX)

NORTH-EAST ELEVATION
SCALE - 1:100 (APPROX)

NOTE:
1. ALL DESIGNS SHOWN ARE PRELIMINARY ONLY AND HAVE BEEN PRODUCED AS 'HIGH LEVEL' DRAWINGS FOR THE PURPOSE OF PROCURING APPROXIMATE BUDGET ESTIMATES FOR THE REQUIRED WORKS ONLY. THE DESIGNS SHOWN ARE SUBJECT TO CHANGE AND MUST NOT BE CONSIDERED AS FINAL DESIGNS OR USED FOR CONSTRUCTION.

REV.	DESCRIPTION	DESIGNER	CHECKED	APPROVED	DATE
P1	ISSUED FOR INFORMATION ONLY	A.S	A.S		29/11/22

ASSOCIATED CONSULTANTS:

CLIENT / PROJECT:
ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP
INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS TO WHITE HOUSE BUILDING, ST KILLIAN'S PARISH BENDIGO

C+S CONSULTGROUP CIVIL + STRUCTURAL

DESIGNED:	A.S.
DRAWN:	A.S.
PROJECT No.	CS22104
SCALE:	AS SHOWN

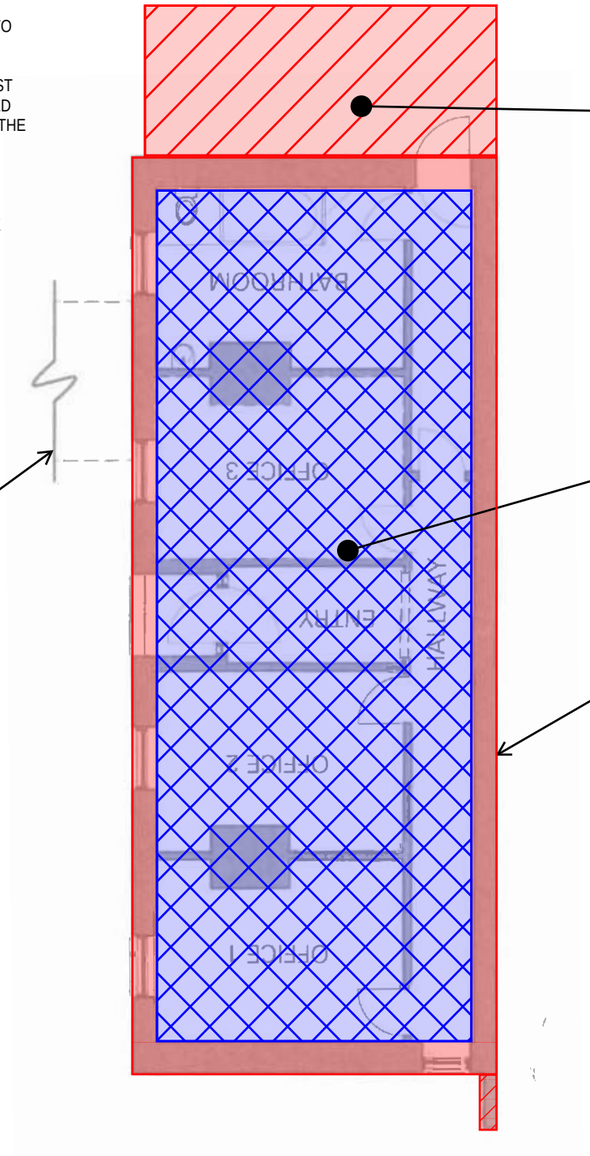
TITLE: INTERMEDIARY REMEDIAL WORKS - ELEVATIONS

A3 FULL SIZE

DRAWING No. SK3

REVISION P1

NOTE:
1. CONTRACTOR TO ALLOW TO ENGAGE SUBCONTRACTOR TO CARRY OUT LOCATION SURVEY OF ALL EXISTING UNDERGROUND SERVICES TO THE AREA OF WORKS.
2. ANY SERVICES IMPACTED BY THE PROPOSED WORKS MUST BE RE-DIVERTED OR TEMPORARILY ISOLATED BY LICENSED SUBCONTRACTORS AS REQUIRED TO SAFELY COMPLETE THE WORKS.
3. ALL EXISTING TEMPORARY FENCING AND ASSOCIATED EXCLUSION ZONES MUST BE REMAIN IN PLACE UNTIL PERMANENT REMEDIAL WORKS HAVE BEEN COMPLETED NOTING THAT THE WORKS SHOWN ON THIS DRAWING ARE INTERMEDIARY ONLY AND MUST NOT A SUITABLE SUBSTITUTION FOR PERMANENT REMEDIAL WORKS.



DEMOLITION PLAN
SCALE - 1:100 (APPROX)

DEMOLITION NOTES:

D1 THE CONTRACTOR SHALL ENGAGE AT THEIR EXPENSE A SUITABLY QUALIFIED ENGINEER TO ADVISE ON THE DEMOLITION WORKS

D2 THE EXTENT OF DEMOLITION TO BE AS DETAILED AND/OR SPECIFIED BY THE ARCHITECT. REFER TO ARCHITECTURAL DRAWINGS FOR EXISTING TO BE DEMOLISHED.

D3 THE DEMOLITION CONTRACTOR IS TO CONFIRM THE ASSUMPTIONS MADE ON THESE PLANS WITH THE EXISTING STRUCTURE ON SITE, SHOULD ANY DISCREPANCIES EXIST THE STRUCTURAL ENGINEER IS TO BE NOTIFIED FOR INSPECTION, AND APPROVAL OR ALTERNATIVE DESIGN, 48 HOURS NOTICE IS TO BE GIVEN PRIOR TO INSPECTION. ANY DISCREPANCIES WITH THE ASSUMPTIONS MADE ON THESE DRAWINGS WILL REQUIRE RE-DOCUMENTATION TO REFLECT THE EXISTING CONDITIONS AND TO CHECK THE LOADING IMPLICATIONS ON OTHER STRUCTURAL MEMBERS.

D4 THE CONTRACTOR SHALL ALLOW FOR THE COSTS ASSOCIATED WITH THE DEMOLITION AND/OR REMOVAL OF THE EXISTING STRUCTURE

D5 THE CONTRACTOR IS TO COORDINATE ALL ON SITE CONSTRUCTION WITH THE ADJOINING PROPERTY OWNERS AND TO ENSURE SITE SAFETY.

D6 IF ADDITIONAL PROPPING IS REQUIRED THE DEMOLITION CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE ADEQUATE PROPS UNDER EXISTING STRUCTURE AS REQUIRED PRIOR TO DEMOLISHING EXISTING WALLS AND INSTALLING NEW BEAMS.

D7 THE CONTRACTOR IS TO SUBMIT DEMOLITION METHODOLOGY PLANS TO THE CLIENT FOR REVIEW TO ENSURE DEMOLITION PROCEDURES ARE IN ACCORDANCE WITH DESIGN INTENT AND STRUCTURAL DRAWINGS. THESE PLANS ARE TO BE APPROVED BY THE CONTRACTORS ENGINEER PRIOR TO SUBMISSION.

D8 THE DEMOLITION CONTRACTOR MUST INSTALL ANY TEMPORARY AND PERMANENT WALL CROSS BRACING PROGRESSIVELY AS DEMOLITION IS UNDERTAKEN.

D9 AT NO TIME SHALL THE DEMOLITION CONTRACTOR ALLOW THE EXISTING STRUCTURE TO STAND UN-BRACED IN ANY DIRECTION.

D10 IF REQUIRED THE DEMOLITION CONTRACTOR IS TO PROVIDE ADEQUATE TEMPORARY PROPPING TO THE EXISTING ROOF AND CEILING TO ENSURE THE STRUCTURAL INTEGRITY OF THE BUILDING DURING DEMOLITION WORKS. PROPPING MUST REMAIN IN POSITION UNTIL ALL NEW AND ANY EXISTING SUPERIMPOSED LOADS ARE TRANSFERRED TO THE FOUNDATIONS.

D11 ANY TEMPORARY BRACING SHOWN ON THESE DRAWINGS MUST REMAIN IN POSITION UNTIL ALL STRUCTURAL ELEMENTS ARE SECURELY FIXED IN POSITION AND EACH ELEMENT HAS BECOME AN INTEGRAL PART OF THE BRACED STRUCTURE.

D12 THE DEMOLITION CONTRACTOR IS TO INSPECT AND DETERMINE THE CONDITION OF EXISTING STRUCTURE AND ALL DAMAGED MEMBERS TO BE REPLACED

D13 THE STABILITY OF THE BUILDING AND ELEMENTS OF THE BUILDING DURING CONSTRUCTION IS THE DEMOLITION CONTRACTORS RESPONSIBILITY. THE DEMOLITION CONTRACTOR MUST ALLOW FOR SECURELY PROPPING ALL FLOORS, REMOVING EXISTING BEAMS AND BUILDING NEW STRUCTURE. IF A DIFFERENT PROPPING PROCEDURE IS TO BE ADOPTED THAN THOSE NOTED ON THESE DRAWINGS, THE PROPPING PROCEDURES AND METHOD OF CONSTRUCTION MUST BE SUPPLIED TO THIS OFFICE TOGETHER WITH ANY RELEVANT COMPUTATIONS AND DETAILS FOR APPROVAL. WRITTEN APPROVAL MUST BE OBTAINED BEFORE THE COMMENCEMENT OF ANY WORK.

D14 THE DEMOLITION CONTRACTOR IS TO INSPECT EXISTING FLOOR STRUCTURE PRIOR TO ANY DEMOLITION OF EXISTING REINFORCED CONCRETE BEAMS, SLABS AND WALLS AND NOTIFY THE ENGINEER IF ADDITIONAL STRUCTURAL ELEMENTS ARE REQUIRED.

D15 NO EXISTING CONCRETE BEAMS AND COLUMNS ARE TO BE DEMOLISHED UNLESS NOTED OTHERWISE ON PLANS

D16 THE DEMOLITION CONTRACTOR SHALL BE RESPONSIBLE FOR MAKING GOOD ALL WORKS THAT HAVE BEEN DAMAGED DURING AND AS A RESULT OF THE DEMOLITION WORKS. THIS INCLUDES:

(a) REPAIR AND/OR REPLACE EXISTING ITEMS NOT NOTED TO BE DEMOLISHED OR REMOVED BUT WHICH HAVE BECOME DAMAGED WHILE UNDERTAKING THE DOCUMENTED DEMOLITION WORKS. ALL SUCH REPAIRS, REPLACEMENTS AND MODIFICATIONS ARE TO RESTORE ANY DAMAGED ITEMS TO THEIR ORIGINAL CONDITION, PRIOR TO THE DAMAGE, TO THE SATISFACTION OF AND AT NO ADDITIONAL COST TO THE OWNER.

(b) PATCH, FILL AND REPAIR ALL SURFACES DISTURBED, CUT, DAMAGED, IN NEED OF REPAIR OR MADE IMPERFECT BY THE DOCUMENTED DEMOLITION WORK AS REQUIRED TO PREPARE FOR NEW WORK AND ARRANGEMENTS.

NOTE:
1. ALL DESIGNS SHOWN ARE PRELIMINARY ONLY AND HAVE BEEN PRODUCED AS 'HIGH LEVEL' DRAWINGS FOR THE PURPOSE OF PROCURING APPROXIMATE BUDGET ESTIMATES FOR THE REQUIRED WORKS ONLY. THE DESIGNS SHOWN ARE SUBJECT TO CHANGE AND MUST NOT BE CONSIDERED AS FINAL DESIGNS OR USED FOR CONSTRUCTION.

