RobertBirdGroup
ABN 67 010 580 248 | ACN 010 580 248
BRISBANE OFFICE
Level 1, Kingsgate, 480 St Pauls Terrace
Fortitude Valley QLD 4006
PO Box 433, Fortitude Valley QLD 4006 Australia
p: +61 (0) 7 3319 2777 | f: +61 (0) 7 3319 2799
www.robertbird.com

Reference: SW:DA LTR/S 13037

31st October 2016

Brookfield Office Properties
Australia Commercial Operations
Level 22, 135 King Street
SYDNEY NSW 2000

Attention: Mr Stuart Harman

Dear Sir,

RE: WYNYARD PLACE, SYDNEY
SHELL HOUSE – SECTION 96 SUBMISSION

Further to your recent request in regards to the Shell House Section 96 submission, please find below commentary on the 'Concrete Cancer' affecting the existing floors.

Shell House was constructed in 1938. The typical construction of the suspended floor comprised steel beams framed on column gridlines with concrete ribs, circa 450mm deep, spanning between the steel floor beams. The concrete ribs are spaced at circa 685mm with a 75mm deep slab spanning between these ribs. The slab is reinforced with a single layer of reinforcement. The steel beams are concrete encased with the concrete floor structure.

In 1978, Shell House was converted from an office building into a hotel. We understand at this time a magnesite topping slab was applied to the concrete slabs to level the floors. Magnesite flooring was in common use in Sydney through the 1960's and 1970's. This product contains magnesium chloride which has been found to leach chloride ions into the concrete substrate over time resulting in the significant corrosion of reinforcement leading to the spalling and deterioration of the concrete slabs of this era. The visible spalling of the concrete surface as a result of reinforcement corrosion is often referred to as 'Concrete Cancer'.

Site investigation works undertaken by Mahaffey Associates and outlined in their Report 'Structure Investigation and Condition Assessment' (Report Reference DRM/LO1/10748, dated 25th April 2016), showed concrete core samples, taken through a typical hotel floor slab, contained a chloride ion concentration twice that required to initiate corrosion of reinforcement and in some instances the concentration was more than five times (5x) this initiation level. Evidence of this highly corrosive environment was evident in an examination of the slab reinforcement which was found to be heavily corroded leading to spalling of the concrete. The reinforcement diameter found ranged from 4mm to 6mm with concrete cover to the top of slab to be circa 50mm.

Further to the above investigation into the ribbed concrete floors, these ribs are supported by concrete encased steel beams. The drawings indicate the top flange of the steel beams are embedded into the concrete ribbed slabs such that they have a similar concrete cover to that of the reinforcement ie. circa 50mm cover.

The site investigation appeared to indicate that the reinforcement may be placed directly onto the top flange of the steel beams. Therefore, the top flange of these beams would also be exposed to the same concentration of chloride ions and therefore subject to a corrosive environment which is also likely to affect their integrity.

It is also important to note the impact of the magnesite topping is considered in respect to a 1938 structure rather a 1960 structure and hence the quality of construction and structural system of the era also has an impact on performance and likely remediation. The low strength and high permeability of the 1938 concrete make it more susceptible for leaching of corrosive materials resulting in general deterioration. The concentration of chloride ions present in the concrete slabs combined with the significant extent of reinforcement corrosion indicates a very corrosive environment which has led to the development of 'concrete cancer' in the Shell House floors. Given the aggressive environment and proximity of the steel beams it is our view that their integrity will also be compromised.

Based upon our review of the findings of the Mahaffey Associates Report, RBG would not be able to provide structural certification for the existing floors to perform to current Australian Standards for another 50 years for the proposed use. It is our recommendation that retention and remediation of these floors to substantially extend the working life of the building is not a viable solution and that the floors affected by the magnesite topping should be replaced.

We trust the above meets with your requirements and should your require any further information please do not hesitate to contact the undersigned.

Yours faithfully
ROBERT BIRD GROUP PTY LTD

SCOTT WHEELER
Managing Director