[redacted]

Graham + Sibbald
233 St Vincent Street
Glasgow
G2 5QY

G8591/[redacted]

30 January 2022

Will Rudd Davidson (Glasgow) Ltd
Consulting Civil & Structural Engineers

100 Brunswick Street
Glasgow G1 1TF

T: 0141 248 4866
E: glasgow@ruddconsult.com

www.ruddconsult.com

Dear [redacted]

Trinity Tower, Glasgow
Recent new structural movement: Precis situational assessment

Please see below our initial assessment of the current situation relating to the southern 'failed wall in Trinity tower. We were preparing our updated assessments of this wall, awaiting the stripping out of the linings in flat 13, however as events have unfolded in front of us over the past 48 hours we have had to refocus as matters have become significantly more serious than we were anticipating. So, we think it is important we recap on the journey so far, for context.

Level 2 South Wall: **Background**

We have been visiting and checking the building over the past 2 years using tell-tales, tilt monitors and visual assessments. We have previously concluded that the tower itself was not 'tilting' progressively, however it had been experiencing sudden intermittent events over its life since the original event causing the commencement of the damage.

We believe the origin of the structural damage was a significant structural alteration of the access stair as much as a century ago. Ever since then, it has been trying to recover through shifting of its load paths. These changes in load paths have been successful for a period, however these new stored stress concentrations which were created, appear to have built up over time eventually fracturing other parts of the brittle masonry structure on several occasions. This is analogous to tectonic plate movement initiating earthquakes.

The danger to the tower is therefore not a tilting, as proposed by earlier engineering assessments but localised stress build-ups rendering relatively small areas of the tower to become significantly weakened and vulnerable. Critically, as with all tower structures of this nature, small areas of weakness present a high degree of risk due to the scarcity of natural redundancy in the structural mass, which exists in abundance in normal masonry building structures of this age. This critical characteristic has been continually missed in earlier engineering assessments.

Regretfully the tower structure has been the subject of astonishingly poor structural repair design and implementation. These have done nothing for the structure other than perhaps instill a false sense of comfort. Even very recently, the seriousness of the towers structural condition was completely missed by the engineers, opting for vague superficial stitching and cosmetic repairs as a minor element accompanying an unnecessary major roof refurbishment.

The end result is the tower structure has been allowed to deteriorate at an ever-increasing rate. Every year that passed, increased the problems exponentially. We became involved in this structural problem when it was already heading for the steepest section of this exponential curve. We were hoping that we would be able to act quick enough before the structure reached a point of not being able to be recovered.

Tilt Monitor Alarms: **Current Situation and Conclusion**

The tilt monitor alarm on 30 January 2022, 6am triggered because of a rapid significant change followed by a 3 hrs. of 'outage'. Storm malic may have triggered this movement on the tower. Similar spikes have occurred during bad weather, however we have never experience outage after this. We therefore raised precautionary concern and visited site to get eyes on the situation as we were not able to see if this movement was a significant progressive event or a large oscillation.

Our visual inspection and study of the tilt monitor graphs after the 3-hour outage confirm that the tower as oscillated and not moved progressively. Therefore, no action is required in this respect.

The monitoring is a critical information gathering tool during the construction works. We will work with the repairs works contractor to ensure they have a full understanding of the detail and nuances of the tilt monitor readings so they can plan and act accordingly.

Level 2 South Wall: **Current Situation**

During our site meeting with JCJ just before Christmas we noticed a newly formed network of slight cracking in the stud wall abutting the 'South failed wall' at the top landing of the access stairs. We actioned a formal inspection and further set of tell-tale readings, together with a review of the tilt monitor graphs. The tell-tale readings and tilt monitors did not reveal any change. The strip out of this wall was imminent with the appointment of the contractor to install the stent and reinstate the 'failed' south wall. Therefore, we waited to see what this would reveal, together with being able to inspect the external wall under the balcony over the 'south failed wall' when the scaffolding had been completed.

