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AtkinsRéalis

Update of structural engineering advice

Ministry of Housing, Communities and Local Government

04 December 2024

518676-ATK-XX-XX-RP-SE-000020

GRENFELL TOWER

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Client signoff

Client	Ministry of Housing, Communities and Local Government
Project	Grenfell Tower
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Contents

Executive Summary

This report has been prepared for the Ministry of Housing, Communities and Local Government (MHCLG) as a review of, and update to, the engineering advice by AtkinsRéalis following completion of the Stage 3 prop installation works from Basement Level to the underside of Level 24 (roof).

Stage 3 propping

The Stage 3 propping is founded at Basement Level and extends to the underside of Level 24.

The purpose of propping from basement level, rather than from Level 04 upwards as had originally been planned, is to provide a robust support system within the structure to mitigate the risks of leaving the building propped for an extended length of time whilst a decision is awaited on the future of the tower.

However, it is important to note that the Stage 3 propping is a mitigation measure only and the significant structural damage to the tower remains as does the on-going deterioration of the primary structure.

Structural deterioration and monitoring

Further deterioration of the structure is a risk and as a mitigation measure it remains AtkinsRéalis advice that the current level of structural monitoring be retained to act as an early warning for unexpected building movement.

Considerations relating to start of deconstruction works

Given the levels of damage to the primary structure it is not seen as practicable to remediate the damaged structure to bring it back in to use. As such it is expected that the superstructure, in whole or in part, will have to be deconstructed.

There is an on-going risk with retaining the entire structure in its current condition and despite the installation of the propping system, residual risks remain due to the damaged nature of the structure.

Furthermore, there is a risk that on-going deterioration may increase the risks associated with any future plan to deconstruct the tower.

Ongoing risks to operatives accessing the tower

Completed in 1974, the structure is approximately 50 years old. Whilst the design life is not known, the building is likely in the latter part of its design life if that has not already passed.

The age of the structure combined with the structural damage due to the fire has a detrimental effect on the long-term resilience of the structure. Putting this in terms of risk, the longer the building is left in-place, the risk of the structure’s condition deteriorating to an unacceptable level and the risks to the site operatives having to go inside the building will increase.

It is the significant structural damage caused by the fire that remains the key concern. Whilst the risks associated with the fire damage have been mitigated by the introduction of internal propping, this does not change the underlying condition of the structure.

From an engineering perspective, AtkinsRéalis advice remains unchanged in that the building (or that part of it that was significantly damaged) should be deconstructed at the earliest possible opportunity as the best means to mitigate these risks.

1. Introduction

This Report provides an updated summary of the current state of structural engineering works at Grenfell Tower following completion of the Stage 3 prop installation.

1.1 Terminology

The terminology of propping stages and structure as used in this Report is defined for clarity:

Stage 1 propping refers to the props installed immediately following the fire to allow emergency service access

Stage 2 propping refers to the propping installed soon after Stage 1 to provide further stability and robustness to the Stage 1 propping scheme

Stage 3 propping refers to the replacement propping system from Basement Level to the underside of Level 24 whilst the future of the tower is decided. The majority of the Stage 1 and Stage 2 props have been removed.

Primary Structure is that part of a building that provides the structural strength, stiffness, and stability. In contrast **Secondary Structure** such as infill wall panels, cladding, windows, etc do not contribute to the building's strength, stiffness, or stability. **Temporary works** relates to items such as props or scaffolding that are designed to be temporary in nature and in the case of propping, provides support to the primary structure.

1.2 Damage to structure

Whilst highlighting specific areas of structural damage is not the purpose of this Report, the photographs included in Appendix A are provided to illustrate the structural damage within Grenfell Tower and to highlight that whilst a propping system has been installed, this damage still remains and that the condition of such areas will continue to deteriorate.

2. Current state of the tower

This section addresses the current state of work at the tower.

2.1 Overview

Whilst a decision is awaited as to the deconstruction of the tower, the level of robustness of Grenfell Tower has been enhanced by the provision of a propping system (Stage 3) from Basement Level to Level 24 with most of the props from earlier stages now removed.

A small number of the Stage 1 and Stage 2 props have been retained, primarily at the northwest corner of the building. Due to the failure of a corner column at Level 13 at the time of the fire, it was not considered safe, or practical, to remove and replace them, and as such they form part of the Stage 3 propping design solution.

2.2 Roles and responsibilities

The Stage 3 propping system was designed by Deconstruct with the design work carried out by their sub-consultant Michael Barclay Partnership.

Deconstruct are also responsible for the ongoing structural stability of the tower and its interface with their propping system.

AtkinsRéalis continue to act as Technical Assurers to the MHCLG whilst testing and inspection services are provided by the RSK Group.

