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EMALAHLENI

DURBAN

Our ref: P 2433-02-01 **Forensic Engineering Assessment Report 02**

NATIONAL HOME BUILDERS NHBRC REGISTRATION COUNCIL

FORENSIC ENGINEERING ASSESSMENT REPORT

for

HOUSE MOCHOARI
ERF 40416, WILD OLIVE
BLOEMFONTEIN

PREPARED BY:

SCIP ENGINEERING GROUP

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THIRD ISSUE

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ISO COMPLIANCE

REVISION NUMBER	REVISION DATE	CHANGE MANAGEMENT	AUTHOR	CHECKED BY
00	November 2025	Report created	S.Sumer (BSc Civil)	B Grobler (Pr.Eng)
01	November 2025	6.1.2, 6.1.3, Table 2 Annexure B2	S.Sumer (BSc Civil)	B Grobler (Pr.Eng)
02	December 2025	Table 2	S.Sumer (BSc Civil)	B Grobler (Pr.Eng)
		Signed:		
		Date:	08 December 2025	08 December 2025

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

SCIP Engineering Group (Pty) Ltd was appointed by the National Home Builders Registration Council (NHBRC) to conduct a forensic engineering assessment for House Mochoari in Wild Olive Estate, Bloemfontein. Concerns were raised with regards to water ingress during rain events causing damp build up in the walls.

The purpose of this report is to outline the concerns raised, address the cause of structural distress, and make recommendations on the way forward.

2 SCOPE OF WORK: FORENSIC ENGINEERING ASSESSMENT

The scope of the forensic assessment as set out by the NHBRC brief includes:

- Establish the condition of the housing unit.
- Evaluate the structural integrity of the housing unit based on a standardised high level visual inspection and evaluate compliance to norms and regulations.
- Indicate problematic areas and defects.
- Propose remedial measures.

3 SITE LOCATION

The site is located at Wild Olive Estate, ERF 40416, Kamoa crescent, Bloemfontein. The site has approximate coordinates as follows:

Latitude:	29° 04' 05.5" S
Longitude:	26° 13' 16.1" E

The site is shown in Figure 1.

Figure 1:Google Earth Image of the Site

4 PROJECT BACKGROUND

Concerns were raised with regards to water ingress during rain events causing damp build up in the walls.

The house is a double storey loadbearing masonry building with timber roof trusses and a concrete roof slab above the kitchen, lounge and dining area. The house has a valley gutter system in place for the timber roofs. During a rainfall event water discharges onto the concrete roof slab and is intended to be diverted to multiple drainage points.

A structural inspection was conducted on 14 October 2025 to identify the cause of the water ingress. A photographic survey was carried out, and the findings of the investigation are discussed in succeeding paragraphs.

No architectural drawings were available for investigation.

5 TERMINOLOGY

The following terminology applies to this report.

Crazing on plaster can be identified as fine cracks in a hexagonal shape. This is caused by plaster shrinkage, which is explained below. Crazing cracks are non-structural cracks.

Plaster shrinkage occurs due to a loss of water due to evaporation at the surface when plaster is drying.

An **upstand beam** typically refers to a concrete beam integrated within a slab. An upstand beam is deeper than the slab with the soffit of the beam and the bottom of the slab lining up such that the top of the beam protrudes above the slab.

Delamination of plaster refers to the loss of bond between plaster and concrete or masonry causing pieces of plaster to fall off or crack.

Penetrating damp refers to moisture entering brickwork through exterior plaster cracks, through roof tiles or through incorrectly waterproofed surfaces.

6 SITE INVESTIGATION RESULTS AND DISCUSSION

The findings from the visual inspection are presented below. The possible causes will be discussed and remedial work presented in Table 2.

Where access was not possible without dismantlement or demolition, assumptions were made to assist with the structural evaluation.

Figure 2 below shows a plan view of House Mochoari, indicating the location of the concrete roof slab and balcony 1 which is referred to in the sections below.

