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By email
10 November 2023

Donald Graham
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Barton House

Structural fire safety

Dear Donald,

Further to the hazard workshop between yourself and Arup, this letter summarises our opinion on the structural fire safety of Barton House (Cotton Mill Ln, Redfield, Bristol BS5 9SL).

Disclosure/Circulation of this letter

We understand that you may wish to share this document with Avon Fire & Rescue Service, Homes England and/or the Department for Levelling Up, Housing and Communities (the 'Interested Parties'). We consent to the sharing of this letter for information purposes only so that the Interested Parties are aware of the issues it raises but we do not provide consent for any third party to formally rely on any aspect of our advice nor to any wider circulation of this letter beyond the Interested Parties. This letter takes into account the particular instructions and requirements of Bristol City Council ("BCC") in respect of the Barton House building only. **It is not intended for and should not be relied upon by any other third party and no responsibility is assumed by Arup towards any third party whatsoever.**

This letter follows advice previously provided in our document Technical Note: "Barton House (Confidential)" (dated 11th October 2023), regarding a review of the report, *Structural Robustness Assessment of Barton House* dated July 2022 provided to BCC by another consultant.

Our review summarised that based on the information available '*The lack of robustness in the building means it will be more susceptible to disproportionate collapse than other well designed/constructed residential buildings*'. The primary consideration for structural failure up to that point was as a result of an explosion due to the release of combustible gas in the building.

A workshop was set up to consider other possible hazards to the building and potential mitigations, including those related to fire safety. This workshop took place on 8 November 2023.

ARUP

Date 8 November 2023

A. Our understanding of the building

Barton House is a 15-storey tall residential tower block containing 98 flats. Based on a search of existing information held at Bristol Archives, the block was completed in 1958, and the building superstructure consists of a combination of precast and insitu concrete elements.

The floors are constructed from 150mm deep precast concrete beams (referred to as 'gothic' beams) spanning between 150mm thick precast or insitu concrete walls. The joints between the precast beams have been grouted.

It appears that the building's stability system consists of insitu concrete walls (at least 150mm in depth) that are continuous through the height of the building down to the foundations.

Although the original drawings show details that indicate that the floors would be tied to the vertical supporting wall elements using anchored reinforcement, recent intrusive investigations of the structure, carried out by others, suggest that this is not the case, i.e. the building hasn't been constructed in accordance with the original design intent. The result is that there is no evidence to suggest that there are 'robustness ties' in place that would connect the floors to the vertical structure, which in turn means that a local structural failure could result in a progressive collapse of several floors.

Furthermore, it was found from investigations by others on site that the concrete cover to reinforcement was significantly less than the original design intent. In any case, the concrete cover specified on the original drawings for the floors was far less than would be required by modern standards to sufficiently insulate against fire.

It is important to note that the primary survey information undertaken by others upon which our opinion is based, is limited to the following:

- Opening up works in three flat (flats 60, 65 and 78) which included-
    - Intrusive investigation regarding presence of robustness ties
    - Establishing the depth of concrete cover to top steel reinforcement to floor slabs and horizontal cover to walls within these flats

    Note: The number and location of intrusive investigations undertaken within these flats is not stated in the *Structural Robustness Assessment* report.

B. Preliminary Advice to BCC

Based on our understanding of the building and our preliminary review of the information already available, it is our preliminary opinion that a fire event within a single flat could result in a localised structural failure that immediately escalates to disproportionate progressive collapse of a vertical stacked section of the building.

This is because of the lack of structural ties between the floors and the load bearing external walls and the lower fire resistance of these structural elements than set out in the original design and guidance (which could cause premature failure of structural elements in a fire).

The presence of the external insulation EPS render system poses a fire hazard and as such increases the overall likelihood of a fully developed fire occurring within the building. BCC have confirmed that the EPS render system is currently in place but is planned for removal**. It is recommended that plans to remove the system are carried out as a matter of urgency**. Removal of the system will contribute to a lowering of the overall likelihood of fire in the building, however this will not mitigate a fully developed fire occurring in an individual flat.

Our advice is based on the following:

- Cover measurements to reinforcement within flank and cross walls indicate the presence of low and variable degrees of reinforcement cover. Low cover to reinforcement results in low duration of fire resistance for that element and increases risk of structural failure during a fully developed fire. Due to the lack of structural robustness ties, there is no clear way vertical loads could be redistributed through the structure.
- Cover measures to floor slab bottom reinforcement do not appear to have been taken. Original drawings indicate an intention to provide 13mm of reinforcement cover for the floor slabs. This degree of cover, although compliant with standards at the time, provides a low duration of fire resistance only, increasing the likelihood of element failure during a fully developed fire.
- Survey of the junction between flank and cross walls with floor slabs indicates that floor slabs are inadequately tied to the supporting walls for structural robustness. It is our opinion that the combination of these issues, i.e. low inherent fire resistance of structural elements and apparent lack of structural ties between elements, means that the collapse of floor slab elements is possible in the event of a fully developed fire within a flat. This has the potential to precipitate disproportionate structural collapse.

Conclusion

As set out above in our Initial Advice, based on the information available it is our preliminary opinion that a fully developed fire event within a single flat could result in premature failure of an element of structure resulting in failure of the floor in a localised area. This could in turn result in a progressive failure of structure in a short period. This would present a risk to life safety of occupants present within the impacted area of the building.

The information upon which our opinion is formed is limited in nature and the opening up survey works was not viewed in person by Arup staff. It is therefore strongly recommended that to improve confidence that the existing survey information more widely reflects the ‘as built’ situation in the building, that **further survey work be undertaken immediately.**

The survey work should be localised, precise and strategically undertaken with due care and caution to avoid unintentional weaking of the structure.

This further survey work shall focus on establishing;

- Whether robustness ties are present between the floor beams and supporting walls; and

- The depth of concrete cover to the steel reinforcement within the primary elements in order to establishing their likely fire resistance period.

Once the survey results are known, the conclusions of our Initial Advice shall be revisited to determine if this results in any changes to the hazards identified.

If it would be helpful to discuss or clarify any points arising from this correspondence, please do contact us and we would be very happy to assist further.

Yours Sincerely,

Ove Arup & Partners Ltd