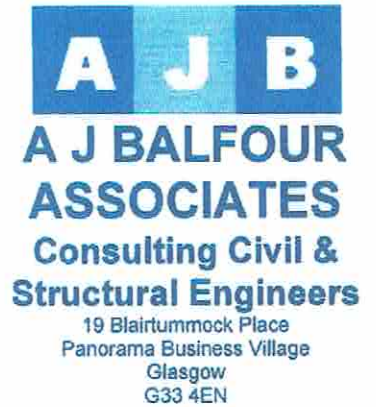


Our ref: 1824/DFW
Your ref:
Contact: A J Balfour Associates
Date: 8th November 2018



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For the Attention of Daniella Sprott

Final Report

Dear Madam

TORYGLEN CHIMNEY INSPECTIONS SURVEY AND REPORT ON CONDITION AND REMEDIAL MEASURES REQUIRED

I refer to the above and to our initial inspection on Wednesday 5th September 2018, when we were initially asked to survey a chimney cope on a 4-storey block of flats at 23 Ardnahoe Avenue, where lumps of concrete fell from the chimney. Further to this initial survey we were then asked to survey all remaining chimneys to 4 storey blocks where EWI works had been completed some 2 years ago. We were advised that similar defects noted at 23 Ardnahoe Avenue were likely to have affected a "small" number of other chimneys, none the less, it was intended to survey all Chimney stacks.

Full survey works were carried out during week commencing 10th September 2018. This report will identify the survey findings and advise on any potential remedial measures required.

Description of Survey Works and Methodology

Survey works were carried out by a representative of A J Balfour Associates who is experienced in the "hammer testing" of concrete.

In order to confirm the stability and suitability of the concrete cope details, "close-up" inspections via use of a hydraulic mobile access platform (commonly known as a cherry picker) were carried out. A scaling hammer (520g) was repeatedly dropped on and tapped against the concrete cope in order to "sound out" any "hollow or bossed" sections of concrete. Where concrete elements which were hammer tested were determined to be loose or dangerous, these were removed as safely as possible via the hydraulic mobile access platform. As such, all concrete elements which were encountered and determined to represent a safety hazard were removed at the time of the survey. Access was attempted to all sides of the chimneys.

All visible cracking was noted to the copes. Perimeter cracking was paid particular attention, since this is likely to be evidence of a "similar type" defective detail as was found at 23/25 Ardnahoe Avenue.

A full photographic record was taken, and this together with the survey notes collated formed the basis of this report.

Survey (Non-Access)

The survey was completed during the week commencing 10th September 2018. Access was gained, where possible, to all chimneys via a hydraulic mobile access platform operated from street level. However, given the restrictive nature of these surveys a chimney was not able to be accessed. This was:

- 29 Ardnahoe Avenue (1No.) – right chimney, no access. However, based on the findings at neighbouring properties, it has been assumed that remedial works will be required. Therefore, reference to 29 Ardnahoe Avenue will be contained within the remedial works section of this report moving forward. Early access to assess condition is recommended.

Survey (Partial Access)

1 No. Chimney, a restricted visual survey was carried out from a distance i.e. no hammer testing could be completed. This is summarised as follows:

- 4 Ardnahoe Avenue (1No.), no close-up inspection, 1 shrinkage crack from where machine could go to. Photos do not appear to show perimeter cracking, again however no hammer test carried out.

In order to complete a full report, the housing association to action access to this address via scaffolding due to the restrictive nature of hydraulic mobile access platforms. This would allow a full complete hammer test survey to be carried out to confirm the initial thoughts that these copes are in reasonable condition.