Figure 3 shows a schematic view of the roof slab, indicating all beams and walls referenced in the sections below.

Figure 2: Google Earth View of House Mochoari

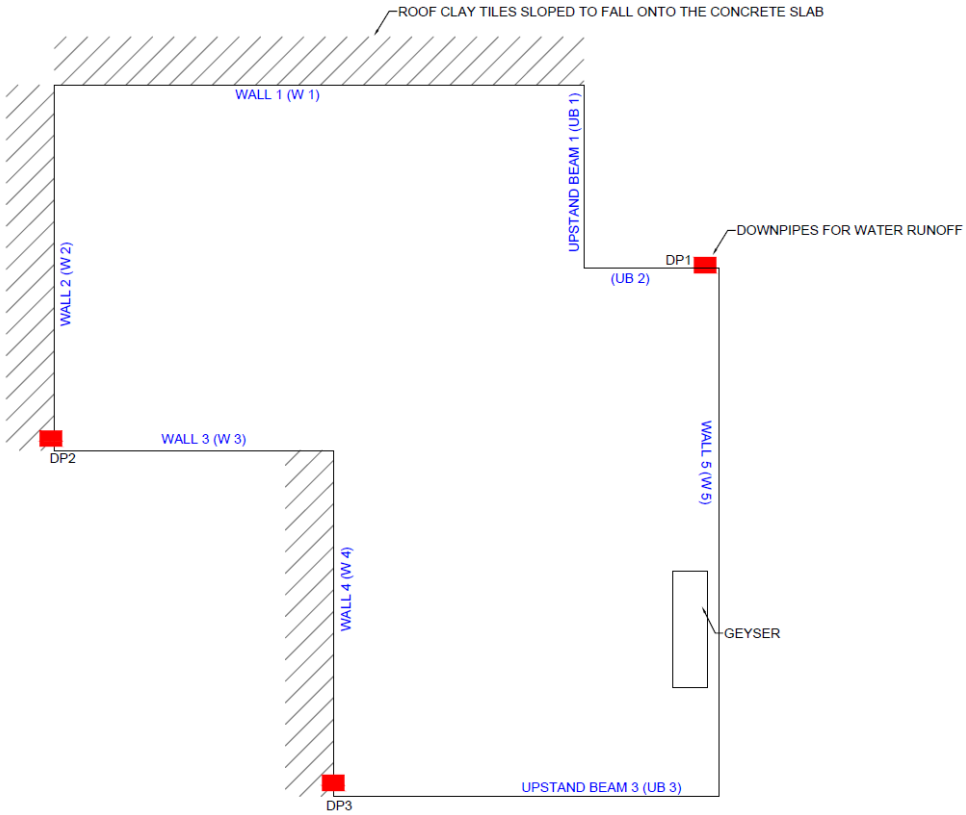


Figure 3: Schematic of Roof Slab

All the defects noted are discussed in succeeding sections:

6.1 EXTERIOR SURFACES

6.1.1 External cracks

Hairline cracks can be observed on all exterior plastered surfaces and are consistent with crazing cracks. Shrinkage is attributed to the mixing ratios of plaster or the quality sand used during construction.

The hairline cracks allow water seepage into the masonry resulting in excessive cracking on exterior walls and damp accumulation on the interior walls as seen below in Figure 4.

Figure 4: Exterior Plaster Cracks

6.1.2 Bedroom Wall Water Ingress

The bedroom wall in Figure 5 below show signs of water ingress. Upon inspection of the exterior wall, excessive hairline cracks are observed on the exterior plaster surface that are consistent with crazing cracks.

FIGURE 5: PLASTER CRACKS ON BEDROOM WALL

6.1.3 Slab-Brickwork Joint and Plaster Line

Aesthetic plaster lines (also known as plaster movement joints) are located near the roof slab as shown in Figure 6 below. Aesthetic plaster lines are found between the interface of the concrete slab and supporting masonry. It is common practice to install such joints where movement is expected between different building materials in order to eliminate random cracking during thermal expansion. The second line below is decorative.