We had expected to see a degree of cracking, however not to the extent already seen on the inner face of this wall, visible from the storage room area, and where we had recommended the installation of temporary shoring several months previously.

What was uncovered was the external leaf of the south failed wall, bulging outward by an estimated 80 mm with accompanying slight to moderate cracking. This reflects what has already been seen on the other side (inner face). However, we had expected the outer face to be similar to that observed in the loft spaces of the other abutting flats i.e., a continuation of the external stone facing of a much more substantial and stronger nature than the inner face. What actually exists is a rubble sandstone wall similar to the inner face.

The bulging sections are leaning against and warping the roof truss collar tie and the abutting stud wall (see above). This bulging may have existed to a relatively minor degree behind the finishes for a considerable length of time. However, the evidence presented by the new cracking observed in the abutting stud wall shows there has been significant movement occurring within the last 6 months between visual inspections.

The restraining effect to the walls significantly bulging outer face provided by the roof trusses is impromptu and cannot be relied upon. The shoring we recommended to be installed to the inner face of the wall several months ago was installed a couple of weeks ago. It is possible that this will

have reduced the magnitude of the current local movement within the wall.

It can now be confirmed that due to very recent movement, the entire south wall at level 2 can no longer support load. As such, the full load paths have likely fully shifted to the tower's corners either side of the south wall via 'natural arch formation'. This arch was already beginning to form, evidenced by the relatively recent cracks in the access stair well observed in our first inspection. These cracks were monitored over 12 months and deemed dormant. The plaster was then removed to reveal the structure below, to enable clear visibility of the new and historic damage suffered by the building in this area.

The very recent movement in the outer wall is highly likely to have completed this arch formation, creating new stress concentrations at the towers level 2 corners.

Level 2 South Wall: **Current Risk**

The inner face or the wall is at high risk of partially falling inwards to the tower structure as previously advised. The shoring added will remedy this action in the short term

The outer face of the wall is now at a high risk of partially falling outwards. The roof trusses have provided and impromptu restraint reducing the risk from very high. The completion of arch formation (see above) throws considerably more load on to the southeast and southwest corers of the tower.

The tower has a history of sudden time dependant readjustments of load paths when the structural fabric can no longer sustain the inherited amplified stresses. The tower has had an exponential reduction in its ability to sustain load redistribution, rendering it highly unpredictable in its responses to 'significant events'.

The recent significant movement of the outer face of the 'failed south wall' is considered a 'significant event'.

The partial collapse of the inner and outer wall presents a high risk for heavy masonry falling to the floor.

The support of the balcony above the wall relies in the integrity of the outer face of the wall and sits at the crown of the natural arch formation (see above). A such it's 'kentledge support' is at high risk of failing in the event of a partial collapse of the wall below.

Level 2 South Wall: **Conclusion**

1. The compound risk of all the above structural issues is high.
2. The structure has become highly vulnerable over its years of neglect, mistreatment, and misunderstanding.
3. The exponential nature of the structure's deterioration and associated vulnerability has recently jumped closer to the point of uneconomic and inviable salvageability.
4. The structures' reaction to the current situation is highly unpredictable.
5. The impact of a partial collapse of both wall faces is highly unpredictable, ranging from significant debris fall through the building to progressive collapse of the entire structure.

Level 2 South Wall: **Recommendation**

1. Due to the recent significant movement in the structure, the risk of partial collapse is now too high to allow the building to be occupied.
2. The risk of progressive collapse is now medium; therefore, the tower collapse debris fall zone should be assessed to evaluate the risk to surrounding properties.
3. Each wall faced should be shored immediately
4. A debris crash deck should be designed and installed as a precaution until the balcony structure can propped or removed to reduce the risk of 'fall through' to an acceptable level.
5. The temporary works construction risks and design should be reassessed in detail in the light of the new risk profile.

Kind Regards

[redacted]

[redacted]

For Will Rudd