Plowman Craven Monitoring are responsible for the monitoring equipment within the tower and providing regular reporting of this information.

RSK Group also provide regular independent Health and Safety inspections and reporting within the tower.

2.3 Monitoring systems output

AtkinsRéalis report 5186876-ATK-XX-XX-RP-SE-000019 *Grenfell Tower - Assessment of monitoring output*, 28 February 2022, provided a comprehensive summary of all monitoring output to that date.

The report concluded that the data from the output of the monitoring systems was as expected and within acceptable bounds with the structural movements recorded by the monitoring systems reflecting the changing climatic conditions throughout the year. This trend has continued since that time, with the monitoring systems reflecting structural movements within acceptable bounds and reflecting the changing climatic conditions throughout the year.

The report also noted that whilst the condition of the tower is degrading, as evidenced through visual inspections, this is due to the passage of time and does not indicate a significant rate-of-change increase in the deterioration of the tower; this essentially remains unchanged at this time, though there is early indication of an increase in size of the spalled concrete in a few localised areas.

Whilst in the period between February 2022 to date, peak temperatures were seen in London in the summer of 2022, the primary structure is expanding and contracting within the bounds expected by the temperature range experienced.

Alerts throughout 2023 and 2024 were caused by either gusting wind, thermal movements, equipment being knocked / disturbed, moisture giving rise to rogue readings or monitoring equipment battery life. However, in no instance was the output of the monitoring systems unexplainable or beyond acceptable limits. It should also be noted that in a few instances this year when stormy conditions resulted in gusting wind damaging the building's wrap, site teams had to be mobilised, often at night or on a weekend, to remedy this damage. This is clearly and additional risk of retaining the tower.

2.4 Condition of primary structure

AtkinsRéalis report 5186876-ATK-XX-XX-RP-SE-000019 *Grenfell Tower - Assessment of monitoring output*, 28 February 2022, also provided a comprehensive review of the regular inspections carried out.

Whilst small, over the last year there have been early indications that the rate of deterioration of the tower may be slowly increasing in a few localised areas. This has been evidenced by two factors. The number of recorded instances of deterioration has remained constant, however, there has been a minor increase in the size/quantity of spalled concrete seen. This has coincided with the hottest periods of the year. Also, testing to assess the likelihood of corrosion occurring within the reinforced concrete structure of the tower has also indicated over the last visits that there is an increased probability of corrosion in some areas. This activity may have influenced the increase of spalled concrete seen.

As such, if the tower remains in its current condition, the likelihood is that the risks associated with deterioration, such as loss of sectional area from the corroding steel reinforcement and a breakdown in bond between reinforcement and concrete, will continue to increase as will the risk of further spalling, and hence the risks associated with retaining the structure increase.

3. Residual risks

Based on the investigation work carried out to-date by AtkinsRéalis and others, with respect to the current state of the structure, the four main residual risks are identified below.

3.1 Stage 3 propping

The Stage 3 propping is founded at Basement Level and extends to the underside of Level 24.

The purpose of propping from basement level, rather than from Level 04 upwards as had originally been planned, was to provide a robust support system within the structure to mitigate the risks of leaving the building propped for an extended length of time whilst a decision is awaited on the future of the tower.

However, it is important to note that the Stage 3 propping is a mitigation measure only and the significant structural damage to the tower remains as does the on-going deterioration of the primary structure.

The props comprise mostly uncoated steel elements with aluminium props located above Level 20. Where water has been able to enter the tower, via the existing damaged envelope or through flooding in the basement, the uncoated steel props have corroded. Whilst minimal and currently mostly slow, this corrosion will eventually affect the capacity of the props to support the loads as intended. In some cases, the props, and also the column casing strengthening the damaged column at Level 13 in the northwest corner, have been painted to stop the progression of the corrosion.

3.2 Ongoing risks to operatives accessing the tower

Completed in 1974, the structure is approximately 50 years old. Whilst the design life is not known, the building is likely in the latter part of its design life if that has not already passed.

The age of the structure combined with the structural damage due to the fire has a detrimental effect on the resilience of the structure. Putting this in terms of risk, the longer the building is left in place, the risk of the structure's condition deteriorating to an unacceptable level and the risks to the site operatives having to go inside the building also increase.

As a mitigation measure for the risks associated with ongoing deterioration of the structure, it remains AtkinsRéalis advice that in addition to regular visual inspections, the current level of structural monitoring be retained to act as an early warning for unexpected building movement.

It is the significant structural damage caused by the fire that remains the key concern. Whilst the risks associated with the fire damage have been mitigated by the introduction of internal propping, this does not change the underlying condition of the structure.