Development of hairline cracks along these lines are expected due to thermal expansion and water ingress between the plaster and brickwork is the result. Good practice is to seal these joints on external surfaces to prevent penetrating damp.

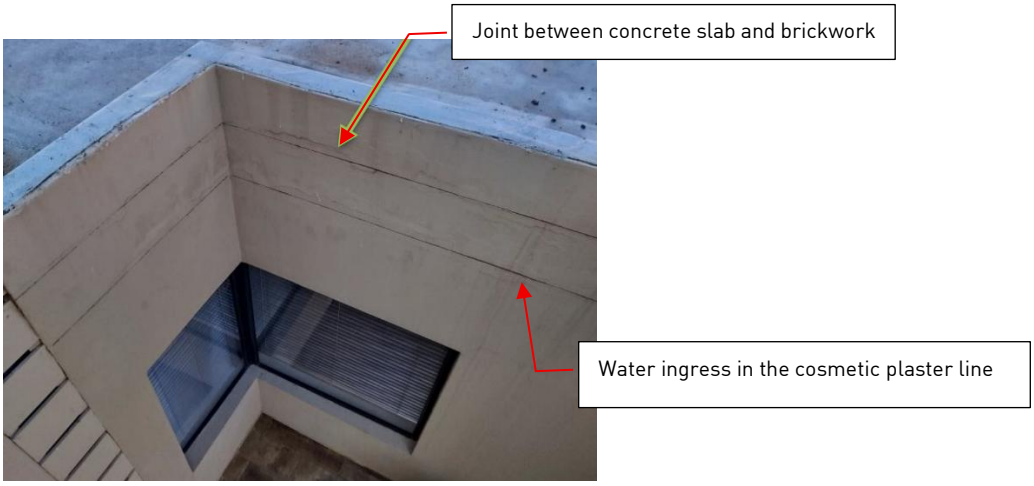


FIGURE 6: AESTETIC PLASTER LINES AND DECORATIVE LINES

6.1.4 Exposed Plumbing Pipes

Water pipes from the first floor are chased too shallow into the wall as shown in the figure below. Insufficient coverage to the pipes creates a weak spot in the plaster attracting cracks and delamination shortly after construction. Water penetrates through the crack and causes damp build up in the walls.

Figure 7: Water Pipes Inadequately Installed

6.1.5 Balcony Slopes

Balcony 1 is located above the side entrance. The balcony was constructed without a weather step at the sliding door which allows free movement of water into the room. This is a construction error and not good practice.

The only way to manage the water flow on the balconies without reconstruction is re-screeding the balcony with a steep slope to ensure water run-off or add an upstand beam at the door which could be a tripping hazard.

Figure 8: Balcony 1 with Insufficient Slope

6.1.6 Altered Window Sizes

We were informed that during the construction of the house there was a shortage of aluminium frames in the size specified by the Architect. The openings in a wall had to be bricked up to accommodate smaller sized windows. Hairline cracks have formed along the line of closure. The development of cracks along the edges is normal considering that the bond between the old and new bricks may be insufficient. Horizontal cracking is bound to occur between the new and old bricks due to different settling and expansion rates since the two sections were not constructed at the same time. Good practice would have been to install galvanized mesh on the joint to limit the appearance of plaster cracks. This is not a structural concern, although if not maintained, it will cause a serviceability failure.

Figure 9: Window Size Change

6.1.7 Window Frame and Plaster Bond

Figure 8 shows a separation between the window frame and the plaster. The plaster and aluminium window frame have different coefficient of expansions resulting in the separation observed. This is a point of water ingress causing major damp to build up in the masonry.

Figure 10: Aluminium Window and Plaster Separation

6.2 INTERIOR SURFACES

6.2.1 Internal Penetrating Damp

Water ingress occurs through crazing cracks on the external walls and from the roof slab. To prevent damp build up in the wall, the external defects need to be addressed.

