



# THE WESTERN RESIDENCES 2-3 WILGA CLOSE CASULA, NSW, 2170

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## Fleetwood Challenge Concept Validation Report





## 1.0 Inspiration

The vision behind the proposed development is a novel approach of building using ‘kit of parts’. The designers were inspired by the Forge, being built at 105 Sumner St, Southwark, London. It is UK’s first commercial building to be endorsed by the UK Green Building Council’s as meeting its framework definition of a net zero carbon building in construction and operation. The Forge transformed the traditional design and reconceived it using a tech enabled, platform (P-DfMA) ‘kit of parts’ approach which ensures faster, safer, more sustainable construction while retaining creative freedom. The designers of the Western Residences scaled down the approach adopted by the Forge into the residential space by using a combination of typical BIM software (Revit, Navisworks) and generated a ‘kit of parts’ instead of a ‘bill of quantity’.

## 2.0 Project Overview and Site Context

The Western Residences on 2-3 Wilga close, Casula is a four-storey affordable housing project offering single bedroom, two-bedroom and three-bedroom dwellings adhering to the requirements of the Fleetwood Challenge brief. The demographic of Casula is burgeoning with family units comprising couples with children and the demand for affordable housing has peaked post COVID-19. The development is proposed on a site approximately 1000m<sup>2</sup>, in a predominantly residential neighbourhood. The subject site is known as 2 - 3 Wilga Close, Casula and is located at the eastern end of the cul-de-sac of Wilga Close. The site consists of two lots that correspond to Lots 82 and 83 in DP 244786. Surrounding the proposed site located on 2-3 Wilga Close Casula (Figure 1), are residential buildings. To the north, of the site is bordered by the rear boundary of 6 Tyalla Close, a two-storey brick and timber dwelling (Figure 2). 10 Birch Avenue is adjacent to the northwest and contains a single-storey brick and tiled dwelling with most of its windows facing Wilga Close. (Figure 3). Lastly 4 Wilga Close is adjacent to the south and contains a single-storey brick and tiled dwelling house with an attached garage (Figure 4). The area was rezoned to R4 High-Density Residential in 2008, but no adjacent sites have yet to be redeveloped. Nonetheless, it is anticipated that zones will eventually be redeveloped under the Zone's higher density controls.



Figure 1: site location (site shown in red line)



Figure 2: Dwelling house at 6 Tyalla close, Casula

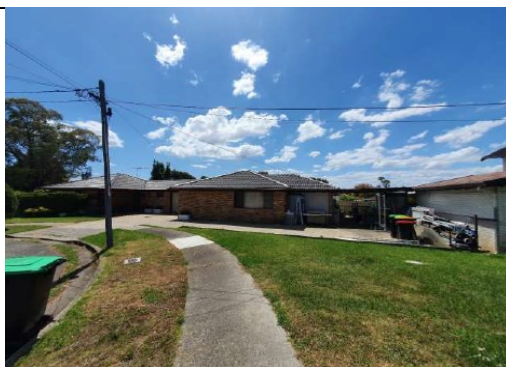


Figure 3: Dwelling house at 10 Birch Avenue Casula



Figure 4: Dwelling house at 4 Wilga Close Casula

The regulatory limits of the proposed site must comply with the Liverpool Local Environmental Plan (LLEP) 2008, Liverpool Development Control Plan (LDCP) 2008 core development standards and applicable planning controls and the Environmental Planning and Assessment Act, 1979. The proposal also complies with the Apartment Design Guide's relevant design criteria.

### 3.0 Deconstructing Net Zero

The designers deconstructed 'Net Zero' for the proposed development in terms of weather and site context (north-facing daytime living areas), geometry (shallow building for natural ventilation and light), fabric (analysing the thermal properties of the building components using Revit), services (lighting analysis using Autodesk Green Studio plug-in on Revit to simulate the amount of natural lighting for each unit and altering the design to allow for more) and renewables (solar analysis to simulate the solar radiation that impacts the roof design and orientation thereby estimating the potential for PV panels). The 'kit of parts' approach ensured simpler buildable details and a clear sequence of works which led to an effective thermal bridging strategy.