Survey Results and Findings

Surveys were attempted/undertaken to the clients 50No chimneys via a hydraulic mobile access platform. The results of these findings were as follows:

- 43 Kerrycroy Avenue (Left Chimney) – Perimeter hairline cracking noted on front right-hand corner of cope. Hairline cracking also noted on left hand edge of cope, continuing along rear edge with cracking increasing to around 1mm in thickness. Concrete tested for "looseness". Client to action expediting access for safe removal of concrete and remedial measures to reinstate overhang and drip check.
- 43 Kerrycroy Avenue (Right Chimney) – Perimeter hairline cracking noted on front edge of cope. Hairline cracks are also noted running from front edge to 3 of the 4 chimney pots. Hairline cracking also noted on left hand edge of cope, continuing along rear edge. Concrete tested for "looseness". Client to action expediting access for safe removal of concrete and remedial measures to reinstate overhang and drip check.
- 45 Kerrycroy Avenue (Left Chimney) – Previous pointing works to front and rear edge noted. Hairline cracking noted on front side continuing from front edge towards a chimney pot, then changing direction 90 degrees to adjacent chimney pot. Chimney appears stable. Client to action close up access to assess condition of cracking on front perimeter section.
- 45 Kerrycroy Avenue (Right Chimney) – Hydraulic mobile access platform unable to get close for a hammer test survey. Possible hairline cracking noted on front edge of perimeter cope. Hairline crack also noted from front edge to right hand side chimney pot. Client to action close up access to assess condition of cracking on front perimeter section.
- 47 Kerrycroy Avenue (Left Chimney) – Hairline perimeter crack noted on front left-hand side edge, continuing onto left hand edge of cope. 0.5mm shrinkage cracking noted from 2 no. chimney pots running to edge of cope. Client to action expediting access for safe removal of concrete and remedial measures to reinstate overhang and drip check.
- 47 Kerrycroy Avenue (Right Chimney) – Hairline perimeter cracking noted to right hand edge of cope. Further perimeter cracking noted to a section approximately 800mm long on front edge. Remaining cracking between chimney pot and edge of cope considered shrinkage. Client to action expediting access for safe removal of concrete and remedial measures to reinstate overhang and drip check.
- 51 Kerrycroy Avenue (Left Chimney) – The left hand/rear corner of the cope has a hairline perimeter crack. A further hairline shrinkage crack is noted from 1 no. chimney pot to the edge of the cope. Client to action safe removal of concrete and remedial measures to reinstate overhang and drip check.

- 51 Kerrycroy Avenue (Right Chimney) – Hairline perimeter cracking noted to right hand edge of cope. Further perimeter cracking noted to a section approximately 800mm long on front edge. Remaining cracking between chimney pot and edge of cope considered shrinkage. Client to action safe removal of concrete and remedial measures to reinstate overhang and drip check.
- 53 Kerrycroy Avenue (Left Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to front and rear edge.
- 53 Kerrycroy Avenue (Right Chimney) – 3 No. shrinkage cracking noted from 3 no. chimney pots to front, right and left edge.
- 55 Kerrycroy Avenue (Left Chimney) – Cracking noted mainly shrinkage cracking from base of chimney pots to edge of cope. Cracks noted at 4 separate locations. Thistle Housing Association carried out retrospective survey, see Ad-Hoc survey notes below.
- 55 Kerrycroy Avenue (Right Chimney) – Cracking noted mainly shrinkage cracking from base of chimney pots to edge of cope. Cracks noted at 3 separate locations.
- 2 Kerrycroy Street (Left Chimney) – No cracking noted.
- 2 Kerrycroy Street (Right Chimney) – No cracking noted based on distant visual survey. Thistle Housing Association carried out retrospective survey, see Ad-Hoc survey notes below.
- 4 Kerrycroy Street (Left Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to front edge.
- 4 Kerrycroy Street (Right Chimney) – 1 No. shrinkage cracking noted from 1 no. chimney pot to front edge.
- 6 Kerrycroy Street (Left Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to front edge.
- 6 Kerrycroy Street (Right Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to front edge.
- 8 Kerrycroy Street (Left Chimney) – 1 No. shrinkage cracking noted from 1 no. chimney pot to front edge.
- 8 Kerrycroy Street (Right Chimney) – No cracking noted.
- 10 Kerrycroy Street (Left Chimney) – 1 No. shrinkage cracking noted from 1 no. chimney pot to front edge. Thistle Housing Association carried out retrospective survey, see Ad-Hoc survey notes below.
- 10 Kerrycroy Street (Right Chimney) – 1 No. shrinkage cracking noted from 1 no. chimney pot to front edge. Thistle Housing Association carried out retrospective survey, see Ad-Hoc survey notes below.
- 48 Kerrycroy Avenue (Left Chimney) – 3 No. shrinkage cracking noted from 3 no. chimney pots to left and right edge.
- 48/50 Kerrycroy Avenue (Central Chimney) – No cracking noted.
- 50/52 Kerrycroy Avenue (Central Chimney) – No cracking noted.
- 52 Kerrycroy Avenue (Right Chimney) – No cracking noted.
- 4 Ardnahoe Avenue – From where access was possible, 1 No. shrinkage cracking noted from 1 no. chimney pot to front edge. No close-up hammer test inspection was able to be carried out.
- 8 Ardnahoe Avenue – No cracking noted.
- 1 Ardnahoe Avenue (Left Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to right hand edge. 2 further minor hairline cracks noted elsewhere. A further hairline crack was noted along the right-hand perimeter, extending for a length of circa 700mm. However with perimeter cracking formed, concern is durability may be affected.
- 1/3 Ardnahoe Avenue (Right Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to front edge. 1 further shrinkage crack noted between 2no. chimney pots.
- 3/5 Ardnahoe Avenue (Left Chimney) – 4 No. shrinkage cracking noted from 4 no. chimney pots to left and right edge.