Figure 11: Interior Plaster Damp and Calcium Build Up Due to Water Ingress

6.2.2 Leaking Window at Stairway

The homeowner noted water ingress through the large window above the stair landing during rain events. The aluminium window in figure 10 below is to be inspected by an aluminium specialist. Windows to be checked for water tightness and sealed if required.

Figure 12: Leaking Aluminium Windows

6.3 CONCRETE ROOF SLAB

Annexure A of this report contains a schematic of the roof slab with abbreviations used below.

6.3.1 Grooves on concrete slab

A concrete roof slab is situated above the dining area, lounge and kitchen area. The slab has been constructed with protruding groves on the surface which extend the full length of the slab. The grooves prevent smooth water flow to the discharge points and result in water pooling behind the groove as shown in the figure below. No signs of water ingress or stained ceilings were noted below the slab during the inspection. The slab parapet walls were inspected; however, the depth could not be measured due to accessibility. A design evaluation is required to determine the minimum depth required to prevent overtopping. The design evaluation in section 7 below indicates the minimum values that need to be present to avoid water overtopping. The roof clay tiles are to be removed, and the parapet wall height measured against the minimum values calculated.

Figure 13: Concrete Slab Surface

6.3.2 Incorrect slope into drainage points

It was observed that the sloped screed at the entrance of the discharge point 1 (DP1) directs water runoff inefficiently. The slope directs water to the side of DP1 instead of the invert of the pipe which results in water pooling around DP1 as shown in figure 12 below. It should be noted that any debris on the slab aggravates the inefficiency of diverting water to the outlets. The incorrectly sloped surface of the slab contributes to insufficient drainage, as pooling water builds up behind the grooves until it overtops the current heights

The incorrectly sloped screed also applies to DP2 and DP3 as shown in figures 13 to 15 respectively.

The design size of the discharge pipe is evaluated in section 7.

Figure 14: Incorrect Slope at DP 1

Figure 15: Incorrectly Sloped Screed at DP 2

Figure 16: Incorrect Sloped Screed at DP 3

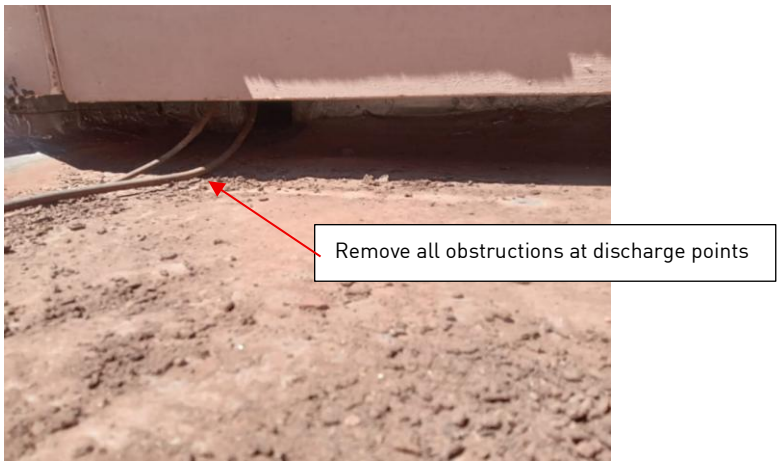


Figure 17: Debris Due to Pooling Water at DP 3

6.3.3 Height of wall above slab

Upon inspection of W1, W2 and W4 it was noted that there is a parapet on the slab. Due to the inaccessibility of the parapet the depth of W1 could not be accurately measured but is visually estimated to be 40mm as shown in figure 16 below. The presence of waterproofing has been confirmed on the parapet. The quality of the waterproofing cannot be evaluated due to access constraints, and we recommend that a contractor open a

small area to confirm that the water proofing is not damaged. W2 and W4 could not be visually assessed as shown in figure 17 below.

