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Attention: Mr Ross Bourke

REVIEW OF LOKPOD FOR AUSTRALIAN CODE COMPLIANCE

At your request we have carried out a comprehensive review of the Raft LOKPOD flooring system (the System) in order to ensure that the System will comply with relevant Australian national standards and the designed system can be safely utilised in construction of a residential waffle raft foundation system. Requirement in the Residential Slabs and Footings Standard (AS 2870-2011), and specifically sections 3 and 4 of this Standard, were considered to evaluate the LOKPOD footing system reliability, and design safety.

COMPLIANCE WITH AS 2870-2011 SECTION 3.4 (WAFFLE RAFTS)

The ARC recycled plastic footing system provides a type of waffle raft footing system that is very similar to the waffle raft footing proposed by the AS 2870 standard. The waffle raft footing created by the LOKPOD is a permanent formwork innovative form of waffle raft footing generated from modifications to cross section details shown in Figure 3.4 proposed by clause 3.4 of AS 2870-2011. Due to these modifications an Engineering design is required to be carried out as per section 4 of the AS 2870 and AS 3600 -2018 standard (Concrete structures). This is required by clause 3.4.1as a waffle raft footing general requirement.

In this system recycled plastic pods can be easily interconnected to form square shape voids and ribbed beams with spaced centres of 1200mm, all required to construct a waffle raft footing for a superstructure as per clause 3.4.1 of AS2870, and its definition of waffle raft footing.

Speed of construction and use of recycled nontoxic Polypropylene (PP) instead of conventional Expanded Polystyrene (EPS) foam are the two advantages which can encourage the construction industry to use this type of general system, however, limitations associated with height and spacing between beams prevent it being used in all site locations with different types of superstructure construction.

To investigate and determine the type of structures in different site classes that LOKPOD footing system can be utilised, it is required to prove that section 3.4 and 3.4.1 of

AS 2870 are satisfied for the nominated site classes areas and types of construction.

The first criteria set in section 3.4 which needs to be satisfied is maintaining continuity of the internal and edge beams at re-entrant corners, using the beam arrangement in accordance with Clause 5.3.8.

- It is apparent that LOKPOD foundation system can be set to form internal beams continuous from one edge to the other edge of the slab.
- Special arrangement such as slab tie reinforcement can be considered to maintain continuity, including where beams are at different levels, or occurrence of a two part concrete casting system.

- Internal beams can be located such that continuity provided with the edge beams at re-entrant corners.
- At least 2 details out of 3 details provided by Figure 5.4 can be arranged where one side of the re-entrant corner is less than 1.5m. This is due to grid form of LOKPOD footing system
- External beams can be continued at least for a length of 1m into the internal beams at a re- entrant corner where an external beam continues as an internal beam. It is also apparent that maintaining 1m length of external beam into the internal beam is easier than the original waffle raft beam proposed by AS-2780, due to having a wider beam width on top of the LOKPOD waffle footing.

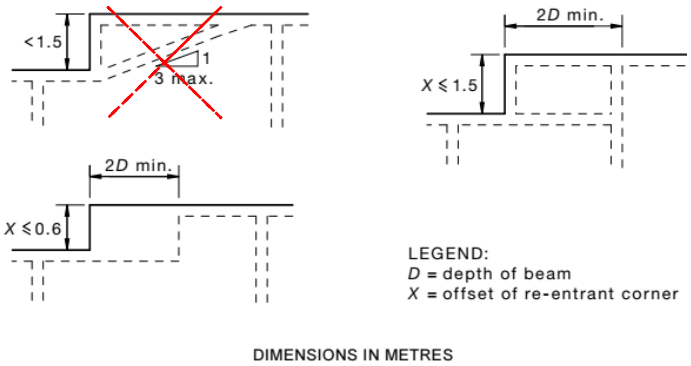

Figure 5.4 CONTINUITY OF FOOTING BEAMS (AS-2870)

WAFFLE RAFT DESIGN CRITERIA (LOKPOD SYSTEM)

As it is mentioned earlier the AS 2870 prohibited use of any modified system to the proposed waffle Raft shown in Figure 3.4 without undertaking an Engineering design in accordance with Section 4. Thus, LOKPOD waffle footing shall be designed as per requirements in Section 4 from 4.1 to 4.7 to prove this system is compatible with the original proposed waffle footing, used over many years in the construction industry.

Four methodologies have been considered in section 4 to design of raft footing. The design criteria are set to differential movement or deflection of the footing (Beams and Slabs) limited less than values provided in the table 4.1. These values are based on construction type of superstructure and provided span. As deflection heavily depends on the stiffness of the main structure, if it can be proven that stiffness of the modified LOKPOD system is compatible with the stiffness of proposed waffle raft for each type of superstructure in different soil environment, then limitation(s) of using LOKPOD system for each construction type in different soil environments can be determined.

A standard waffle raft has 110 mm wide ribs at maximum centres of 1200 mm, with the depth of the rib being varied to increase the stiffness in accordance with the predicted soil movement (with more reactive sites having deeper and therefore stiffer ribs). Alternatively, the LOKPOD system comprises of ribs with 110mm wide at the bottom tapered vertically with 3° angle to give 133mm wide on top of the beam and 141mm wide at slab level. Beams height including slab thickness (85mm) are 310mm or 385mm, spaced at 1200 mm centres. Result from using a simplified method proposed in AS 2780 to calculate stiffness of each system are shown in table 2 of this report.