Despite the installation of the propping system, on-going deterioration of the structure continues to be a risk. From an engineering perspective, AtkinsRéalis advice remains unchanged in that the building (or that part of it which was significantly damaged above Level 10) should be deconstructed at the earliest possible opportunity as the best means to mitigate these risks. However, as each year passes and the building is exposed to more winter cycles, the likelihood of accelerated degradation increases, which may require the tower to be deconstructed on safety grounds, and not just to mitigate the risk.

3.3 Considerations relating to start of deconstruction works

Given the levels of damage to the primary structure it is not seen as practicable to remediate all or part of the damaged structure to bring it back in to use. As such it is expected that the superstructure, in whole or in part, will have to be deconstructed.

The level of damage above Level 10 is such that there is realistically no option to retain the structure, and even below Level 10, with the design life already expired, we don't believe that it is practicable to retain the building below Level 10 either.

There is an on-going risk with retaining the entire structure in its current condition and despite the installation of the propping system, residual risks remain due to the damaged nature of the structure.

Furthermore, there is a risk that on-going deterioration may increase the risks associated with any future plan to deconstruct the tower.

3.4 Structural deterioration and monitoring

Further deterioration of the structure is a risk and as a mitigation measure, it remains AtkinsRéalis advice that the current level of structural monitoring be retained to act as an early warning for unexpected building movement.

APPENDICES

Appendix A. Photographs of damage

A.1 13th Floor, Flat 5

Spalling of corner

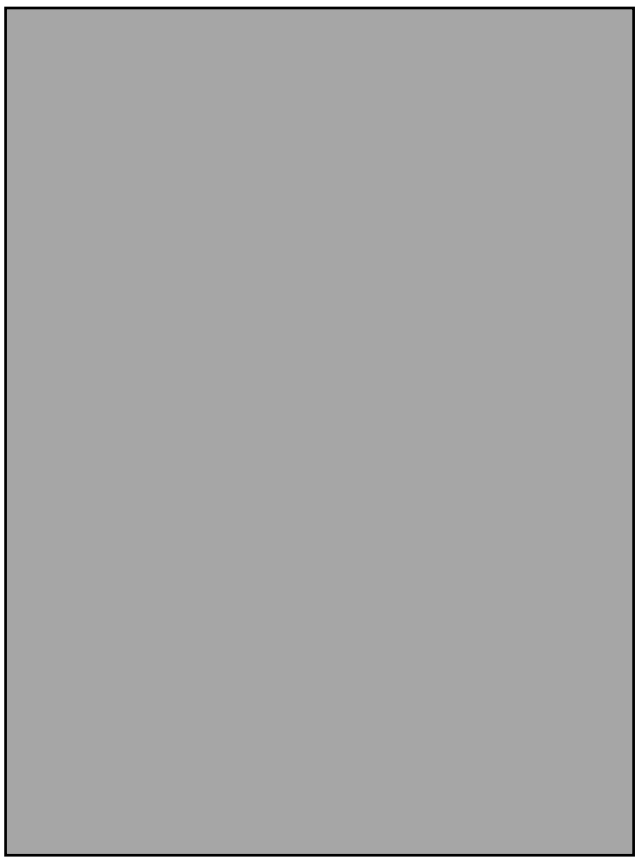
A.2 13th Floor, Flat 5

Spalling of corner column from outside (photograph courtesy of the MPS)

N.B. Figure A.2 has been supplied by the MPS; not for circulation beyond the MHCLG without MPS permission.

A.3 13th Floor, Flat 5

Propping around corner column



A.4 24th Floor (roof) soffit, Flat 2

Cover layer of concrete lost and bars debonded from slab.

A.5 23rd Floor soffit, Flat 2

Concrete has spalled to the depth of the inner layer of reinforcement; bars debonded from slab.

A.6 17th Floor soffit, Flat 3

Note the kink in the reinforcement bars due to one side of the slab falling away; note also the apparently intact piece of soffit on the left of the image has delaminated from the body of the slab above.

A.7 14th Floor soffit, Flat 5

An example of a slab that has undergone significant deflection; note also the extent of the loss of concrete from the slab soffit.

A.8 14th Floor soffit, Flat 5

A second photograph from this flat showing that adjacent reinforcing bars have debonded and fallen away from the slab; in some instances, they have been tied to the still bonded reinforcing bar for the safety of the site operatives.

A.9 8th Floor soffit, Flat 6:

Significant structural damage local to a corner column; depth of spalling is to the inner layer of reinforcement with other bars debonding.

A.10 8th Floor soffit, Flat 6:

A second photograph from a different area within the same flat illustrating the local nature of damage in some flats.

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