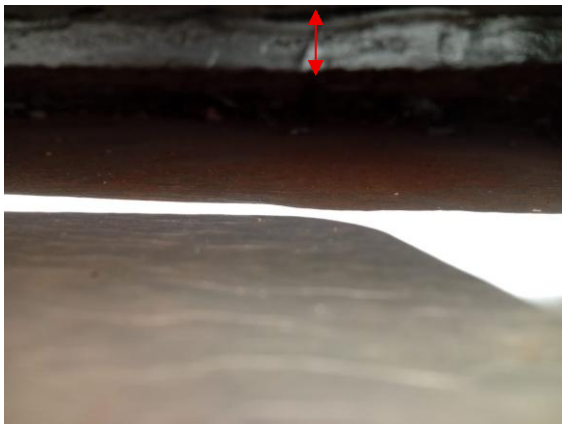


Figure 18:W1 Parapet Inspection

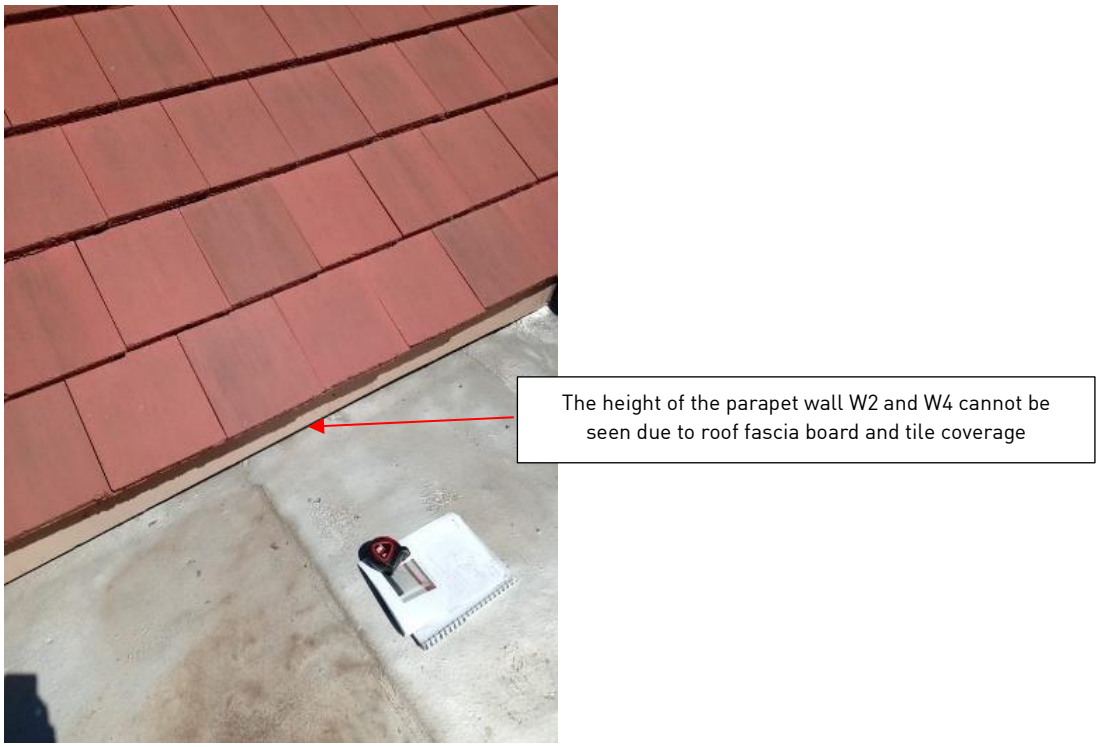


Figure 19:Inspection of Parapet Height Under Roof

The height of UB 3 is inconsistent along the length of the beam as shown in the figure below. The height of upstand ranges from 30mm to 100mm. These depths will be evaluated in section 7 below to confirm their adequacy in preventing overtopping of the slab.

Figure 20:UB 3 Depth

7 DESIGN EVALUATION AND PARAMETERS

In order to ensure effectiveness of the roof slab as a drainage system, a water runoff analysis was performed using PROKON. The concrete slab is divided into three catchment areas which divert water to the individual downpipes.