REV.	DESCRIPTION	DESIGNER	CHECKED	APPROVED	DATE
P1	ISSUED FOR INFORMATION ONLY	A.S	A.S		29/11/22

ASSOCIATED CONSULTANTS:

CLIENT / PROJECT:
ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP
INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS TO WHITE HOUSE BUILDING, ST KILLIAN'S PARISH BENDIGO

C+S CONSULTGROUP CIVIL + STRUCTURAL

DESIGNED: A.S.
DRAWN: A.S.
PROJECT No. CS22104
SCALE: AS SHOWN

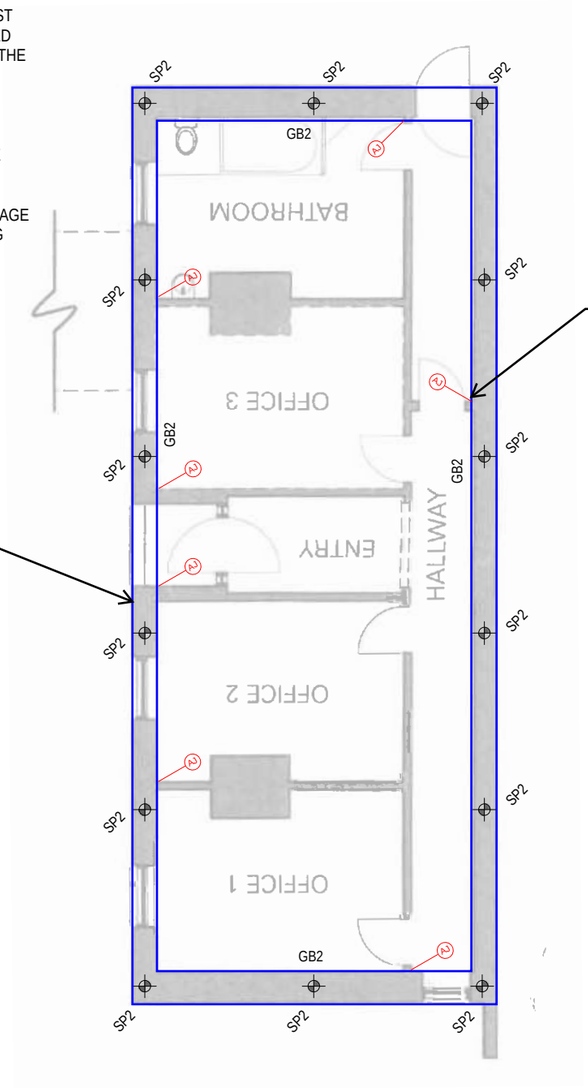
TITLE: PERMANENT REMEDIAL WORKS - DEMOLITION PLAN GENERAL ARRANGEMENT PLAN

A3 FULL SIZE

DRAWING No. SK4

REVISION P1

NOTE:
1. CONTRACTOR TO ALLOW TO ENGAGE SUBCONTRACTOR TO CARRY OUT LOCATION SURVEY OF ALL EXISTING UNDERGROUND SERVICES TO THE AREA OF WORKS.
2. ANY SERVICES IMPACTED BY THE PROPOSED WORKS MUST BE RE-DIVERTED OR TEMPORARILY ISOLATED BY LICENSED SUBCONTRACTORS AS REQUIRED TO SAFELY COMPLETE THE WORKS.
3. ALL EXISTING TEMPORARY FENCING AND ASSOCIATED EXCLUSION ZONES MUST BE REMAIN IN PLACE UNTIL PERMANENT REMEDIAL WORKS HAVE BEEN COMPLETED NOTING THAT THE WORKS SHOWN ON THIS DRAWING ARE INTERMEDIARY ONLY AND MUST NOT A SUITABLE SUBSTITUTION FOR PERMANENT REMEDIAL WORKS.
4. A SUITABLE HARDSTAND PAVEMENT AND SURFACE DRAINAGE MUST BE INSTALLED TO THE PERIMETER OF THE BUILDING PER CIVIL ENGINEERS DESIGN T.B.C.



PROVIDE FULL HEIGHT ARTICULATION JOINTS BETWEEN ANY NEW BRICKWORK AND EXISTING INTERNAL BRICK WALLS

REBUILD GROUND FLOOR EXTERNAL WALLS AS PER ORIGINAL CONSTRUCTION USING RECLAIMED BRICKS.
ALL NEW BRICKWORK TO BE CONSTRUCTED IN ACCORDANCE WITH AS3700.
REFER GENERAL NOTES.

NOTES:
1. SCREW PILES TO BE INSTALLED BY AN APPROVED CONTRACTOR. SCREW PILES ARE TO BE DESIGNED AND CERTIFIED BY THE PILING CONTRACTOR.
2. MACHINERY TO BE CALIBRATED THROUGH EITHER DRIVING RESISTANCE OR PREDETERMINED SET TO ENSURE PILES WILL BE ACHIEVE THEIR NOMINATED SAFE WORKING CAPACITY. PILING LOGS TO BE RETAINED AND COPIES FORWARDED TO THE STRUCTURAL ENGINEER.
3. PROVIDE ADDITIONAL SCREW PILE UNDER CONCENTRATED COLUMN LOCATIONS AS SHOWN ON PLAN.
4. DURABILITY DESIGN OF SCREW PILES MUST ACHIEVE A MINIMUM SERVICE LIFE OF 50 YEARS.

FOOTINGS PLAN
SCALE - 1:100 (APPROX)

FOOTING SCHEDULE			
MARK	SIZE (WxD)	REINFORCEMENT	REMARKS
GB1	600 x 400	4N20 TOP & BOTTOM WITH N12 CLOSED LIGS AT 200 CTS	GROUND BEAM
GB2	600MIN. T.B.C. x 600D	4N20 TOP & BOTTOM WITH N12 CLOSED LIGS AT 200 CTS	GROUND BEAM

SCREW PILE SCHEDULE			
MARK	WORKING LOAD (DL + LL)	LOAD	REMARKS
SP1	T.B.C.	T.B.C.	TEMPORARY WORKS SCREW PILE (SCREW PILE DESIGN BY OTHERS)
SP2	T.B.C.	T.B.C.	PERMANENT WORKS SCREW PILE (SCREW PILE DESIGN BY OTHERS)

CONCRETE NOTES:

C1 ALL MATERIALS, WORKMANSHIP, HANDLING AND PLACEMENT SHALL BE IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
C2 BEAM DEPTHS ARE WRITTEN FIRST AND INCLUDE SLAB THICKNESS. BEAMS AND SLABS ARE TO BE POURED TOGETHER UNLESS NOTED OTHERWISE.
C3 SIZES OF CONCRETE ELEMENTS DO NOT INCLUDE THICKNESS OF APPLIED FINISHES.
C4 HOLES, CHASES OR EMBEDMENT OF PIPES OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL NOT BE MADE IN ANY STRUCTURAL CONCRETE WITHOUT PRIOR APPROVAL OF THE SUPERINTENDENT.
C5 CONSTRUCTION JOINTS SHALL BE PROPERLY FORMED AND USED ONLY WHERE SHOWN ON THE DRAWINGS OR SPECIFICALLY APPROVED BY THE SUPERINTENDENT.
C6 ALL EXPOSED CONCRETE CORNERS TO HAVE 15mm CHAMFER U.N.O.
C7 CAMBER TO SUSPENDED SLABS SHALL BE POSITIVE UPWARD CAMBER OF 3mm PER 1000mm SPAN UNLESS NOTED OTHERWISE. BEAMS SHALL BE CAMBERED AS SHOWN ON DRAWINGS. NO CAMBER IS REQUIRED TO POST-TENSIONED BEAMS AND SLABS.
C8 FORMWORK AND BACKPROPPING SHALL BE DESIGNED, CONSTRUCTED AND STRIPPED IN ACCORDANCE WITH AS 3610. REFER TO ARCHITECTURAL DRAWINGS AND THE SPECIFICATION FOR CLASSES OF SURFACE FINISH.
C9 UNLESS OTHERWISE NOTED ON THE DRAWINGS THE FOLLOWING CONCRETE STRENGTHS AND COVER TO REINFORCEMENT, INCLUDING LIGATURES AND TIES, SHALL BE PROVIDED:

CONCRETE ELEMENT	CONCRETE STRENGTH (MPa)	BOTTOM COVER (mm)	TOP COVER (mm)	SIDE COVER (mm)
PILE CAPS	32	50	50	50
STRIP FOOTINGS AND GROUND BEAMS	32	50	50	50
SLAB ON GROUND	25	40	20	-

SIDE COVER TO BEAMS SHALL BE 50mm UNLESS NOTED OTHERWISE.
MAXIMUM AGGREGATE SIZE SHALL BE 20mm
C10 CONCRETE IS TO HAVE A MAXIMUM SHRINKAGE STRAIN OF 600 MICROSTRAIN
C11 ALL CEMENT IS TO BE 'GP' GENERAL PURPOSE PORTLAND CEMENT OR 'GB' GENERAL PURPOSE BLENDED CEMENT OR TYPE 'SR' SULPHATE-RESISTING CEMENT AS REQUIRED COMPLYING WITH AS3972 UNLESS NOTED OTHERWISE ON THE DRAWINGS. EXTRA RAPID HARDENING SUPERSULPHATED AND HIGH ALUMINA CEMENTS AND CEMENTS CONTAINING CHLORIDE SHALL NOT BE USED. THE USE OF FLY ASH AND/OR SILICA FUME AS A CEMENT SUBSTITUTE, OTHER THAN THAT PROPORTION ALLOWED AS PART OF THE 'GB' CEMENT CONTENT WILL ONLY BE PERMITTED AS PART OF A DESIGNED CONCRETE MIX WHICH HAS BEEN APPROVED IN WRITING BY THE SUPERINTENDENT.
C12 (D) DENOTES SPECIAL DURABLE CONCRETE WHERE THE ELEMENT HAS AT LEAST ONE FACE EXPOSED TO THE WEATHER OR POSSIBLE CORROSIVE ATTACK. (THIS CONCRETE REQUIRES A SPECIAL TOLERANCE FOR THE COVERS OF - 0mm + 10mm). SPECIAL PRECAUTIONS ARE REQUIRED TO IMPROVE THE LONG TERM PERFORMANCE OF THESE FACES OF CONCRETE. IN PARTICULAR, NO METAL INSERTS, METAL BAR CHAIRS OR METAL FORM SPACERS OF ANY KIND ARE TO BE PLACED IN THE COVER ZONES WITHOUT THE EXPRESS PERMISSION OF THE SUPERINTENDENT. TAKE SPECIAL CARE TO AVOID SCRAP TIE WIRE OR OTHER MATERIAL BEING PRESENT. REFER DRAWINGS FOR LOCATIONS.
C13 CONCRETE TESTING SHALL COMPLY WITH THE REQUIREMENTS OF AS1379 FOR PROJECT ASSESSMENT.
C14 CONCRETE SLUMP TO BE A MAXIMUM OF 80mm UNLESS NOTED OTHERWISE ON THE DRAWINGS.
C15 FREE DROPPING OF CONCRETE FROM A HEIGHT GREATER THAN 1000mm IS NOT PERMITTED.
C16 SURFACES RECEIVING GROUT SHALL BE LEFT ROUGH AND FREE OF LAITANCE.
C17 CONCRETE MUST BE CURED BY AN APPROVED CURING COMPOUND ACHIEVING A MINIMUM 90% MOISTURE RETENTION IN ACCORDANCE WITH AS3799.
C18 REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY AND NOT NECESSARILY SHOWN IN TRUE PROJECTION OR SCALE.
C19 REINFORCEMENT SYMBOLS:
N -NORMAL DUCTILITY CLASS HOT ROLLED DEFORMED BARS OR MESH TO AS/NZS 4671 WITH fsy=500 MPa.
R -NORMAL DUCTILITY CLASS 250N PLAIN ROUND BAR TO AS/NZS 4671 WITH fsy=250 MPa.
L -LOW DUCTILITY CLASS 500L REINFORCING MESH OR BAR TO AS/NZS 4671 WITH fsy=500 MPa. LOW DUCTILITY CLASS L REINFORCEMENT IS NOT TO BE USED OTHER THAN WHERE SHOWN ON DRAWINGS THE NUMBER FOLLOWING THE BAR SYMBOL IS THE NORMAL BAR DIAMETER IN MILLIMETRES.
C20 SPLICES IN REINFORCEMENT SHALL BE MADE IN THE POSITIONS SHOWN OR AS OTHERWISE APPROVED BY THE SUPERINTENDENT. MINIMUM LAP FOR ALL FABRICS SHALL BE THE SPACING OF TWO TRANSVERSE WIRES PLUS 25mm. GRADE 500N BARS SHALL BE LAPPED IN ACCORDANCE WITH THE STANDARD LAP LENGTH TABLE IF NOT STATED OTHERWISE ON THE DRAWINGS.
C21 HOOKS AND COGS SHALL COMPLY WITH AS 3600 UNLESS OTHERWISE SHOWN ON THE DRAWINGS.
C22 CUTTING OR WELDING OF REINFORCEMENT IS NOT ALLOWED WITHOUT THE APPROVAL OF THE SUPERINTENDENT.
C23 ALL REINFORCEMENT SHALL BE SECURELY SUPPORTED IN ITS CORRECT POSITION DURING CONCRETING BY APPROVED BAR CHAIRS, SPACERS OR SUPPORT BARS AT 1000mm MAXIMUM CENTRES. THE CHAIR MATERIAL SHALL SUIT THE EXPOSURE CONDITIONS.
C24 CONDUITS AND OTHER CAST IN ITEMS SHALL BE FABRICATED AND INSTALLED SO THAT NO CUTTING, BENDING OR DISPLACEMENT OF THE REINFORCEMENT FROM ITS PROPER POSITION WILL BE REQUIRED.
C25 3N12-100 TOP DIAGONAL CORNER TRIMMER BARS x 2000mm LONG ARE REQUIRED DIAGONALLY ACROSS ALL RE-ENTRANT CORNERS FOR SLABS ON GROUND. 2N16-100 TOP DIAGONAL CORNER TRIMMER BARS x 1500mm LONG ARE REQUIRED DIAGONALLY ACROSS ALL RE-ENTRANT CORNERS OF OPENINGS IN SUSPENDED SLABS AND WALLS.
C26 REINFORCEMENT LENGTHS INDICATED ARE IN MILLIMETRES AND ARE PLAN LENGTH ONLY. TURN DOWNS AND CRANKS ARE NOT INCLUDED IN THE DIMENSION.
C27 BARS SHOWN STAGGERED ON PLAN SHALL BE PLACED ALTERNATELY.
C28 BARS SHALL BE EVENLY DISTRIBUTED OVER THE WIDTH OF THE STRIP INDICATED ON THE DRAWINGS UNLESS NOTED OTHERWISE.
C29 ALL STEEL EMBEDMENTS WITHIN THE CONCRETE COVER ZONE SHALL BE HOT DIP GALVANIZED UNLESS APPROVED OTHERWISE BY THE SUPERINTENDENT.
C30 CONCRETE SHALL BE SEPARATED FROM SUPPORTING MASONRY BY TWO LAYERS OF MALTHOID (OR AN APPROVED EQUIVALENT). VERTICAL FACES OF CONCRETE SHALL BE KEPT FREE OF ADJOINING SURFACES BY 10mm THICKNESS OF ABLEFLEX (OR AN APPROVED EQUIVALENT) UNLESS NOTED OTHERWISE ON THE DRAWINGS. ALL NON-LOADBEARING WALLS SHALL BE KEPT CLEAR OF THE UNDERSIDE OF SLABS AND BEAMS BY 20mm UNLESS NOTED OTHERWISE ON THE DRAWINGS.

