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Hall School – Explanation of why enhanced green roof loading on extension is not structurally viable

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We have been asked to address the question of whether an enhanced green roof loading is justifiable from a structural perspective for the flat roof of the Hall School extension project. Please see below technical input into this query with regards our structural design for this extension project.

The extension to Hall School consists of a single level of new classrooms supported on steel beams at floor level which span onto the concrete perimeter walls of the existing gym building. The roof of the extension is supported on steel beams which in turn are supported on columns that transmit this load onto the steel floor beams, therefore any increase in roof load leads to an increase in the loads on the floor beams.

The floor beams are supported on the concrete walls by steel brackets which have been designed for the original loading shown in fig. 1 on the following page. A more detailed assessment of the roof loading at construction stage has been made to try to justify an enhanced green roof loading, this can be seen in fig. 2 on the following page. An enhanced green roof loading of 1.5kN/m^2 has been provided to us from Lifebuild which we understand to be relative to the average of a green roof varying in thickness from 80 – 150mm (a green roof with peaks and troughs). The current proposed green roof loading of 1.05kN/m^2 is based on a green roof thickness of approx. 85mm (including sedum blanket).

Fig. 2 shows that even with a reduction in the imposed load to the bare minimum allowable for roofs of this nature (0.6kN/m^2 for maintenance access), there is still an increase in overall loading due to the assumed enhanced green roof loading of 1.5kN/m^2. The increase can be seen as 2.52kN/m^2 compared with 2.3kN/m^2, which is an increase of 10%.

This uplift in ULS design loads is seen as an unacceptable increase in relation to the utilisation of some aspects of the structural design. The elements with the highest utilisation are the beam to concrete connections of the floor steelwork beams which we are not able to justify for this increase in load while maintaining necessary safety factors.

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To strengthen the steel to concrete connections would require the deconstruction of the steel framing which would have extensive programme impacts.

Proposed	G_o (kN/m²)	Q_k (kN/m²)	Notes
Proposed 'Ground' Floor Level			
140 THK Metal Deck (trapezoidal decking)	2.60		
85mm Screed	1.70		
Ceiling / Services / Finishes	0.25		Imposed load includes 0.5 kN/m² for lightweight partitions
Classrooms (EN 1991 Table NA.2 – C13) (3+0.5)		3.50	
Total	4.55	3.50	
Roof level – Green Roof			
Timber board and joists	0.25		
Ceiling / Services/ Insulation / Waterproofing	0.65		Green roof 65kg/m2 (Arch email) and Green wall 72kg/m² (Scotscape)
Green Roof / Living Wall Panel	0.65		
Imposed load (maintenance)		0.75	
Total	1.55	0.75	

Total SLS = 2.30kN/m² Total ULS = 3.22kN/m²

Figure 1 *- Original Design Loads*

Proposed	G_o (kN/m²)	Q_k (kN/m²)	Notes
Proposed 'Ground' Floor Level			
140 THK Metal Deck (trapezoidal decking)	2.60		
85mm Screed	1.70		
Ceiling / Services / Finishes	0.25		Imposed load includes 0.5 kN/m² for lightweight partitions
Classrooms (EN 1991 Table NA.2 – C13) (3+0.5)		3.50	
Total	4.55	3.50	
Roof level – Green Roof			
Timber board and joists	0.17		
Ceiling / Services/ Insulation / Waterproofing	0.25		Green roof 105kg/m²
Green Roof / Living Wall Panel	1.05 / 1.5		Green roof (enhanced peaks and troughs) 150kg/m²
Imposed load (maintenance)		0.6	
Total	1.47 / 1.92	0.6	

Total SLS (including peaks and troughs loading) = 2.52kN/m²

Total ULS (including peaks and troughs loading) = 3.49kN/m²

Figure 2 *- Proposed Design Loads, including 'peaks and troughs green roof loading'*

Yours faithfully,

Ben Procter

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