From the results of the water analysis the downpipe size for DP1, DP2 and DP3 is sufficient. Figure 19 below shows the analysis model. The minimum height required of the parapet walls and upstand beams are shown in Table 1 below:

Table 1:Analysis Results Minimum Values

Designation	Minimum Height (mm)
Wall 1 (W1)	65
Wall 2 (W2)	65
Wall 4 (W4)	65
Upstand 1 (UB1)	65
Upstand 2 (UB2)	65
Upstand 3 (UB3)	100

From the visual inspection of the height of the parapet, it is rational to conclude that the depth of W1 is inadequate and contributes to the water ingress into the walls.

Once the facia boards and clay tiles have been removed on site, the results in Table 1 can be compared to the actual measurements taken for W2 and W4 to confirm our findings. Insufficient parapet heights should be increased to accommodate the design rainfall without over topping.
UB 1 and UB 2 are found to have sufficient depth.

UB 3 has a varying depth. The minimum depth required is 100mm therefore, the lower sections should be increased to prevent overtopping.

Figure 21: Existing Slab Simulation Model

8 RECOMMENDATION

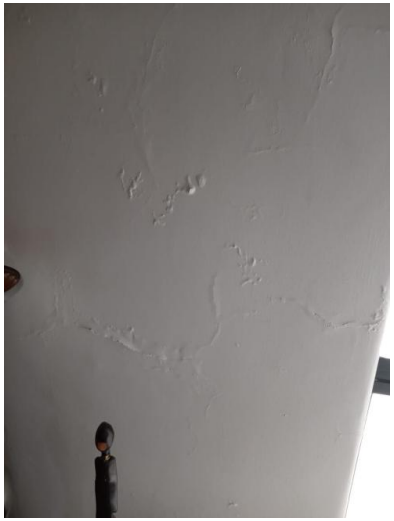
The following table reflects the defects encountered along with the recommendations to repair the damages.

Table 2:Summary of Defects and Recommendations

ITEM	REFERENCE PHOTO	DEFECT ENCOUNTERED	EFFECT ON STRUCTURE	RECOMMENDATIONS ON REMEDIAL WORK
1		Exterior wall cracks	**Serviceability Defect**	The plaster strength will need to be confirmed prior to a recommendation on a suitable product to bond the cracks. The product will depend on the current strength of the plaster
2		Exterior wall cracks	**Serviceability Defect**	The plaster strength will need to be confirmed prior to a recommendation on a suitable product to bond the cracks. The product will depend on the current strength of the plaster

3		Water ingress and cracking	Does not conform to the serviceability limit state requirements of the building regulations- **Serviceability Defect** A cause for water ingress into the building	All plaster with cracks at the movement joint to be removed. The decorative line to have all plaster with cracks removed. Replaster the above surfaces in accordance with Method Statement 2 in Annexure B
4		Incorrect placement depth of water pipes	Delamination of exterior plaster. **Serviceability Defect**	A certified plumber is to remove the water pipes and re-chase the pipe to an adequate depth Replaster in accordance with Method Statement 1 in Annexure B
5		Incorrect sloped surface	Does not conform to the serviceability limit state requirements of the building regulations **Serviceability Defect**	Tiles to be removed. Re-screed the surface in order to allow for a 2% slope away from the door. Waterproofing to be installed by a waterproofing specialist.

			A cause for water ingress into the building	Screed depth to be confirmed with Engineer Prior to construction
6		Cracks on plaster	**Serviceability Defect**	The plaster strength will need to be confirmed prior to a recommendation on a suitable product to bond the cracks. The product will depend on the current strength of the plaster

7		Separation of aluminium window and plaster	Does not conform to the serviceability limit state requirements of the building regulations – **Serviceability Defect** A cause for water ingress into the building	The gap to be filled with a polyurethane sealant approved by the engineer.
8		Water ingress into interior walls	Calcium build-up on the interior wall. **Serviceability Defect**	Exterior cracks to be remedied prior to remedial work. The extent of the damage to the plaster will need to be evaluated: (i) A plaster surface that has delaminated, will require re-plastering. (ii) A plaster surface that no signs of delamination as shown in the figure to the left. The surface should be smoothened by sanding, damp proof sealant applied and paint to match existing