NOTE:
1. ALL DESIGNS SHOWN ARE PRELIMINARY ONLY AND HAVE BEEN PRODUCED AS 'HIGH LEVEL' DRAWINGS FOR THE PURPOSE OF PROCURING APPROXIMATE BUDGET ESTIMATES FOR THE REQUIRED WORKS ONLY. THE DESIGNS SHOWN ARE SUBJECT TO CHANGE AND MUST NOT BE CONSIDERED AS FINAL DESIGNS OR USED FOR CONSTRUCTION.

REV.	DESCRIPTION	DESIGNER	CHECKED	APPROVED	DATE
P1	ISSUED FOR INFORMATION ONLY	A.S	A.S		29/11/22

ASSOCIATED CONSULTANTS:

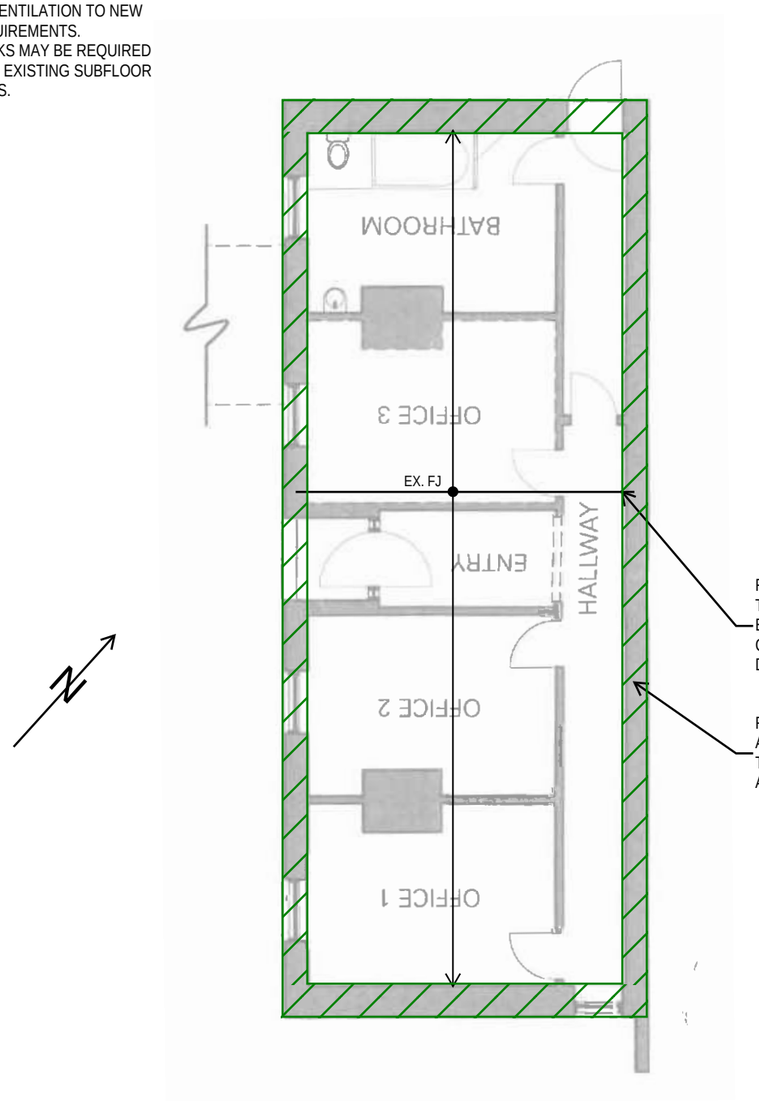
CLIENT / PROJECT:
ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP
INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS TO WHITE HOUSE BUILDING,
ST KILLIAN'S PARISH BENDIGO

C+S CONSULTGROUP CIVIL - STRUCTURAL

DESIGNED: A.S.
DRAWN: A.S.
PROJECT No. CS22104
SCALE: AS SHOWN

TITLE: PERMANENT REMEDIAL WORKS - FOOTINGS PLAN
A3 FULL SIZE
DRAWING No. SK5
REVISION P1

NOTE:
1. EXTERNAL WALLS TO UPPER FLOOR TO BE CONSTRUCTED AS BRICK VENEER.
2. ALLOW TO PROVIDE 100x10 EA ROLLED OR CRANKED GALVANISED STEEL ANGLES FOR SUPPORT OF BRICKWORK TO OPENINGS AND ARCHWAYS.
3. ALLOW TO PROVIDE SUBFLOOR VENTILATION TO NEW EXTERNAL WALLS TO N.C.C. REQUIREMENTS.
4. SOME FLOOR RELEVELLING WORKS MAY BE REQUIRED TO REINSTATE FIXINGS BETWEEN EXISTING SUBFLOOR AND NEW EXTERNAL BRICK WALLS.



REINSTATE FIXINGS BETWEEN EXISTING TIMBER FLOOR JOISTS AND BEARERS TO ENGAGED PIERS OR WALING PLATE. CONSTRUCTION DETAIL T.B.C. FOLLOWING DEMOLITION OF EXISTING WALL.

REBUILD BRICKWORK AND REINSTATE ASSOCIATED MASONRY TIES/FIXINGS AND TIE-DOWN AS REQUIRED TO UPPER FLOOR AND ROOF

GROUND FLOOR REBUILD WORKS PLAN
SCALE - 1:100 (APPROX)

MASONRY NOTES:

M1 ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3700 EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS
M2 THE DESIGN STRENGTH OF MASONRY SHALL BE IN ACCORDANCE WITH THE MASONRY SCHEDULE SHOWN ON THIS DRAWING. MORTAR ADMIXTURES SHALL NOT BE USED WITHOUT THE WRITTEN APPROVAL OF THE SUPERINTENDENT
M3 BONDING OF MASONRY SHALL BE STRETCHER BOND UNLESS SHOWN OTHERWISE ON THE DRAWINGS OR SPECIFIED IN THE CONTRACT DOCUMENTS. INTERSECTING WALLS SHALL BE FULLY BONDED UNLESS SHOWN OTHERWISE ON THE DRAWINGS
M4 MORTAR JOINTS SHALL BE 10mm THICK AND HAVE A MAXIMUM TOOLED DEPTH OF 3mm UNLESS NOTED OTHERWISE. ALL PERPENDS AND BED JOINTS ARE TO BE FULLY FILLED WITH MORTAR
M5 NO CHASES SHALL BE CUT INTO LOAD-BEARING MASONRY WITHOUT THE APPROVAL OF THE SUPERINTENDENT
M6 NON LOAD BEARING WALLS ARE TO BE KEPT 20mm CLEAR OF THE SOFFIT OF SLABS AND BEAMS. THE GAP IS TO BE FILLED WITH APPROVED COMPRESSIBLE FILLER AND SEALANT. FILLER AND SEALANT ARE TO PROVIDE APPROPRIATE FIRE RATING WHERE THESE PRODUCTS ARE INSTALLED IN FIRE RATED WALLS. REFER TO THE ARCHITECTURAL DRAWINGS FOR DETAILS OF FILLER AND SEALANT MATERIAL
M7 THE MAXIMUM LIFT OF MASONRY WALLS UNDER CONSTRUCTION SHALL NOT EXCEED 1200mm
M8 THE CONTRACTOR IS TO PROVIDE ADEQUATE PROPPING OF WALLS UNDER CONSTRUCTION IN ACCORDANCE WITH AS 3828
M9 CLEANOUT HOLES SHALL BE PROVIDED AT THE BASE OF ALL CORES OR CAVITIES WHICH ARE TO BE GROUTED OR FILLED
M10 ALL MORTAR OBSTRUCTIONS IN CORES OR CAVITIES SHALL BE REMOVED PRIOR TO GROUTING. THIS MAY BE DONE USING A ROD FROM THE TOP OF THE WALL. ALL MORTAR THUS REMOVED SHALL BE CLEANED FROM THE BOTTOM OF THE WALL BEFORE THE CLEANOUT HOLES ARE CLOSED FOR GROUTING
M11 REINFORCING STEEL SHALL BE SECURELY FIXED IN POSITION BEFORE GROUTING
M12 GROUT FOR BOND BEAMS, CORE FILLING OR CAVITY FILLING SHALL COMPRISE OF 1 PART CEMENT, 0.25 PART LIME, 3 PARTS 10mm AGGREGATE UNLESS NOTED OTHERWISE ON THE DRAWINGS. MAXIMUM SLUMP TO BE 230mm AND CEMENT SHALL HAVE A GB OR GP CONTENT OF NOT LESS THAN 300kg/m^3
M13 CORES AND CAVITIES SHALL BE FILLED IN 1200mm MAXIMUM LIFTS. GROUTING OF CAVITIES BETWEEN MASONRY SKINS IS NOT TO TAKE PLACE UNTIL 3 DAYS AFTER MASONRY HAS BEEN LAID.
M14 GROUT SHALL BE THOROUGHLY COMPACTED USING A PLAIN BAR
M15 WALL TIES SHALL BE PROVIDED AT 600mm MAXIMUM CENTRES HORIZONTALLY AND VERTICALLY AND SHALL BE IN ACCORDANCE WITH AS 2699 AND AS 3700 UNLESS NOTED OTHERWISE ON THE DRAWINGS
M16 CONTROL JOINTS SHALL BE PLACED IN ALL MASONRY WALLS AT 6000mm MAXIMUM CENTRES HORIZONTALLY AND 4000mm MAXIMUM CENTRES VERTICALLY UNLESS NOTED OTHERWISE ON THE DRAWINGS.
M17 REFER TO THE ARCHITECT$_4$S DRAWINGS FOR SPECIFIC LOCATIONS. CONTROL JOINTS SHALL ALSO BE PLACED ABOVE ONE CORNER OF ALL DOOR AND WINDOW OPENINGS UNLESS NOTED OTHERWISE
M18 MORTAR DROPPINGS OR OTHER HARD MATERIALS SHALL BE KEPT CLEAR OF ALL CONTROL JOINTS. PLACE POLYSTYRENE OR SIMILAR IN ALL VERTICAL JOINTS TO AVOID MORTAR DROPPINGS FILLING THE JOINTS DURING CONSTRUCTION
M19 WALL FINISHES MUST BE JOINTED AT THE SAME LOCATIONS AS THE MASONRY CONTROL JOINTS TO AVOID UNCONTROLLED CRACKING IN WALL FINISHES
M20 ALL MASONRY IS TO BE FIXED TO ADJOINING CONCRETE AND/OR STEEL SUPPORTING MEMBERS BY MFA 3/3 MASONRY ANCHORS (OR AN APPROVED EQUIVALENT) AT 600 MAXIMUM CENTRES VERTICALLY AND MFA 4/M MASONRY ANCHORS (OR AN APPROVED EQUIVALENT) AT 1000 MAXIMUM CENTRES HORIZONTALLY UNLESS OTHERWISE NOTED ON THE DRAWINGS
M21 MASONRY ANCHORS ARE TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS
M22 SOLID BRICKS, SOLID BLOCKS OR CORE FILLED HOLLOW BLOCKS ARE TO BE USED AT ALL MASONRY ANCHOR LOCATIONS

DIRECTION				
ELEMENT	CHARACTERISTIC UNCONFIRMED COMPRESSIVE STRENGTH (MPa)	MORTAR MIX		
		CEMENT	LIME	SAND
NON-LOAD BEARING BLOCKWORK WALLS	12	1	1	6
LOAD BEARING BLOCKWORK WALLS	12	1	0.25	3
NON-LOAD BEARING BRICKWORK WALLS	40	1	1	6
LOAD BEARING BRICKWORK WALLS	40	1	0.25	3

M23 MASONRY MUST NOT BE BUILT ON CONCRETE SLABS OR BEAMS UNTIL FORMWORK SUPPORTING SAME HAS BEEN REMOVED.

NOTE:
1. ALL DESIGNS SHOWN ARE PRELIMINARY ONLY AND HAVE BEEN PRODUCED AS 'HIGH LEVEL' DRAWINGS FOR THE PURPOSE OF PROCURING APPROXIMATE BUDGET ESTIMATES FOR THE REQUIRED WORKS ONLY. THE DESIGNS SHOWN ARE SUBJECT TO CHANGE AND MUST NOT BE CONSIDERED AS FINAL DESIGNS OR USED FOR CONSTRUCTION.