- 5 Ardnahoe Avenue (Right Chimney) – 3 No. shrinkage cracking noted from 3 no. chimney pots to left edge.
- 9 Ardnahoe Avenue (Left Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to left and right edge.
- 9/11 Ardnahoe Avenue (Central Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to left and right edge.
- 11/15 Ardnahoe Avenue (Central Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to left and right edge.
- 15 Ardnahoe Avenue (Right Chimney) – 1 No. shrinkage cracking noted from 1 no. chimney pot to front edge.
- 17 Ardnahoe Avenue (Left Chimney) – No cracking noted.
- 17/19 Ardnahoe Avenue (Central Chimney) – Loose section of perimeter concrete removed to left hand/front edge corner approximately 900mm in length. Repairs required to be carried out to reinstate overhang and drip check at section removed.
- 19/21 Ardnahoe Avenue (Central Chimney) – Large sections of loose perimeter concrete removed. Left hand side edge removed in its entirety along with the front edge cope. Repairs required to be carried out to reinstate overhang and drip check at section removed.
- 21 Ardnahoe Avenue (Right Chimney) – 2 No. shrinkage cracking noted from 2 no. chimney pots to left and right edge.
- 23 Ardnahoe Avenue (Gable Elevation) – The entire loose perimeter of the concrete cope was removed manually due to concerns regarding the size of the cracks noted. Remedial measures required to reinstate the overhang and drip check.
- 23/25 Ardnahoe Avenue (Central Chimney) – Reported on previously, report issued 12/09/18, where urgent remedial works were recommended.
- 25 Ardnahoe Avenue (Gable Elevation) – Hairline cracking noted around the perimeter of the chimney cope. Deemed to be stable in current condition, however perimeter cracking indicates evidence of similar defective detail being present. Client to expedite access (i.e. scaffolding) to safely remove chimney cope. Remedial detail to reinstate the overhang and drip check.
- 27 Ardnahoe Avenue (Gable Elevation) - Hairline cracking noted around the perimeter of the chimney cope. Client to expedite access (i.e. scaffolding) to safely remove chimney cope. Remedial detail to reinstate the overhang and drip check.
- 27/29 Ardnahoe Avenue (Central Chimney) - Hairline cracking noted around the perimeter of the chimney cope. Client to expedite access (i.e. scaffolding) to safely remove chimney cope. Remedial detail to reinstate the overhang and drip check.
- 29 Ardnahoe Avenue (Gable Elevation) – No access, however based on above findings it is apparent that this chimney will require similar remedial works. Client to expedite access (i.e. scaffolding) to safely remove chimney cope. Remedial detail to reinstate the overhang and drip check.
- 3-7 Kerrylamont Avenue (Left Chimney) – Significant perimeter cracking noted on the front, left and right edge of the cope. Client to action expediting access for safe removal of concrete and remedial measures to reinstate overhang and drip check.
- 3-7 Kerrylamont Avenue (Right Chimney) – 4 No. shrinkage cracking noted from 4 no. chimney pots to left and right edge.