For the case of articulated masonry veneer ribs sizes conventionally required to be 385 mm x 110 mm (depth x width) at 1200 mm centres, based on the un-cracked section[1] the stiffness per metre is:

$$I = \frac{bD^3}{12} \times \frac{1}{Spacing}$$

$$I_{AS2870} = \frac{110mm \cdot 385mm^3}{12} \times \frac{1m}{1.2m} = 4.36 \times 10^8 mm^4$$

$$I_{AS2870} = \frac{110mm \cdot 460mm^3}{12} \times \frac{1m}{1.2m} = 7.5 \times 10^8 mm^4$$

Similarly, for LOKPOD:

$$I_{Arc\ POD} = \frac{126mm \cdot 385mm^3}{12} \times \frac{1m}{1.2m} = 4.99 \times 10^8 mm^4$$

A comparison between the result from this simplistic analysis reveals that using LOKPOD footing system is compatible with its identical dimension of conventional waffle rib footing, less than 400 mm height. We believe the suitable types of construction which require a waffle rib footing with depth of 385 mm or less, can be considered for use of the LOKPOD footing system, which can improve the footing performance having approximately 14% better system stiffness. Further studies can be carried out to investigate effects of reducing slab thickness to achieve more efficient and economical system by utilising 14% extra stiffness into reducing slab thickness.

This product therefore, can only be utilised in areas with required beam height up to 385mm including the slab thickness. This is indicated in the following table 2 which shows limited type of superstructures can be used in areas with different soil category if LOKPOD technology is considered for the footing system.

Based on above investigation this product is able to pass requirements of Waffle Raft footing system set in clause 3.4 and 3.4.1 of AS 2870-2011 for limited types of construction in different soil environments as per Table 2 of this report.

Site class	Type of Construction	Beam Reinforcement				Slab Mesh	
		Depth (mm)	Edge Beam		Internal Beam	Slab Length (m)	
			Mesh Alternative	Bar Alternative		<20	≥20 and <30
A	Clad frame	260	3-L8TM	3N12	1N12	SL72	SL82
	Articulated masonry veneer	310	3-L8TM	3N12	1N12	SL72	SL82
	Masonry veneer	310	3-L8TM	3N12	1N12	SL72	SL82
	Articulated full-masonry	310	3-L8TM	3N12	1N12	SL72	SL82
	~~Full-masonry~~	-	-	-	-	-	-
S	Clad frame	260	3-L11TM	3N12	1N12	SL72	SL82
	Articulated masonry veneer	310	3-L11TM	3N12	1N12	SL72	SL82
	Masonry veneer	310	2x3-L11TM	3N12	1N12	SL72	SL82
	Articulated full-masonry	385	2x3-L11TM	3N12	1N16	SL72	SL82
	Full-masonry	-	-	-	-	-	-
M	Clad frame	310	3-L11TM	3N12	1N12	SL72	SL82
	Articulated masonry veneer	310	3-L11TM	3N12	1N12	SL72	SL82
	Masonry veneer	310	2x3-L11TM	3N12	1N12	SL72	SL82
	~~Articulated full-masonry~~	610	2x3-L11TM	3N16	1N16	SL72	SL82
	~~Full-masonry~~	-	-	-	-	-	-
H1	Clad frame	310	3-L11TM	3N12	1N12	SL82	SL92
	Articulated masonry veneer	385	3-L11TM	3N12	1N12	SL82	SL92
	~~Masonry veneer~~	460	2x3-L11TM	3N16	1N16	SL82	SL92
	~~Articulated full-masonry~~	610	2x3-L11TM	3N16	1N16	SL82	SL92
	~~Full-masonry~~	-	-	-	-	-	-
H2	Clad frame	310	3-L11TM	3N12	1N12	SL82	SL92
	Articulated masonry veneer	385	3-L11TM	3N12	1N12	SL82	SL92
	~~Masonry veneer~~	460	2x3-L11TM	3N16	1N16	SL82	SL92
	~~Articulated full-masonry~~	-	-	-	-	-	-
	~~Full-masonry~~	-	-	-	-	-	-

Table 2: Table showing conditions suggested to be suitable for LOKPOD (~~not suitable~~, suitable)

SUMMARY

At your request we have carried out a due diligence review of the proposed Waffle Raft LOKPOD footing system to ascertain whether the System would achieve compliance with Section 3.4 and Clause 3.4.1 of the Australian Standard AS 2870-2011 for Residential slab and footings.

As both the spacing and depth of the ribs of the LOKPOD system are fixed there is limited flexibility available to adjust the System for reasons of economy and performance. However, provided the System is used within the limits outlined previously, in our opinion the LOKPOD System is able to pass requirements of Waffle Raft footing system set in clause 3.4 and 3.4.1 of AS 2870-2011 for limited types of construction in different site environments.

Yours faithfully,

Shane Hull (Director)

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For and on behalf of Glynn Tucker Consulting Engineers