REV.	DESCRIPTION	DESIGNER	CHECKED	APPROVED	DATE
P1	ISSUED FOR INFORMATION ONLY	A.S	A.S		29/11/22

ASSOCIATED CONSULTANTS:

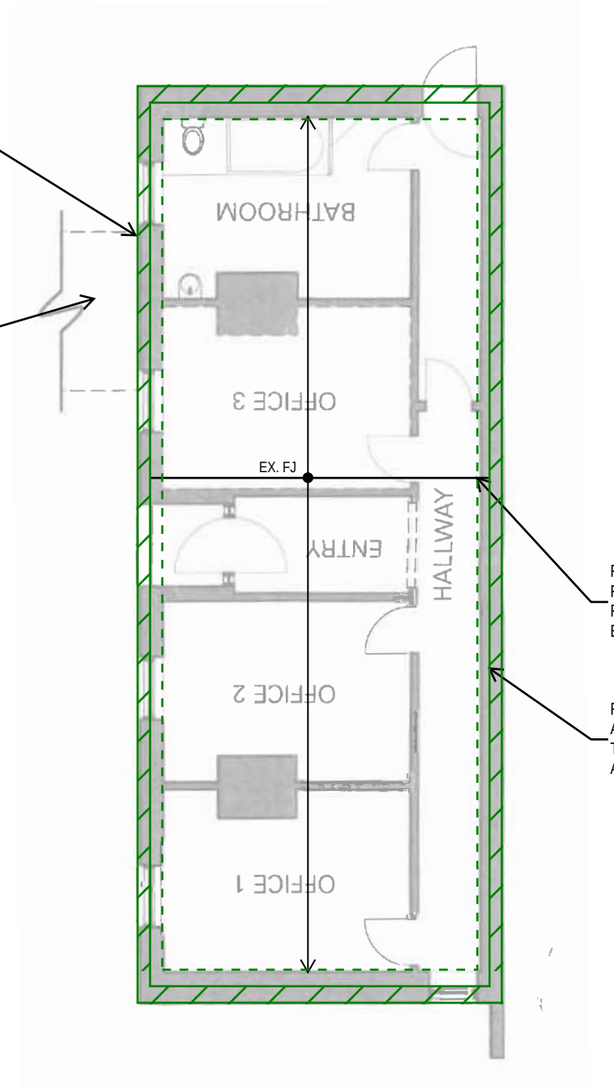
CLIENT / PROJECT:
ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP
INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS
TO WHITE HOUSE BUILDING,
ST KILLIAN'S PARISH BENDIGO

C+S CONSULTGROUP CIVIL + STRUCTURAL

DESIGNED: A.S.
DRAWN: A.S.
PROJECT No. CS22104
SCALE: AS SHOWN

TITLE: PERMANENT REMEDIAL WORKS - GROUND FLOOR REBUILD WORKS PLAN
A3 FULL SIZE
DRAWING No. SK6
REVISION P1

NOTE:
1. ALLOW TO PROVIDE 100x10 EA ROLLED OR CRANKED GALVANISED STEEL ANGLES FOR SUPPORT OF BRICKWORK TO OPENINGS AND ARCHWAYS.



REINSTATE BEARING SUPPORT AND SLIP JOINTS TO EXISTING LINK BRIDGE STRUCTURE.

EXISTING LINK BRIDGE STRUCTURE.

REINSTATE FIXINGS BETWEEN EXISTING FLOOR JOISTS AND TOP OF NEW GROUND FLOOR BRICKWORK. FIXINGS T.B.C. BY ENGINEER.

REBUILD BRICKWORK AND REINSTATE ASSOCIATED MASONRY TIES/FIXINGS AND TIE-DOWN AS REQUIRED TO UPPER FLOOR AND ROOF

UPPER FLOOR REBUILD WORKS PLAN
SCALE - 1:100 (APPROX)

NOTES:
1. SCREW PILES TO BE INSTALLED BY AN APPROVED CONTRACTOR. SCREW PILES ARE TO BE DESIGNED AND CERTIFIED BY THE PILING CONTRACTOR.
2. MACHINERY TO BE CALIBRATED THROUGH EITHER DRIVING RESISTANCE OR PREDETERMINED SET TO ENSURE PILES WILL BE ACHIEVE THEIR NOMINATED SAFE WORKING CAPACITY. PILING LOGS TO BE RETAINED AND COPIES FORWARDED TO THE STRUCTURAL ENGINEER.
3. PROVIDE ADDITIONAL SCREW PILE UNDER CONCENTRATED COLUMN LOCATIONS AS SHOWN ON PLAN.
4. DURABILITY DESIGN OF SCREW PILES MUST ACHIEVE A MINIMUM SERVICE LIFE OF 50 YEARS.

MASONRY NOTES:

M1 ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS3700 EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS
M2 THE DESIGN STRENGTH OF MASONRY SHALL BE IN ACCORDANCE WITH THE MASONRY SCHEDULE SHOWN ON THIS DRAWING. MORTAR ADMIXTURES SHALL NOT BE USED WITHOUT THE WRITTEN APPROVAL OF THE SUPERINTENDENT
M3 BONDING OF MASONRY SHALL BE STRETCHER BOND UNLESS SHOWN OTHERWISE ON THE DRAWINGS OR SPECIFIED IN THE CONTRACT DOCUMENTS. INTERSECTING WALLS SHALL BE FULLY BONDED UNLESS SHOWN OTHERWISE ON THE DRAWINGS
M4 MORTAR JOINTS SHALL BE 10mm THICK AND HAVE A MAXIMUM TOOLED DEPTH OF 3mm UNLESS NOTED OTHERWISE. ALL PERPENDS AND BED JOINTS ARE TO BE FULLY FILLED WITH MORTAR
M5 NO CHASES SHALL BE CUT INTO LOAD-BEARING MASONRY WITHOUT THE APPROVAL OF THE SUPERINTENDENT
M6 NON LOAD BEARING WALLS ARE TO BE KEPT 20mm CLEAR OF THE SOFFIT OF SLABS AND BEAMS. THE GAP IS TO BE FILLED WITH APPROVED COMPRESSIBLE FILLER AND SEALANT. FILLER AND SEALANT ARE TO PROVIDE APPROPRIATE FIRE RATING WHERE THESE PRODUCTS ARE INSTALLED IN FIRE RATED WALLS. REFER TO THE ARCHITECTURAL DRAWINGS FOR DETAILS OF FILLER AND SEALANT MATERIAL
M7 THE MAXIMUM LIFT OF MASONRY WALLS UNDER CONSTRUCTION SHALL NOT EXCEED 1200mm
M8 THE CONTRACTOR IS TO PROVIDE ADEQUATE PROPPING OF WALLS UNDER CONSTRUCTION IN ACCORDANCE WITH AS 3828
M9 CLEANOUT HOLES SHALL BE PROVIDED AT THE BASE OF ALL CORES OR CAVITIES WHICH ARE TO BE GROUTED OR FILLED
M10 ALL MORTAR OBSTRUCTIONS IN CORES OR CAVITIES SHALL BE REMOVED PRIOR TO GROUTING. THIS MAY BE DONE USING A ROD FROM THE TOP OF THE WALL. ALL MORTAR THUS REMOVED SHALL BE CLEANED FROM THE BOTTOM OF THE WALL BEFORE THE CLEANOUT HOLES ARE CLOSED FOR GROUTING
M11 REINFORCING STEEL SHALL BE SECURELY FIXED IN POSITION BEFORE GROUTING
M12 GROUT FOR BOND BEAMS, CORE FILLING OR CAVITY FILLING SHALL COMPRISE OF 1 PART CEMENT, 0.25 PART LIME, 3 PARTS 10mm AGGREGATE UNLESS NOTED OTHERWISE ON THE DRAWINGS. MAXIMUM SLUMP TO BE 230mm AND CEMENT SHALL HAVE A GB OR GP CONTENT OF NOT LESS THAN 300kg/m^3
M13 CORES AND CAVITIES SHALL BE FILLED IN 1200mm MAXIMUM LIFTS. GROUTING OF CAVITIES BETWEEN MASONRY SKINS IS NOT TO TAKE PLACE UNTIL 3 DAYS AFTER MASONRY HAS BEEN LAID.
M14 GROUT SHALL BE THOROUGHLY COMPACTED USING A PLAIN BAR
M15 WALL TIES SHALL BE PROVIDED AT 600mm MAXIMUM CENTRES HORIZONTALLY AND VERTICALLY AND SHALL BE IN ACCORDANCE WITH AS 2699 AND AS 3700 UNLESS NOTED OTHERWISE ON THE DRAWINGS
M16 CONTROL JOINTS SHALL BE PLACED IN ALL MASONRY WALLS AT 6000mm MAXIMUM CENTRES HORIZONTALLY AND 4000mm MAXIMUM CENTRES VERTICALLY UNLESS NOTED OTHERWISE ON THE DRAWINGS.
M17 REFER TO THE ARCHITECT$_4$S DRAWINGS FOR SPECIFIC LOCATIONS. CONTROL JOINTS SHALL ALSO BE PLACED ABOVE ONE CORNER OF ALL DOOR AND WINDOW OPENINGS UNLESS NOTED OTHERWISE
M18 MORTAR DROPPINGS OR OTHER HARD MATERIALS SHALL BE KEPT CLEAR OF ALL CONTROL JOINTS. PLACE POLYSTYRENE OR SIMILAR IN ALL VERTICAL JOINTS TO AVOID MORTAR DROPPINGS FILLING THE JOINTS DURING CONSTRUCTION
M19 WALL FINISHES MUST BE JOINTED AT THE SAME LOCATIONS AS THE MASONRY CONTROL JOINTS TO AVOID UNCONTROLLED CRACKING IN WALL FINISHES
M20 ALL MASONRY IS TO BE FIXED TO ADJOINING CONCRETE AND/OR STEEL SUPPORTING MEMBERS BY MFA 3/3 MASONRY ANCHORS (OR AN APPROVED EQUIVALENT) AT 600 MAXIMUM CENTRES VERTICALLY AND MFA 4/M MASONRY ANCHORS (OR AN APPROVED EQUIVALENT) AT 1000 MAXIMUM CENTRES HORIZONTALLY UNLESS OTHERWISE NOTED ON THE DRAWINGS
M21 MASONRY ANCHORS ARE TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS
M22 SOLID BRICKS, SOLID BLOCKS OR CORE FILLED HOLLOW BLOCKS ARE TO BE USED AT ALL MASONRY ANCHOR LOCATIONS

DIRECTION				
ELEMENT	CHARACTERISTIC UNCONFIRMED COMPRESSIVE STRENGTH (MPa)	MORTAR MIX		
		CEMENT	LIME	SAND
NON-LOAD BEARING BLOCKWORK WALLS	12	1	1	6
LOAD BEARING BLOCKWORK WALLS	12	1	0.25	3
NON-LOAD BEARING BRICKWORK WALLS	40	1	1	6
LOAD BEARING BRICKWORK WALLS	40	1	0.25	3

M23 MASONRY MUST NOT BE BUILT ON CONCRETE SLABS OR BEAMS UNTIL FORMWORK SUPPORTING SAME HAS BEEN REMOVED.

NOTE:
1. ALL DESIGNS SHOWN ARE PRELIMINARY ONLY AND HAVE BEEN PRODUCED AS 'HIGH LEVEL' DRAWINGS FOR THE PURPOSE OF PROCURING APPROXIMATE BUDGET ESTIMATES FOR THE REQUIRED WORKS ONLY. THE DESIGNS SHOWN ARE SUBJECT TO CHANGE AND MUST NOT BE CONSIDERED AS FINAL DESIGNS OR USED FOR CONSTRUCTION.

REV.	DESCRIPTION	DESIGNER	CHECKED	APPROVED	DATE
P1	ISSUED FOR INFORMATION ONLY	A.S	A.S		29/11/22

ASSOCIATED CONSULTANTS:

CLIENT / PROJECT:
ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP
INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS
TO WHITE HOUSE BUILDING,
ST KILLIAN'S PARISH BENDIGO