Summary of Suveys

A total of 50 Chimney copes were proposed to be inspected during the course of this survey. Of the 50 intended for survey, 1 was not able to be fully surveyed from the access system available. It is noted below that this address was visually inspected from a distance. This is as follows:

- 4 Ardnahoe Avenue

The following Chimneys have been surveyed by Thistle Housing Association and commented upon as follows:

Ad-Hoc Surveys by Thistle Housing Association

During the course of the initial survey, access to a number of addresses was not possible by means of hydraulic mobile access platform. Thistle Housing Association therefore arranged for a saddle access ladder to be positioned to allow a full hammer test to be carried out to the chimney cope. These surveys were completed by an operative from City Building Glasgow.

Full photographic evidence was forwarded onto A J Balfour Associates for review, as well as a descriptive account of the survey being provided by Thistle Housing Association.

49 Kerrycroy Avenue

Based on the above evidence and information, it is concluded that the cracking which has been recorded on the chimney cope is shrinkage cracking, with no evidence of perimeter cracking noted.

55 Kerrycroy Avenue

Based on the above evidence and information, it is concluded there is no evidence of cracking recorded on the chimney.

2 Kerrycroy Street

Based on the above evidence and information, it is concluded there is no evidence of cracking recorded on the chimney.

10 Kerrycroy Street

Based on the above evidence and information, it is concluded there is no evidence of cracking recorded on the chimney.

Summary of Findings

- * 18 chimneys (36% of the total chimneys) have been identified as having some form of perimeter cracking and represent a significant risk to safety
 - 12 chimneys (24% of the total chimneys) THA have confirmed that the copes were cast monolithically as a single unit. Based on this list, provided in good faith, it is considered that no further action is required
 - 20 Chimneys (40% of the total chimneys) while these showed no evidence of perimeter cracking at the time of the survey. However, there is sufficient "degree of doubt" with the occurrence and quality of the detail so as to be satisfied as to the long-term stability of these copes.

Conclusion

Having considered the number of chimneys which are displaying perimeter cracking, (18no, i.e. 36%), against the original suggestion that only a few chimneys had "add on chimney cope edge extensions"; in view of the significant number, there has to remain some doubt over the structural durability of all chimney copes.

Consequently, the 18no chimneys with perimeter cracking require **urgent action** to remove the defective concrete and form a new "tied back edge detail".

* Thistle Housing Association provided a list of 12 properties where they have confirmed that the copes were cast monolithically as a single unit. Consequently, we are happy to incorporate these into the report in good faith; and while we cannot validate the methodology of casting, we can compare this against the findings of our survey; we can state that none of these 12 chimneys display perimeter cracking. It would therefore not be unreasonable to assume that the list is a true record. *

This would therefore leave the remaining 20No chimneys where there remains a reasonable degree of doubt with regards to the quality of the detail incorporated at the time of the chimney works. It would be considered prudent that precautionary measures are undertaken to install dowel bars to tie back all the other 20no chimney copes. This would be considered the only recommendation to reduce the risk of failure to negligible and ensure that no currently unidentified copes with "cast-on extensions" have the potential to fail in the future.

Refer to recommended works below and the attached spreadsheet, where it highlights the recommendations.