9		Grooves on screeded surface of concrete slab.	Does not conform to the serviceability limit state requirements of the building regulations – **Serviceability Defect** A cause for water ingress Into the building due to Uneven runoff flow	Waterproofing and screed on concrete slab to be removed. New screed to slope as per engineering drawing in Annexure A. Waterproofing done by a specialist.
10		Entrance slopes into downpipes inefficient	**Serviceability Defect**	Waterproofing and screed on concrete slab to be removed. New screed to slope as per Annexure A. Waterproofing done by a specialist.

11		Upstand beam depth not sufficient	Water flows over the upstand. **Serviceability Defect**	Increase depth of upstand to 100mm throughout the length. Waterproofing to be redone by specialist.
12		Wall height above slab not sufficient	Water flows over the wall And into the home. **Serviceability Defect**	Increase parapet heights as per Table 1. Waterproofing to be redone by specialist.

9 CONCLUSION

SCIP Engineering Group (Pty) Ltd was appointed by NHBRC to conduct a forensic engineering assessment for House Mochoari in Bloemfontein. Concerns were raised due to water ingress into the walls in the house.

Crazing cracks on the exterior plaster allow water to enter the masonry causing penetrating damp and calcium build up.

An analysis was done to evaluate the performance of the concrete slab as a drainage system. The downpipes, parapet wall height and upstand beam height were evaluated against the minimum values required.

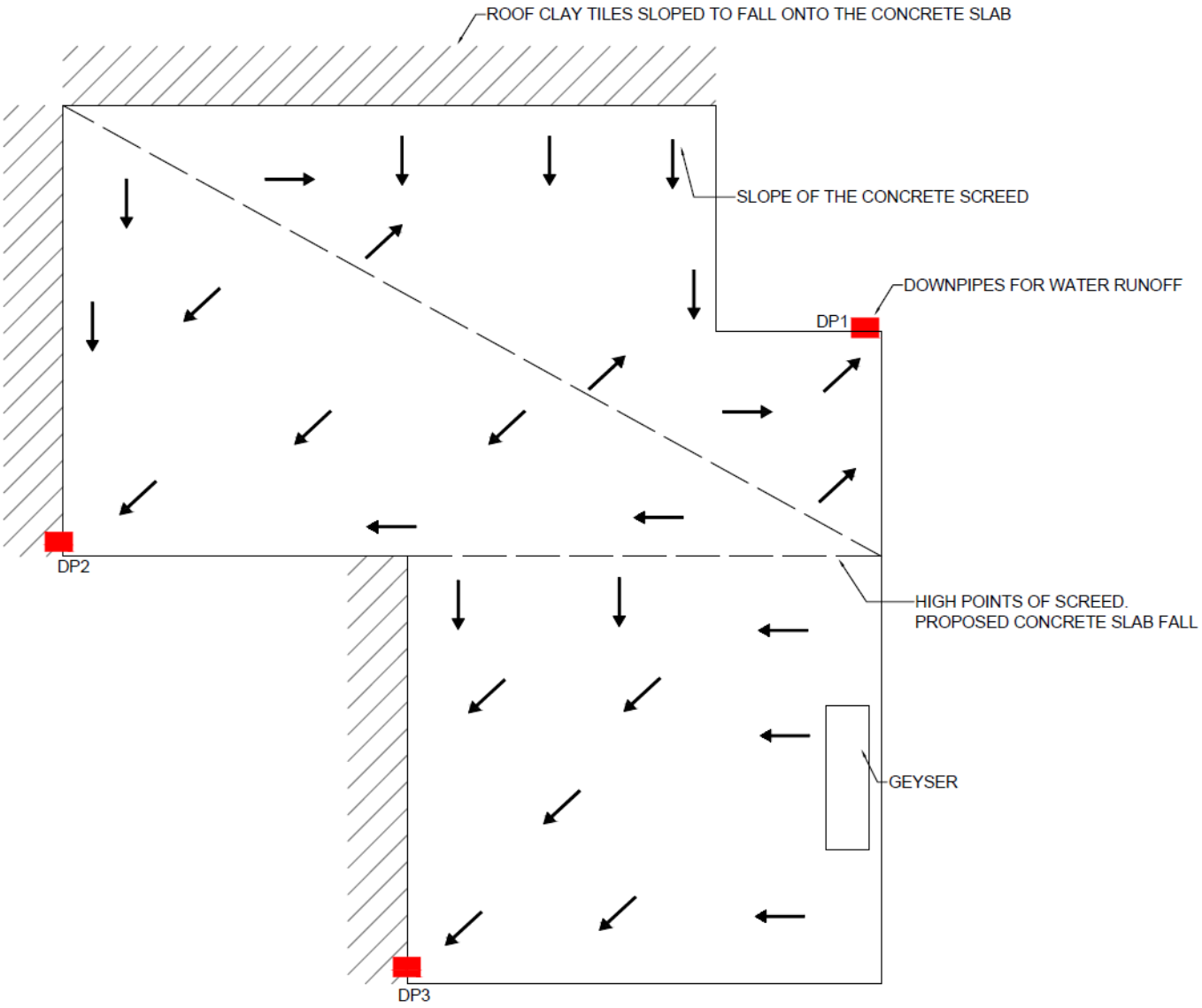
The results indicate that water ingress into the house is caused mainly by the lack of parapet depth to prevent overtopping. The diameter of the downpipes is sufficient. The incorrectly sloped surface of the slab contributes to insufficient drainage, as pooling water builds up until it overtops the current heights.