C+S CONSULTGROUP CIVIL + STRUCTURAL

DESIGNED: A.S.
DRAWN: A.S.
PROJECT No. CS22104
SCALE: AS SHOWN

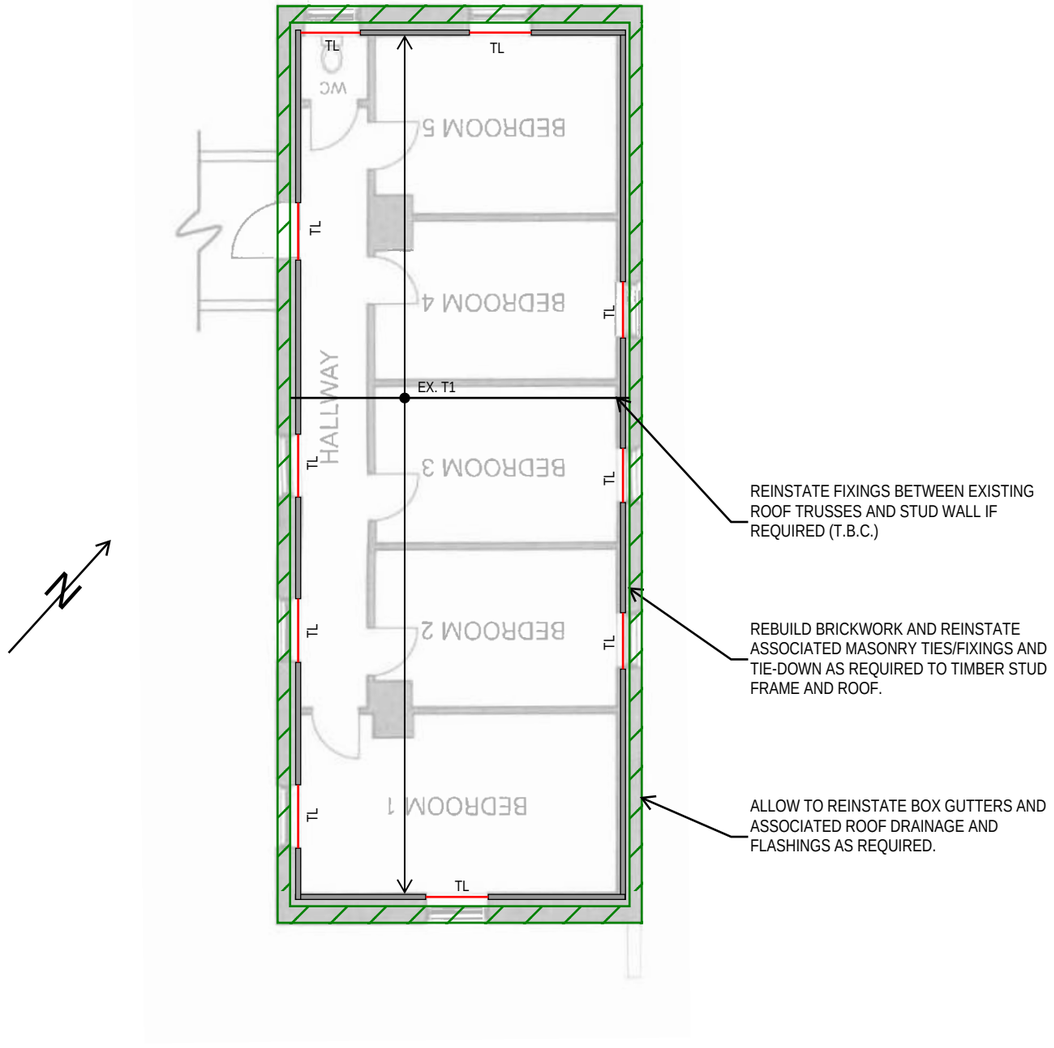
TITLE: PERMANENT REMEDIAL WORKS - UPPER FLOOR REBUILD WORKS PLAN

A3 FULL SIZE

DRAWING No. SK7

REVISION P1

NOTE:
1. EXTERNAL WALLS TO UPPER FLOOR TO BE CONSTRUCTED AS BRICK VENEER.
2. ALLOW TO PROVIDE 100x10 EA ROLLED OR CRANKED GALVANISED STEEL ANGLES FOR SUPPORT OF BRICKWORK TO OPENINGS AND ARCHWAYS.
3. UPPER FLOOR WALL MAKEUP SHOWN INDICATIVE ONLY AS BRICK VENEER AND IS SUBJECT TO CONFIRMATION.



ROOF REBUILD WORKS PLAN
SCALE - 1:100 (APPROX)

TIMBER NOTES:

T1 ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS1684, AS1684.1 AND AS1720 EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS

T2 TIMBER MEMBERS NOT SIZED OR SCHEDULED ON THE DRAWINGS SHALL BE SELECTED USING AS1684.1

T3 ALL TIMBER CONNECTIONS TO BE IN ACCORDANCE WITH AS1684 UNLESS NOTED OTHERWISE ON THE DRAWINGS.

T4 ALL TIMBER MEMBERS ARE TO CONSIST OF A SINGLE NATURAL PIECE OF TIMBER. LAMINATIONS OR FINGER JOINTS ARE NOT ALLOWED WITHOUT THE APPROVAL OF THE SUPERINTENDENT

T5 TIMBER JOINTS SHALL BE FREE OF DEFECTS.

T6 NO PENETRATIONS ARE ALLOWED IN TIMBER MEMBERS UNLESS APPROVED BY THE SUPERINTENDENT

T7 ALL PROPRIETARY CONNECTORS AND FIXINGS ARE TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS

T8 TIMBER MEMBERS SHALL HAVE THE FOLLOWING MINIMUM STRESS GRADES UNLESS NOTED OTHERWISE ON THE DRAWINGS

MPG10	FOR SEASONED PINE
F8	FOR UNSEASONED HARDWOOD
F8	FOR OREGON
F17	FOR SEASONED HARDWOOD

T9 MAXIMUM UNDERSIZE FOR ALL TIMBER MEMBERS SHALL BE AS FOLLOWS:

(i)	0	FOR SEASONED PINE SPECIES AND OTHER SEASONED SOFTWOODS
(ii)	3mm	FOR UNSEASONED HARDWOODS
(iii)	0	FOR SEASONED HARDWOODS
(iv)	4mm	FOR OREGON

T10 ALL NAILS, BOLTS AND SCREWS SHALL BE GALVANIZED UNLESS APPROVED OTHERWISE BY THE SUPERINTENDENT

T11 STUDS IN ALL LOAD BEARING STUD WALLS ARE TO BE 90 X 45 MGP10 AT 450 MAX CTS WITH NOGGINS AT 1300 VERTICAL CENTRES, UNLESS NOTED OTHERWISE

T12 ALL TIMBER BEAMS AND/OR LINTELS ARE TO BE SUPPORTED AT THEIR ENDS BY 2/90 X 45 MGP10 STUDS SECURELY NAILED TOGETHER, UNLESS NOTED OTHERWISE

T13 TOP AND BOTTOM PLATES ARE TO BE 90 X 45 MGP12, UNLESS NOTED OTHERWISE

T14 ALL NON LOAD BEARING STUD WALLS ARE TO BE TIED AT TOP AND BOTTOM INTO FLOORING AND ROOF FRAMING

T15 FIX STUDS TO CROSS MASONRY OR CONCRETE WALLS WITH M10 MASONRY ANCHORS AT 900 CTS, UNLESS NOTED OTHERWISE

T16 PROVIDE DOUBLE JOISTS UNDER WALLS

T17 PROVIDE TIMBER BLOCKING AT 1800 CTS TO ALL TIMBER FLOOR JOISTS, UNLESS NOTED OTHERWISE

T18 PROVIDE DOUBLE PURLINS EITHER SIDE OF ROOF PENETRATIONS, UNLESS NOTED OTHERWISE.

T19 ALL TIMBER ROOF FRAMING IS TO BE SECURELY TIED DOWN. AS A MINIMUM PROVIDE 30 X 1.0mm STRAPS BY 900 LONG AT 1200 MAX CTS, UNLESS NOTED OTHERWISE

T20 TIMBER LINTELS FOR SINGLE OR TOP STOREY STRUCTURES SHALL BE AS FOLLOWS, UNLESS NOTED OTHERWISE:
SPANS UP TO 1000mm - 190 X 45 F17 KDHW
SPANS UP TO 1600mm - 240 X 45 F17 KDHW
SPANS UP TO 2900mm - 290 X 45 F17 KDHW

T21 BEAM TO BEAM CONNECTIONS SHALL BE VIA APPROVED GIRDER BRACKETS, UNLESS NOTED OTHERWISE

NOTES:
1. SCREW PILES TO BE INSTALLED BY AN APPROVED CONTRACTOR. SCREW PILES ARE TO BE DESIGNED AND CERTIFIED BY THE PILING CONTRACTOR.
2. MACHINERY TO BE CALIBRATED THROUGH EITHER DRIVING RESISTANCE OR PREDETERMINED SET TO ENSURE PILES WILL BE ACHIEVE THEIR NOMINATED SAFE WORKING CAPACITY. PILING LOGS TO BE RETAINED AND COPIES FORWARDED TO THE STRUCTURAL ENGINEER.
3. PROVIDE ADDITIONAL SCREW PILE UNDER CONCENTRATED COLUMN LOCATIONS AS SHOWN ON PLAN.
4. DURABILITY DESIGN OF SCREW PILES MUST ACHIEVE A MINIMUM SERVICE LIFE OF 50 YEARS.

NOTE:
1. ALL DESIGNS SHOWN ARE PRELIMINARY ONLY AND HAVE BEEN PRODUCED AS 'HIGH LEVEL' DRAWINGS FOR THE PURPOSE OF PROCURING APPROXIMATE BUDGET ESTIMATES FOR THE REQUIRED WORKS ONLY. THE DESIGNS SHOWN ARE SUBJECT TO CHANGE AND MUST NOT BE CONSIDERED AS FINAL DESIGNS OR USED FOR CONSTRUCTION.

REV.	DESCRIPTION	DESIGNER	CHECKED	APPROVED	DATE
P1	ISSUED FOR INFORMATION ONLY	A.S	A.S		29/11/22

ASSOCIATED CONSULTANTS:

CLIENT / PROJECT:
ST KILLIAN'S PARISH BENDIGO
C/- C+M BUILD GROUP
INTERMEDIARY REMEDIAL WORKS AND PERMANENT REMEDIAL WORKS TO WHITE HOUSE BUILDING, ST KILLIAN'S PARISH BENDIGO

C+S CONSULTGROUP CIVIL + STRUCTURAL

DESIGNED: A.S.
DRAWN: A.S.
PROJECT No. CS22104
SCALE: AS SHOWN

TITLE: PERMANENT REMEDIAL WORKS - ROOF REBUILD WORKS PLAN

A3 FULL SIZE

DRAWING No. SK8

REVISION P1

Appendix D

Historical Geotechnical Reports

- Geotechnical report No. 114090, prepared by AS James, dated 23rd March 2012.
  Prepared for the subject building following historical building damaged from subsidence.
- Geotechnical report No. 107988, prepared by AS James, dated 16th October 2006.
  Prepared for the adjacent property St Killian's Primary School.
- Geotechnical report No. 19C 0989, prepared by GTS, dated 3rd December 2019.
  Prepared for the adjacent property St Killian's Primary School.

SANDHURST TRUSTEES

WILLIAMS BOAG ARCHITECTS

OSBORNE CONSULTING GROUP PTY LTD

This is .....
referred to in the Contract Agreement dated .....
Proprietor .....
Witness .....
Builder .....
Witness .....

INVESTIGATION OF MOVEMENT

"WHITE HOUSE"

ST KILIANS CHURCH, McCRAE STREET

BENDIGO

Report No: 114090

Date: 23 March 2012

GEOTECHNICAL INVESTIGATION

By

A.S. JAMES PTY LIMITED
15 Libbett Avenue,
Clayton South Vic. 3169
Tel: 613 9547 4811
Fax: 613 9547 5393
E-mail: melb@asjames.com.au

A.S.JAMES PTY LTD
A.C.N. 004 584 534 A.B.N. 40 004 584 534
Geotechnical Engineers
SINCE 1963

15 Libbett Avenue
Clayton South Vic 3169
Tel: (613) 9547 4811
Fax: (613) 9547 5393
E-mail: melb@asjames.com.au

1. INTRODUCTION

1.01 **Investigation Requested By:** The geotechnical investigation was commissioned by Dion Keech of Williams Boag Architects on behalf of Sandhurst Trustees.

1.02 **Purpose of Investigation:** Visible movement has occurred on the southern corner of the "White House" building at St Kilians Church, McCrae Street, Bendigo. Herein, it was required to determine the probable causes of movement, together with appropriate remedial action.

1.03 **Geology & Background:** The 1:250,000 Geological Survey of Victoria, Bendigo Sheet, indicates the subject site to be underlain by Ordovician siltstone, sandstone, shale and slate which make up part of the greater "Castlemaine Group". Weathering of the rock has typically resulted in shallow, surface residual silts underlain by firm to very stiff residual clays, which grade to variably weathered rock at depth. The residual clays are generally of low reactivity and the depth to rock is often highly variable over short distances. Significant variations in the weathering of the siltstone exist.

Reworked mining material consisting of silt, clay and gravels, generally quartz, are common across the Bendigo district, in particular within the Golden Square region, and are therefore likely across the subject site.

The DPI Earth Resources GEOVIC online map indicates shaft localities close to the subject site. Several shafts exist in close proximity to the subject site, in particular they comprise of Hustlers Royal Reserve Co. No.2 mines. These are not thought to be of any concern, in that they appear outside the subject site area and are likely to be below the depths investigated. There may, however, be unmapped shafts underlying the site.

1.04 **Laboratory Methods:** All soil samples were transferred to A. S. James Pty. Ltd.'s National Association of Testing Authorities (NATA) registered laboratory, where mechanical testing was undertaken. All laboratory testing was performed in strict accordance with the test methods outlined in Australian Standard A.S. 1289, "Method of Testing Soils for Engineering Purposes", as follows:-

	A S 1289 Test Method
• Moisture Content Testing	2.1.1
• Atterberg Limits	3.1.1, 3.2.1, 3.4.1

1.05 **Field Methods:** Boreholes were drilled using a Dingo Mounted Ezi Drill fitted with continuous flight tungsten tipped augers. In-situ vane shear strength testing was carried out in each borehole and soil profiles were logged in accordance with Australian Standard A.S. 1726 – 1993, "Geotechnical Site Investigations".

2. RESULTS

2.01 **Construction:** The actual date of construction of the "White House" structure is unknown; however, given St Kilians Church was constructed in the 1860's, it is possible it was constructed in the late 1800's or early 1900's.

2.02 **Visual Inspection:** A detailed inspection has not been carried out; however, the main area of movement is noticeable in the brickwork on the southern corner of the building.

2.03 **Borehole Drilling:** In order to determine the sub-surface soil conditions at the site, two (2) boreholes were drilled at the time of the site investigation, at the approximate locations indicated on Figure 1 attached. One (1) footing probe was also exposed at the location marked on figure 1 and the dimensions are given on Figure 4.

The logs of the boreholes, together with results of in-situ vane shear strength tests conducted in each of the boreholes, are given on Figures 2 and 3.