Recommendations

Perimeter Cracking

It would be recommended that the client makes access to the 18 chimneys identified with perimeter cracking by way of an access scaffold system to allow the safe inspection and removal of any concrete, regardless of the crack width identified at the time of the survey. It is noted that loose concrete, caused by perimeter cracking at 17/19, 19/21 & 23 Ardnahoe Avenue, was removed at the time of the survey.

It is our opinion that once the initial perimeter cracking has occurred, that these sections will continue to deteriorate. We cannot predict when these sections may become unsafe, however crack widths will only continue to increase as water continues to enter to crack. The freeze and thaw cycle of upcoming winters will exacerbate cracking, with the potential for large sections to spall, posing health and safety risks to the residents and public below.

It would be recommended that upon removal of any loose of cracked perimeter sections, that the client reinstates the cope with an overhang of sufficient width to incorporate a drip check to prevent water from entering the roughcast on the chimney. There are three options; 2 removal methods and 1 alternative repair method which are recommended:

- Remove all in situ poured concrete and recast the entire cope with the correct overhang in one section (monolithically), ensuring that a drip chick is formed to ensure no water ingress into the rendered chimney stack.
- Remove all in situ poured concrete back to the brick chimney stack and introduce a pre-cast concrete cope. A High bond DPC will be bedded into the mortar below the capping piece, with a durable mortar mix (M12) used to lay the capping piece. Due to potential variances in cope sizes and pots, this may not be an economic option.
- Following on from the repair to 23/25 Ardnahoe Avenue an alternative repair proposal has been proposed by Thistle HA's contractor. The proposal would allow for 8mm Dowels at 150mm crs to be drilled into the remaining concrete cope to allow the casting of an additional concrete extension. Scarifying the edge of the concrete and bonding new concrete using an SBR type additive would be required as part of this proposal.

Having regard to the aims of the client to form a less disruptive repair quickly, which is likely to provide medium-long term durable solution. The proposal to install 8mm dowels at 150mm crs would appear to satisfy the above criteria. Quality of concrete to be checked.

However, it should be noted that monolithically cast concrete i.e., in one piece is considered a better solution.

Chimneys completed to incorporate drip check detail

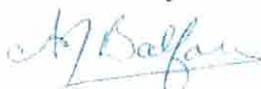
Where no perimeter cracking has been identified, and where the client is unable to confirm these chimneys as being cast as one monolithic concrete section, these 20No chimneys should be subject to precautionary remedial measures. The methodology for these remedial works would be for 100mm long dowel bars are drilled and resined into position at 150mm crs. If at any time during the drilling, the concrete becomes loose and unstable, then the detail should revert back to the proposals as described above and the loose concrete removed.

Chimneys completed as one monolithic concrete cope

Thistle Housing Association have provided a list of 12 properties where the client can confirm that chimneys have been completed as one monolithic concrete section. It is considered that the risk of any deterioration and spalling of concrete is negligible, as no perimeter cracking has been identified at the time of the survey. Therefore, no further action would be considered to these chimneys.




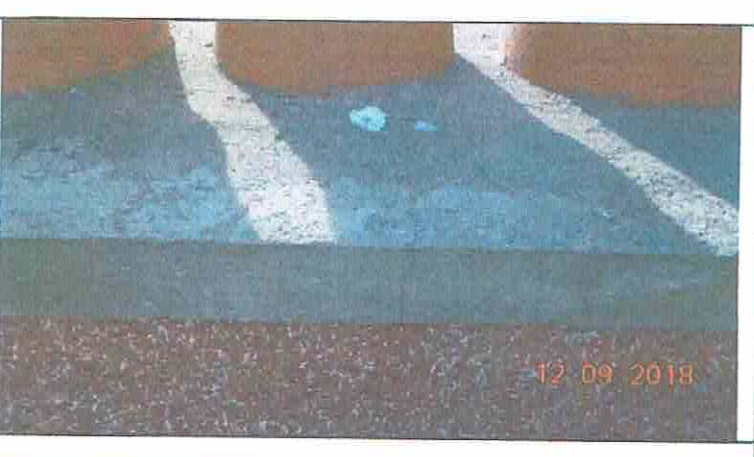
I trust the above is suitable for your purposes at this stage, however should you require any further information then please do not hesitate to contact me.