10 REFERENCES

NHBRC, N. H. (2015). *House Building Manual 2015.* Johannesburg: NHBRC Communications.

SABS. (2011). SANS 10400 -South African National Standard. *The application of the National Building Regulations*.

ANNEXURE A
- SLAB ANALYSIS – PROPOSED SLOPES


ROOF CLAY TILES SLOPED TO FALL ONTO THE CONCRETE SLAB
SLOPE OF THE CONCRETE SCREED
DOWNPIPES FOR WATER RUNOFF
DP1
DP2
HIGH POINTS OF SCREED.
PROPOSED CONCRETE SLAB FALL
GEYSER
DP3

ANNEXURE B
- METHOD STATEMENTS

METHOD STATEMENT B1: REPLASTERING WATER DAMAGED AREAS

To:	HOUSE MOCHOARI	**Date:**	2025-11-28
Attention:	NHBRC	**Site Instruction Number:**	N/A
Ref. Spec.:		**Ref. Drawing:**	N/A

This method statement applies to replastering of walls.

1. Remove plaster that has delaminated or shows signs of penetrating damp and crazing.
2. Allow to dry for at least 3 days if calcium build up is present.
3. Cover the exposed masonry with galvanised wire mesh.
4. Replaster with plaster key and make good the surrounding area.

Issued By:	Suvaksh Sumer
Authorised By:	Bianca Grobler, Pr.Eng (Civil)

METHOD STATEMENT B2: REPLASTERING JOINT AND COSMETIC LINE

To:	**HOUSE MOCHOARI**	**Date:**	**2025-11-28**
Attention:	**NHBRC**	**Site Instruction Number:**	**N/A**
Ref. Spec.:		**Ref. Drawing:**	**N/A**

This method statement applies to replastering over a movement joint and decorative line.

1. Remove plaster that has cracks
2. Replaster with plaster key additive including the plaster line/ joint and make good the surrounding area.
3. Paint on a waterproofing membrane
4. Repaint the plaster to match exterior paint
5. Apply a polyurethane sealant along the plaster line

Issued By:	**Suvaksh Sumer**
Authorised By:	**Bianca Grobler, Pr.Eng (Civil)**