2.04 **Sub-Surface Soil Profile:** Borehole 1 consisted of a 0.4m surface layer of fill which was underlain by medium dense silt fill from 0.4-0.9m which was further underlain by a layer of silty sand which extended to the termination depth of 4.0m. Borehole 2 consisted of a 0.3m surface layer of fill which was underlain by a layer of firm silty clay which extended to the termination depth of 4.0m. The underlying clay is assessed as moderately reactive.

2.05 **Ground Water:** At the time of the site investigation no permanent free ground water was encountered in the bores.

2.06 **Footing Probe:** The basic dimensions and conditions of the existing footing, which provides support to the wall of the main structure, was probed at the location indicated on the site plan. Details of the footing are given on Figures 4.

2.07 **Laboratory Testing:** Upon receipt in the laboratory moisture content and atterberg limits testing were carried out on samples of silt & clay taken from each of the boreholes. The results of these tests are also enclosed.

3. DISCUSSION & RECOMMENDATIONS

3.01 **Cause of Foundation Movement:** On the basis of the geotechnical investigation work completed to date, together with our inspection, it is apparent that the cause of the movement may be a combination of factors:

1. The actual footing of the "White House" structure consists of a continuation of the brickwork which terminates at 0.45m below the existing surface level. At the base of the brickwork is a cemented combination of broken bricks, rubble and cement. This rough "blinding" footing is founded in clayey silt at a depth of 0.9m below the existing surface level and has become weakened and easily broken. Based on the log of the nearby borehole 1, the underlying soil profile changes to silty sand from 0.9m.

2. The variation in underlying soil profiles between borehole 1 and borehole 2 may be cause for inconsistent seasonal volume change of the soils over the length of the building.

   The underlying silty clay indicated in borehole 2 from a depth of 0.3m is more susceptible to volume change due to seasonal variations in moisture content than the clayey silt and silty sand encountered in borehole 1 and footing probe 1.

This variable profile is typical of the area, especially given the close vicinity to the nearby Bendigo Creek to the north of the site.

3.02 **Structural Stability:** It should be noted that if the movements are not controlled, ongoing, additional cracking of the brickwork will obviously occur; that is the movements will continue unless appropriate remedial action is taken.

3.03 **Foundation Inspection:** From the footing inspection and drilling performed it has been determined that it's likely the footings of the structure are founded on different underlying material types.

3.04 **Future Performance of the Structure:** In considering remedial measures, it must be appreciated from the outset that once a foundation arrangement has proven inadequate in relation to the conditions which prevail on a site, it is extremely difficult, if not impossible, to arrest all future movements. Any remedial measures are thus aimed at minimising future movements, such that they do not impair the performance of the structure and can be dealt with as part of routine maintenance.

3.05 **Underpinning of Footings:** It is our recommendation that consideration should be given to reconstruction and deepening of the rough cemented "blinding footings" which underpin the existing brick footing. It must be appreciated, however, that if underpinning of isolated problem areas only is undertaken, this in itself may lead to cracking of sections which are currently in relatively good repair, due to "propping" of the affected area.

This should, however, be minimal if the entire structure is underpinned or a progressive program introduced.

It is recommended that the proposed underpins for the existing structures footings should extend to stiff clay or dense silty sand at a minimum depth of 1.8m and such underpins should be designed using a maximum bearing pressure of 150 kPa.

It is essential to prevent the ingress of moisture down to the base of the underpins by ensuring that the backfill to the front of the underpins comprises clean clay fill compacted in layers not greater than 150 millimetres when loose and to a dry density not less than 95% of the maximum dry density value determined by the Standard Compaction Test, in accordance with Australian Standard A.S. 1289 5.1.1 – 1993, using appropriate compactive equipment.

During compaction the clay fill material should have a moisture content within the range 85% - 115% of the optimum moisture content, as determined by the Standard Compaction Test in accordance with A.S. 1289 5.1.1. – 1993.

In order to prevent future cracking of the structure at the transition points, it is recommended that full height articulation be introduced into the brick work at all points where the underpinning is terminated.

It is thought that in the refurbishment works adequate detailing and partial demolition may articulate the structure to accommodate minor movements.

3.06 **New Footings:** Any new footings should extend to the minimum depths outlined above.

3.07 **General:** Conditions may change with the seasons. In particular, following prolonged periods of rainfall the soils underlying the site at shallow depth may become saturated and unworkable.

We trust the above information is satisfactory; however, should any point remain in doubt, please do not hesitate to contact this office.

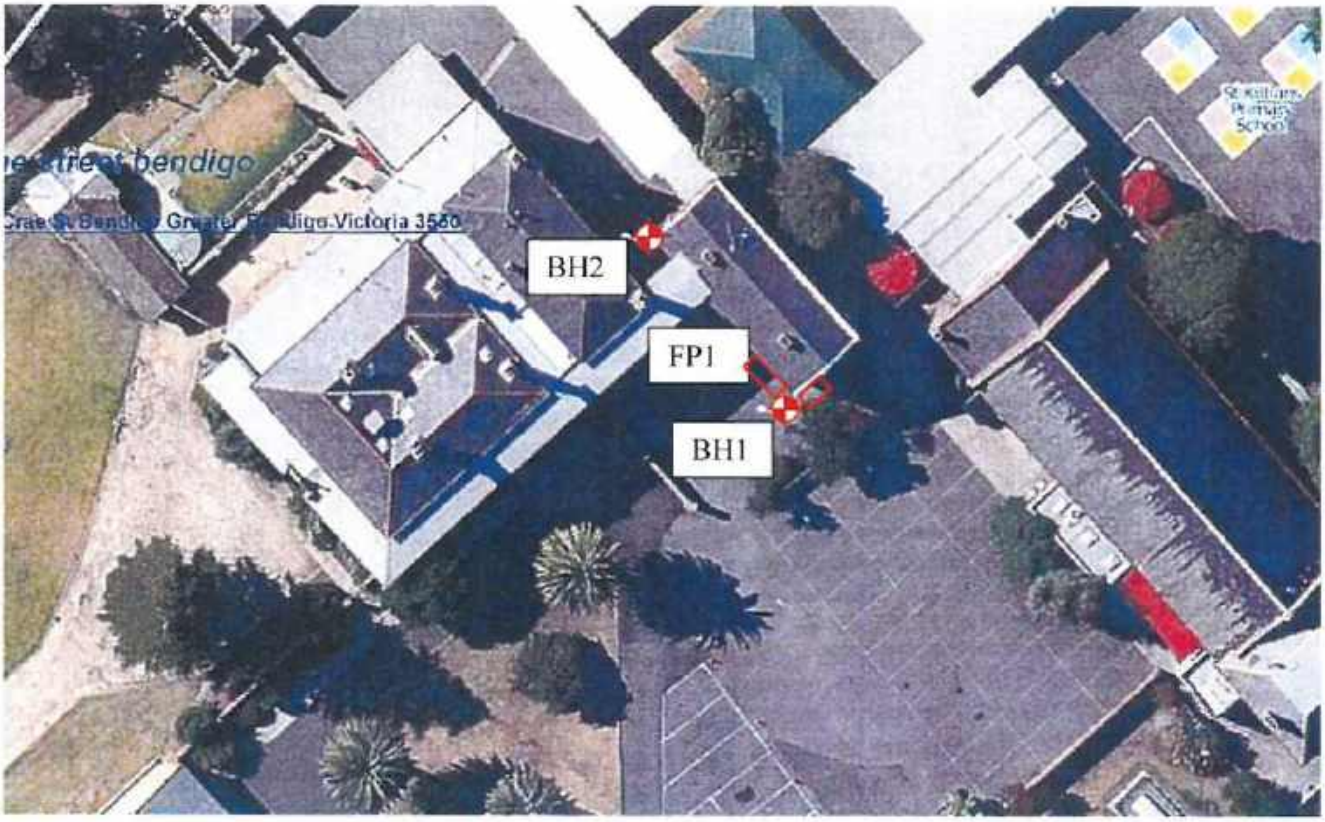
Under no circumstances should this report be reproduced, unless in full.

D.C.GUNN OMIEAust
A.S. JAMES PTY LTD

Reviewed by:
T.J. HOLT MIEAust CPEng EC-1022
A.S. JAMES PTY LTD

Enc.
W:\114090\114090-report.doc

A.S. JAMES PTY LTD Geotechnical Engineers	JOB: "White House" ST KILIANS CHURCH BENDIGO VIC	JOB No. 114090 DATE: MAR '12



Denotes Approximate Footing Probe Location

Denotes Approximate Borehole Locations

PLAN OF APPROXIMATE BOREHOLE LOCATIONS (N.T.S.)	Tested: D.Gunn Drawn: D.Gunn	Figure 1

A.S.JAMES PTY. LTD.
Geotechnical Engineers

Location: "White House" St Kilians Church, BENDIGO VIC **Borehole:** 1
Job No. 114090 **Date:** Mar ' 12
Ground Water: NIL

Soil Type	Description	Depth	Tests	Results
FILL	-Gravelly sand	0.0		
	-Orange brown			
	-Moist			
	-Medium dense			
	-30mm asphalt at surface	0.4		
SILT (ML)	-Brown			
	-Clayey			
	-Moist			
	-Medium dense	0.9		
SAND (SM)	-Orange brown			
	-Silty with trace clay			
	-Moist			
	-Medium dense		+	N = 5,10,12
			+	N = 21 and bouncing (no recovery)
	Borehole terminated	4.0		

+ Standard Penetration Test - N blows/150mm. incr.	c Apparent Cohesion	L.L. Liquid Limit	**Figure 2**
I Undisturbed Sample - Diameter Stated	Ø Friction Angle	P.L. Plastic Limit	
s Vane Shear Strength	P Wet Density	P.I. Plasticity Index	
p Pocket Penetrometer Resistance	w Moisture Content	L.S. Linear Shrinkage	

A.S.JAMES PTY. LTD.
Geotechnical Engineers

Location: "White House" St Kilians Church, BENDIGO VIC **Borehole:** 2

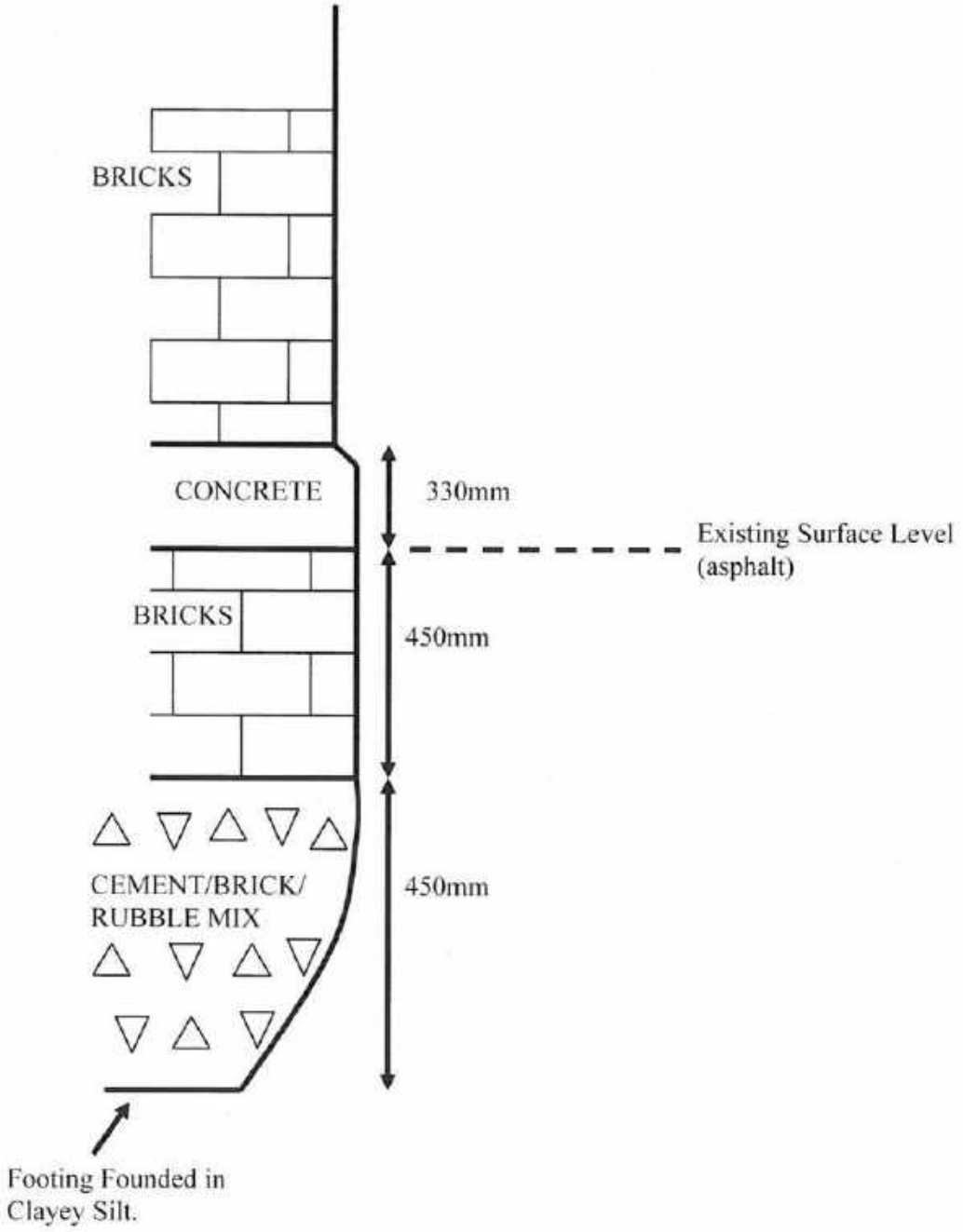
Job No. 114090 **Date:** Mar ' 12

Ground Water: NIL

Soil Type	Description	Depth			
FILL	-Gravelly sand	0.0			
	-Orange brown				
	-Moist				
	-Medium dense	0.3			
	-30mm asphalt at surface				
CLAY (CL)	-Orange brown				
	-Gravelly with silt				
	-Moist				
	-Firm				
				s	70 kPa
				s	72 kPa
	Borehole terminated	4.0			