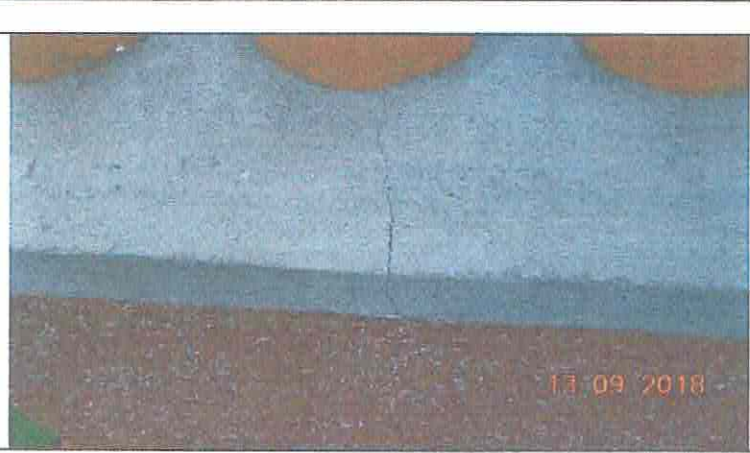
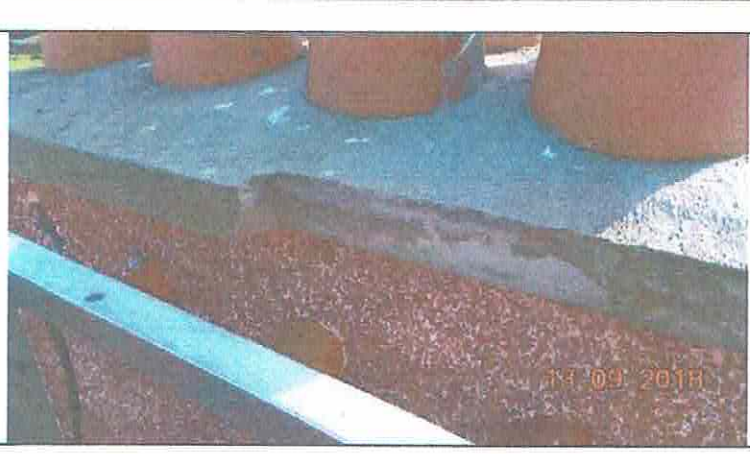

Yours faithfully



A J BALFOUR ASSOCIATES

Photographs

	<p>23/25 Ardnahoe Avenue</p> <p>Perimeter Cracking to right hand side of chimney, resulted in section being removed by hand</p>
	<p>43 Kerrycroy Avenue</p> <p>Perimeter cracking to rear side of cope</p>
	<p>47 Kerrycroy Avenue</p> <p>Hairline perimeter cracking noted to front side</p>
	<p>10 Kerrycroy Street</p> <p>Typical shrinkage crack between chimney stack and edge of cope</p>

	<p>6 Kerrycroy Street</p> <p>Typical shrinkage crack between chimney stack and edge of cope</p>
	<p>48 Kerrycroy Avenue</p> <p>Typical shrinkage crack between chimney stack and edge of cope</p>
	<p>17/19 Ardnahoe Avenue</p> <p>Section of concrete removed from cope</p>
	<p>19/21 Ardnahoe Avenue</p> <p>Section of concrete removed from cope</p>



3-7 Kerrylamont Avenue

Perimeter Cracking to right hand side of cope



3-7 Kerrylamont Avenue

Perimeter Cracking to left hand side of cope



51 Kerrycroy Avenue (Left)

Hairline perimeter cracking to left/rear side of chimney



51 Kerrycroy Avenue (Right)

Perimeter Cracking to right hand side of cope