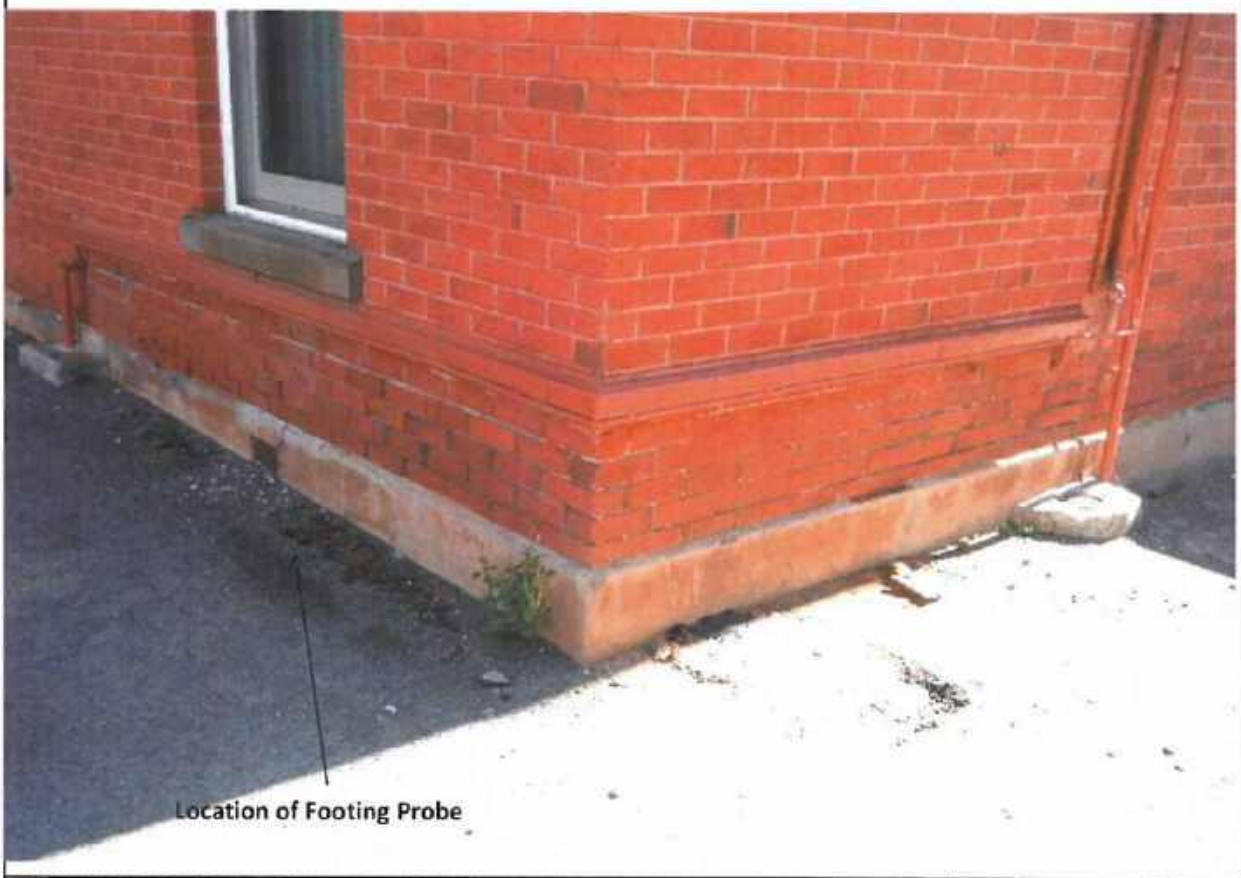
+ Standard Penetration Test - N blows/150mm. incr.	c Apparent Cohesion	L.L. Liquid Limit	**Figure 3**
I Undisturbed Sample - Diameter Stated	Ø Friction Angle	P.L. Plastic Limit	
s Vane Shear Strength	P Wet Density	P.I. Plasticity Index	
p Pocket Penetrometer Resistance	w Moisture Content	L.S. Linear Shrinkage	

A.S. JAMES PTY LTD Geotechnical Engineers	JOB: "White House" St Kilians Church, McCrae Street, BENDIGO	JOB No. 114090 DATE: MARCH'12



FOOTING PROBE DETAIL – FP 1

FOOTING PROBE 1	Figure 4



AS JAMES FORM NO. LW000 REV 0, 14/11/2005

FIG 5

AS JAMES FORM NO. LW000 REV 0, 14/11/2005

FIG 6

AS JAMES FORM NO. LW000 REV 0, 14/11/2005

FIG 7

A.S. JAMES PTY. LTD. Geotechnical Engineers Clayton Laboratory 16 Libbett Av Clayton South	JOB: "White House" St Killian'S Church Mccrae Street, Bendigo	JOB No. 114090 REPORT No. L001 DATE. 22-Mar-12

FOR Osborne Consulting Group Pty Ltd,
133 Mccrae Street,
BENDIGO, VIC. 3550

Lab Sample No.	Soil Description	Sample Location	Depth of Sample (m)	Insitu Moisture Content (%)
46587	SILT, Sandy, Clayey	Bore Hole 1	0.50	6.6
46588	SILT, Sandy, Clayey	Bore Hole 1	1.00	7.3
46589	SILT, Sandy, Clayey	Bore Hole 1	1.50	6.7
46590	SILT, Sandy, Clayey	Bore Hole 1	2.50	12.4
46591	SILT, Sandy, Clayey	Bore Hole 2	1.00	10.7
46592	SILT, Sandy, Clayey	Bore Hole 2	1.50	10.7
46593	SILT, Sandy, Clayey	Bore Hole 2	3.00	16.4
46594	SILT, Sandy, Clayey, Some Gravel	Bore Hole 2	3.50	13.4

NOTES: Testing Carried Out On Samples As Supplied

NATA
Accredited for compliance with ISO/IEC 17025
Accreditation No. 934

APPROVED SIGNATORY B.McFarlane 22-Mar-12

Soil moisture content tests - Determination of the moisture content of a soil - AS PER AS1289 .1.1,2.1.1, A.S.JAMES FORM No: LR014 (Fig 1) / REV 9 / 12/12/11	TESTED : S.Bailey REPORTED : B.McFarlane	FIGURE 1 of 1

A.S. JAMES PTY.LTD **Geotechnical Engineers** **Clayton Laboratory** **16 Libbett Av Clayton South**	**JOB:** "White House" St Kilian'S Church Mccrae Street Bendigo	**JOB No.**	114090
		REPORT No:	L001-1
		DATE:	22-Mar-12

FOR Osborne Consulting Group Pty Ltd,
133 Mccrae Street,
BENDIGO, VIC. 3550

Test	Lab Sample No.	Location	Depth (m)	Sample Description	Condition	Preparation
1	46589	Bore Hole 1	1.5	SILT, Sandy, Clayey	Oven Dried < 50 Deg	Dry Sieved
2						
3						
4						

Grading of Samples

Aperture Size mm		75.0	53.0	37.5	26.5	19.0	13.2	9.5	6.7	4.75	2.36	1.18	0.600	0.425	0.300	0.150	0.075
% passing Sample	No.																
% passing Sample	No.																
% passing Sample	No.																
% passing Sample	No.																

Plastic Index of Samples

Test	Lab Sample No	Liquid Limit	Plastic Limit	Linear Shrinkage	Shrinkage Behaviour	Plasticity Index
1	46589	24 %	13 %	5 %	Cracking	11 %
2						
3						
4						

NATA
Accredited for compliance with ISO/IEC 17025
Accreditation No. 934

Approved Signatory
B.Mcfarlane 22-Mar-12

Notes: Testing Carried Out On Samples As Supplied

REPORT OF TEST RESULTS ON SOILS - SIEVE ANALYSIS & PLASTIC LIMITS AS PER AS1289 .1.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1, A.S.JAMES FORM No: LR007A (Fig 1) / REV 11 / 12/12/11	Tested By :	V.Gauld	Figure
	Reported By :	D.Vuarchoz	1 of 1

WILLIAMS BOAG ARCHITECTURE

OSBORNE CONSULTING GROUP PTY LTD

This is .....
referred to in the Contract Agreement dated .....
Proprietor .....
Witness .....
Builder .....
Witness .....

INVESTIGATION OF MOVEMENT

"WHITE HOUSE"

ST KILIANS CHURCH, McCRAE STREET

BENDIGO

Report No: 114090/Rev2.

Date: 17 April, 2012

GEOTECHNICAL INVESTIGATION

By

A.S. JAMES PTY LIMITED
15 Libbett Avenue,
Clayton South Vic. 3169
Tel: 613 9547 4811
Fax: 613 9547 5393
E-mail: melb@asjames.com.au

A.S.JAMES PTY LTD
A.C.N. 004 584 534 A.B.N. 40 004 584 534
Geotechnical Engineers
SINCE 1963

15 Libbett Avenue
Clayton South Vic 3169
Tel: (613) 9547 4811
Fax: (613) 9547 5393
E-mail: melb@asjames.com.au

1. INTRODUCTION

1.01 **Investigation Requested By:** The geotechnical investigation was commissioned by Mr. Howard Osborne of Osborne Consulting Group Pty. Ltd..

1.02 **Purpose of Investigation:** Visible movement has occurred on the southern corner of the "White House" building at St Kilians Church, McCrae Street, Bendigo. Herein, it was required to determine the probable causes of movement, together with appropriate remedial action.

1.03 **Geology & Background:** The 1:250,000 Geological Survey of Victoria, Bendigo Sheet, indicates the subject site to be underlain by Ordovician siltstone, sandstone, shale and slate which make up part of the greater "Castlemaine Group". Weathering of the rock has typically resulted in shallow, surface residual silts underlain by firm to very stiff residual clays, which grade to variably weathered rock at depth. The residual clays are generally of low reactivity and the depth to rock is often highly variable over short distances. Significant variations in the weathering of the siltstone exist.

Reworked mining material consisting of silt, clay and gravels generally quartz, are common across the Bendigo district, in particular within the Golden Square region, and are therefore likely across the subject site.

The DPI Earth Resources GEOVIC online map indicates shaft localities close to the subject site. Several shafts exist in close proximity to the subject site. In particular, they comprise of Hustlers Royal Reserve Co. No.2 mines. These are not thought to be of any concern, in that they appear outside the subject site area and are likely to be below the depths investigated. There may, however, be unmapped shafts underlying the site.

1.04 **Laboratory Methods:** All soil samples were transferred to A. S. James Pty. Ltd.'s National Association of Testing Authorities (NATA) registered laboratory, where mechanical testing was undertaken. All laboratory testing was performed in strict accordance with the test methods outlined in Australian Standard A.S. 1289, "Method of Testing Soils for Engineering Purposes", as follows:-

	A S 1289 Test Method
• Moisture Content Testing	2.1.1
• Atterberg Limits	3.1.1, 3.2.1, 3.4.1

1.05 **Field Methods:** Boreholes were drilled using a Dingo Mounted Ezi Drill fitted with continuous flight tungsten tipped augers. In-situ vane shear strength testing was carried out in each borehole and soil profiles were logged in accordance with Australian Standard A.S. 1726 – 1993, "Geotechnical Site Investigations".

2. RESULTS

2.01 **Construction:** The actual date of construction of the "White House" structure is unknown; however, given St Kilians Church was constructed in the 1860's it is possible it was constructed in the late 1800's or early 1900's.

2.02 **Visual Inspection:** A detailed inspection has not been carried out; however, the main area of movement is noticeable in the brickwork on the southern end of the building.

2.03 **Borehole Drilling:** In order to determine the sub-surface soil conditions at the site, three (3) boreholes were drilled at the time of the site investigation at the approximate locations indicated on Figure 1 attached. The footings were also exposed in two (2) locations marked on figure 1 and the dimensions are given on Figures 5 & 6. This indicates that no footing of any substance exists.

The logs of the boreholes, together with results of in-situ vane shear strength tests conducted in each of the boreholes, are given on Figures 2, 3 and 4.

2.04 **Sub-Surface Soil Profile:** Borehole 1 consisted of a 0.4m surface layer of fill which was underlain by medium dense silt fill from 0.4-0.9m which was further underlain by a layer of silty sand which extended to the termination depth of 4.0m.

Borehole 2 consisted of a 0.3m surface layer of fill which was underlain by a layer of firm silty clay which extended to a depth of 4.3m this was further underlain by weathered siltstone, which extended to the termination depth of 5.0m.

Borehole 3 consisted of a 0.9m surface layer of fill which was underlain by a layer of medium dense silty sand which extended to a depth of 3.3m this sand became clayey and graded to a silty clay which was further underlain by weathered siltstone, which was encountered at a depth of 4.2m and extended to the termination depth of 5.0m.

The materials underlying the site are typical of the area, given the mining history of Bendigo and the vicinity to the nearby Bendigo Creek. In areas such as this it can be difficult to determine whether the sands and clays underlying the subject site are existing site materials that have been reworked in the past or naturally deposited alluvial materials.

Nevertheless, all excavations should be examined carefully and any unusual feature reported to us in order to determine whether any changes might be advisable.

2.05 **Ground Water:** At the time of the site investigation no permanent free ground water was encountered in the bores.

2.06 **Footing Probe:** The basic dimensions and conditions of the existing footing, which provides support to the wall of the main structure, was probed at two locations indicated on the site plan. Details of the footing are given on Figures 5 & 6.

2.07 **Laboratory Testing:** Upon receipt in the laboratory moisture content and atterberg limits testing were carried out on samples of silt & clay taken from each of the boreholes. The results of these tests are also enclosed.

3. DISCUSSION & RECOMMENDATIONS

3.01 **Cause of Foundation Movement:** On the basis of the geotechnical investigation work completed to date, together with our inspection, it is apparent that the cause of the movement may be a combination of factors:

1. The actual footing of the "White House" structure consists of a continuation of the brickwork which terminates at 0.45m & 0.26m below the existing surface level. At the base of the brickwork is a cemented combination of broken bricks, rubble and cement. This rough "blinding" footing is founded in clayey silt at a depth of 0.9m & 0.59m below the existing

surface level and has become weakened and easily broken. The clayey silt at the base of the footing in the vicinity of Footing Probe 2 was saturated and a further investigation into nearby sewer and stormwater pipes should be initiated.

2. The variation in underlying soil profiles underlying the structure may also be cause for inconsistent seasonal volume change of the soils over the length of the building.

   The underlying silty clay indicated in borehole 2 from a depth of 0.3m is more susceptible to volume change due to seasonal variations in moisture content than the clayey silt and silty sand encountered in borehole 1 & 3.

3.02 **Structural Stability:** It should be noted that if the movements are not controlled, ongoing, additional cracking of the brickwork will obviously occur; that is the movements will continue unless appropriate remedial action is taken.

3.03 **Foundation Inspection:** From the footing inspection and drilling performed it has been determined that it's likely the footings of the structure are founded on different underlying material types. Again it should be noted that the moisture condition of the materials under the footing encountered in footing probe 2 indicate that water infiltration is an issue and will require further investigation.

3.04 **Future Performance of the Structure:** In considering remedial measures, it must be appreciated from the outset that once a foundation arrangement has proven inadequate in relation to the conditions which prevail on a site, it is extremely difficult, if not impossible, to arrest all future movements. Any remedial measures are thus aimed at minimising future movements, such that they do not impair the performance of the structure and can be dealt with as part of routine maintenance.

3.05 **Underpinning of Footings:** It is our recommendation that consideration should be given to reconstruction and deepening of the rough cemented "blinding footings" which underpin the existing brick footing. It must be appreciated, however, that if underpinning of isolated problem areas only is undertaken, this in itself may lead to cracking of sections which are currently in relatively good repair, due to "propping" of the affected area.

This should, however, be minimal if the entire structure is underpinned.

It is recommended that the proposed underpins for the existing structure's footings should extend to stiff clay or dense silty sand at a minimum depth of 2.0m and such underpins should be designed using a maximum bearing pressure of 150 kPa. As an interim measure, however, it will be necessary to provide some structural strength to the brickwork and it is recommended that 'shallow underpinning' or reconstruction of a footing beam be firstly carried out. This could involve the removal of the existing rubble footing and replacement with a footing beam at 300 – 400mm depth, which could then be used to proceed with underpinning works.

Depending on the depth and damage to the sewer and stormwater, appropriate sequencing will also be a factor.

It is essential to prevent the ingress of moisture down to the base of the underpins by ensuring that the backfill to the front of the underpins comprises clean clay fill compacted in layers not greater than 150 millimetres when loose and to a dry density not less than 95% of the maximum dry density value determined by the Standard Compaction Test, in accordance with Australian Standard A.S. 1289 5.1.1 – 1993, using appropriate compactive equipment.

During compaction the clay fill material should have a moisture content within the range 85% - 115% of the optimum moisture content, as determined by the Standard Compaction Test in accordance with A.S. 1289 5.1.1. – 1993.

In order to prevent future cracking of the structure at the transition points, it is recommended that full height articulation be introduced into the brick work at all points where the underpinning is terminated.

It is thought that in the refurbishment works adequate detailing and partial demolition may articulate the structure to accommodate minor movements.

It is understood that consideration is being given to a two staged approach to underpin the structure. Firstly to replace the existing shallow, low strength footing and second to underpin the newly constructed footing to the recommended depth.

Removal of any saturated founding materials will be required regardless of the method adopted; this may necessitate deepening of the underpinning to in excess of 2.0m in moisture affected areas.

It is understood that considerable disturbance of the surrounding pavements and buildings will be required if the above recommendations are adopted.

In an attempt to stabilise and arrest further movement of the foundations, consideration could be given to injecting an expanding resin (Uretek or similar) into the underlying soils in areas where the worst movement of the foundation has been noted.

Regular monitoring of movement in these areas once this injection method of underpinning has been completed will be required to ensure no further movement of the footing or damage occurs to the structure.

It should be noted that given the nature of the underlying soils and the fragile condition of the existing footing, it may still be necessary to adopt the staged underpinning process recommended above.

Care should be taken to ensure grout does not infiltrate existing services.

3.06 **New Footings:** Any new footings should extend to the minimum depths outlined above.

3.07 **General:** Conditions may change with the seasons. In particular, following prolonged periods of rainfall the soils underlying the site at shallow depth may become saturated and unworkable.

We trust the above information is satisfactory; however, should any point remain in doubt, please do not hesitate to contact this office.

Under no circumstances should this report be reproduced, unless in full.

Yours faithfully,

D.C.GUNN OMIEAust
A.S. JAMES PTY LTD
W:\114090\114090-report Rev2 doc.doc

Reviewed by:
T.J. HOLT MIEAust CPEng EC-1022
A.S. JAMES PTY LTD

183 McCrae Street Bendigo

Geotechnical Investigation for Bree Architects

Report 19C 0989
December 2019

GTS
GEOTECHNICAL TESTING SERVICES

183 McCrae Street
Bendigo

Geotechnical Investigation
for
Bree Architects

Revision

Revision	Date	Authorised
19C 0989	03/12/2019	BAB

Distribution (this version only)

Recipient	Format	Date
GTS	On file	03/12/2019
Bree Architects	Email PDF joost@breearchitects.com	03/12/2019

1 INTRODUCTION

Bree Architects commissioned Geotechnical Testing Services (GTS) to conduct a geotechnical investigation for a proposed development at 183 McCrae Street, Bendigo.

The investigation has been conducted for the purpose of assessing general subsurface conditions at the site and consequently providing design parameters and a Site Classification in accordance with *AS2870 – 2011 Residential Slabs and Footings*.

2 INVESTIGATION

The investigation was conducted on the 25/11/2019 and the 29/11/2019 using a hand auger to drill 2 boreholes to a depth of 1m each, and a vehicle mounted drill-rig to drill one borehole to 4.5m within the designated area as marked out by the client. It is noted that there was not suitable access to the rear of the site with our drill rigs. The subsequent soil profiles are presented on page 4 and the location of the boreholes is presented on page 5.

At the time of this investigation, the type of development proposed was unknown.

3 SITE CONDITIONS

At the time of the investigation, the surface of the site was dry, with no grass cover or visual rock within the immediate surroundings. The site is currently occupied by an existing residential dwelling surrounded by at least four small trees less than 8m in height that may affect the subsurface conditions. The site has a north eastern exposure, falling back-to-front and right-to-left from the front of the property. There is was visual evidence of surface cracking or groundwater seepage encountered over the investigated depths.

Full details of the soil conditions are presented in the borehole logs.

4 SITE CLASSIFICATION

After allowing due consideration to the site geology, soil conditions, drainage, vegetation and known details of the proposed structure, the site has been classified as **Class P** (*AS2870 – 2011*) due to the depth of uncontrolled fil l in excess of 0.4 metres, and the presence of trees and existing dwelling that may cause abnormal moisture conditions

across the site. The reactivity of the material at the site would typically lead to a **Class M-D** classification.

5 DISCUSSION

Particular attention should be paid to the design of footings as required by *AS2870 – 2011*.

In addition to the normal founding requirements arising from the above classification, particular conditions at the site dictate that the founding medium and minimum depth below existing surface levels for all footings should be as follows:

- Siltstone, extremely weathered, off-white, moderately hard.
  At depths below 3.6 metres

It is noted that suitable founding conditions weren't encountered at the rear of the site, however, based on past investigations in the region, it is expected that Siltstone will be encountered at depths of between 3 and 4 metre.

An allowable bearing pressure of 300kPa is available for edge beams, strips and stump footings founded as above. All foundations should extend a minimum of 100mm into the above foundation material. Blinding concrete (minimum strength15MPa) may be used to bring the excavations up to design levels.

Due to the founding depth, along with the wet, low strength material which has potential to collapse on excavation, it is the recommendation of GTS that screw piers be used. Screw piers should be driven to refusal on the weathered Siltstone rock and proportioned for an allowable end bearing pressure of 500kPa. If bored piers are preferred, then they may be socketed at least 0.5 metres into the weathered Siltstone rock and designed for an allowable end bearing pressure of 700kPa. It is noted that shoring or casing is likely to be required for the bored pier excavations.

6 IMPORTANT NOTES ABOUT THIS REPORT

- The site classification presented in Section 4 assumes that the current natural drainage and infiltration conditions at the site will not be markedly affected by the proposed site development work. Care should therefore be taken to ensure that surface water is not permitted to collect adjacent to the structure and that significant changes to seasonal soil moisture equilibria do not develop as a result of service trench construction or tree root action.

- This is not a comprehensive investigation nor is it economic or practical to determine every subsurface feature on the site. Although this investigation indicates that soil conditions are relatively uniform across the site, it is recommended that the base of all footing excavations be inspected to ensure that the founding medium meets that requirements referenced herein with respect to type and strength of founding materials. If further variations in descriptions in soil types, colour or depths are discovered during construction, this office should be notified immediately so that potential influence on the footings may be assessed.

- The soil colours provided in the borehole logs attached may vary with soil moisture content and individual interpretation, therefore colour alone should not be used to identify these soils.

- Strength characteristics of soils often exhibit a large variation between wet and dry conditions. Soil characteristics of a soil profile are given on the soil conditions at the time of the investigation.

- In the event of significant earthworks being undertaken on the site after this investigation, this report may require an amendment if appropriate.

- If uncontrolled FILL is found during this investigation, it is an indication of what was found during the investigation and it may vary over the site. It may be in the best interest of the buyer / seller to undertake a more detailed investigation, in this instance.

Should you have any further queries concerning these results, please do not hesitate to contact GTS on 03 5441 4881.

Shane Hampton (BE(Hons))
Principal Geotechnical Engineer

BOREHOLE LOGS

Client:	Bree Architects	Borehole log no:	1-3
		Report number:	19C 0989
		Date drilled:	25-29/11/19
Project:	183 McCrae Street Bendigo	Logged by:	RC,BT,MM
		Drilling method:	AS+HA

Profile (mm):	* Structure: (see key)	Material Description:	Moisture Description:	Cohesion Density:	Plasticity:	Testing / Sampling:
0 to 1000	FILL	**HA1 (25/11/2019)** Gravelly Sandy CLAY low plasticity, brown, fine to coarse sand, fine to coarse gravel, traces of brick and slate.	D	Very Stiff	Low	
0 to 1000	FILL	**HA2 (25/11/2019)** Gravelly Sandy CLAY low plasticity, brown, fine to coarse sand, fine to coarse gravel, traces of brick and slate.	D	Very Stiff	Low	
0 to 400	FILL	**BH1 (29/11/2019)** Clayey Sandy SILT dark brown, fine to coarse sand.	Dry	Medium dense	Low	
to 2000	Worked Alluvial	Sandy CLAY dark brown, brown, orange/brown.	Moist	Stiff	Low	
to 2800	Worked Alluvial	Clayey SAND brown	Wet	Very Loose	Low	
to 3600	Worked Alluvial	Clayey GRAVEL brown	Moist	Very stiff	Low	
to 4500	Rock	SILTSTONE extremely weathered, off-white	Dry	Moderately hard	-	

Key

Drilling Method	Moisture Condition	Cohesion	Density	Testing/Sampling
AS – auger screwing	D – dry	VS – very soft	VL – vey loose	PP – pocket penetrometer
HA – hand auger	M – moist	S – soft	L – loose	V – hand vane sheer
	W – wet	F – firm	MD – medium dense	DCP – dynamic cone penetrometer
		St – stiff	D – dense	SPT – standard penetration test
		VSt – very stiff	VD – very dense	US – undisturbed sampling
		H – hard		DS – disturbed sampling
		VH – very hard		* see notes on bore location page

GTS
GEOTECHNICAL TESTING SERVICES

GEOTECHNICAL INVESTIGATION

APPROXIMATE LOCATIONS: NOT TO SCALE

CLIENT: BREE ARCHITECTS

PROJECT: 183 McCRAE STREET, BENDIGO, VIC

GTS REF: 19C 0989

DATE: 3 December 2019