#### Step 1: North-facing daytime living areas

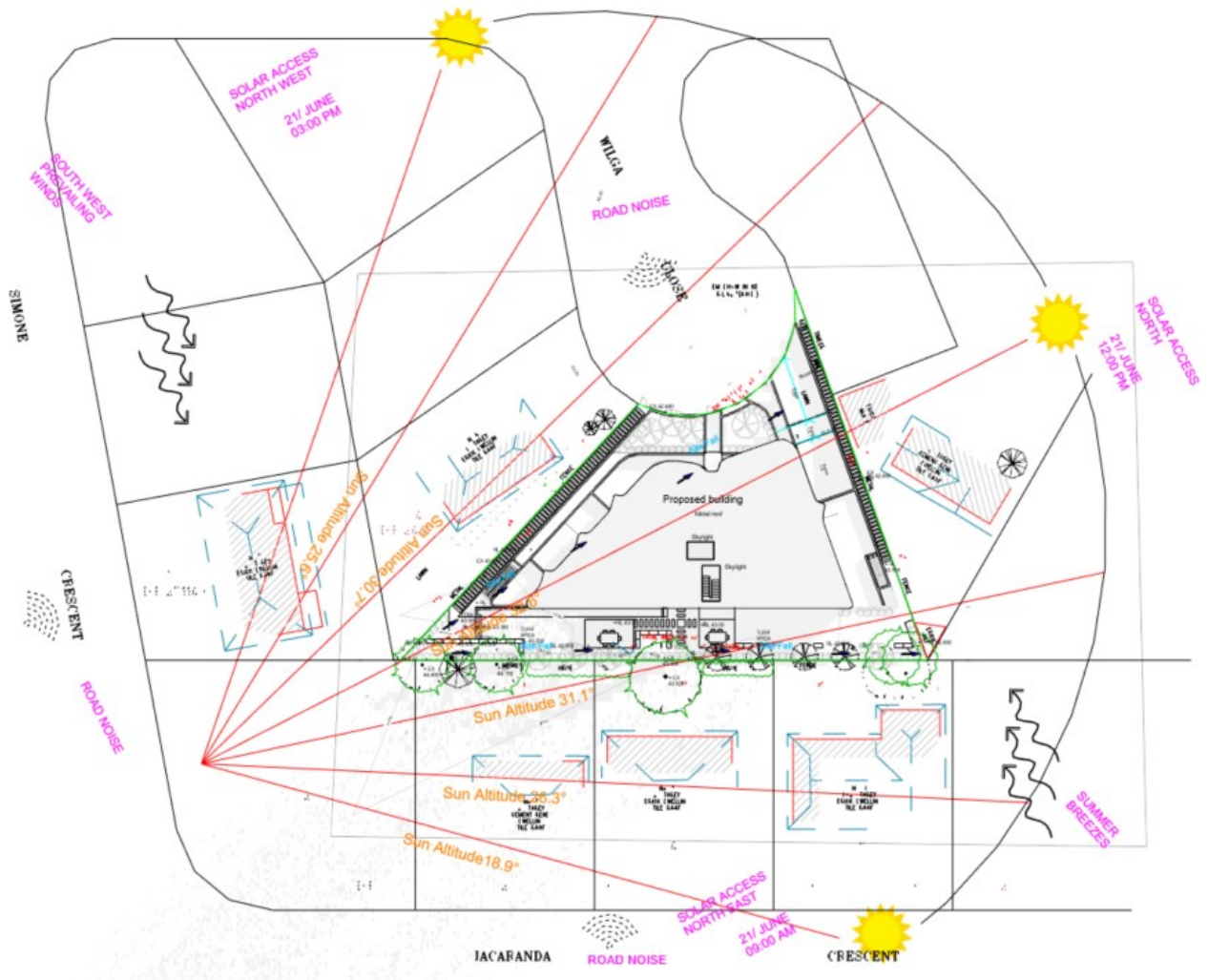


Figure 5: Weather and Site context (using Revit 2022)

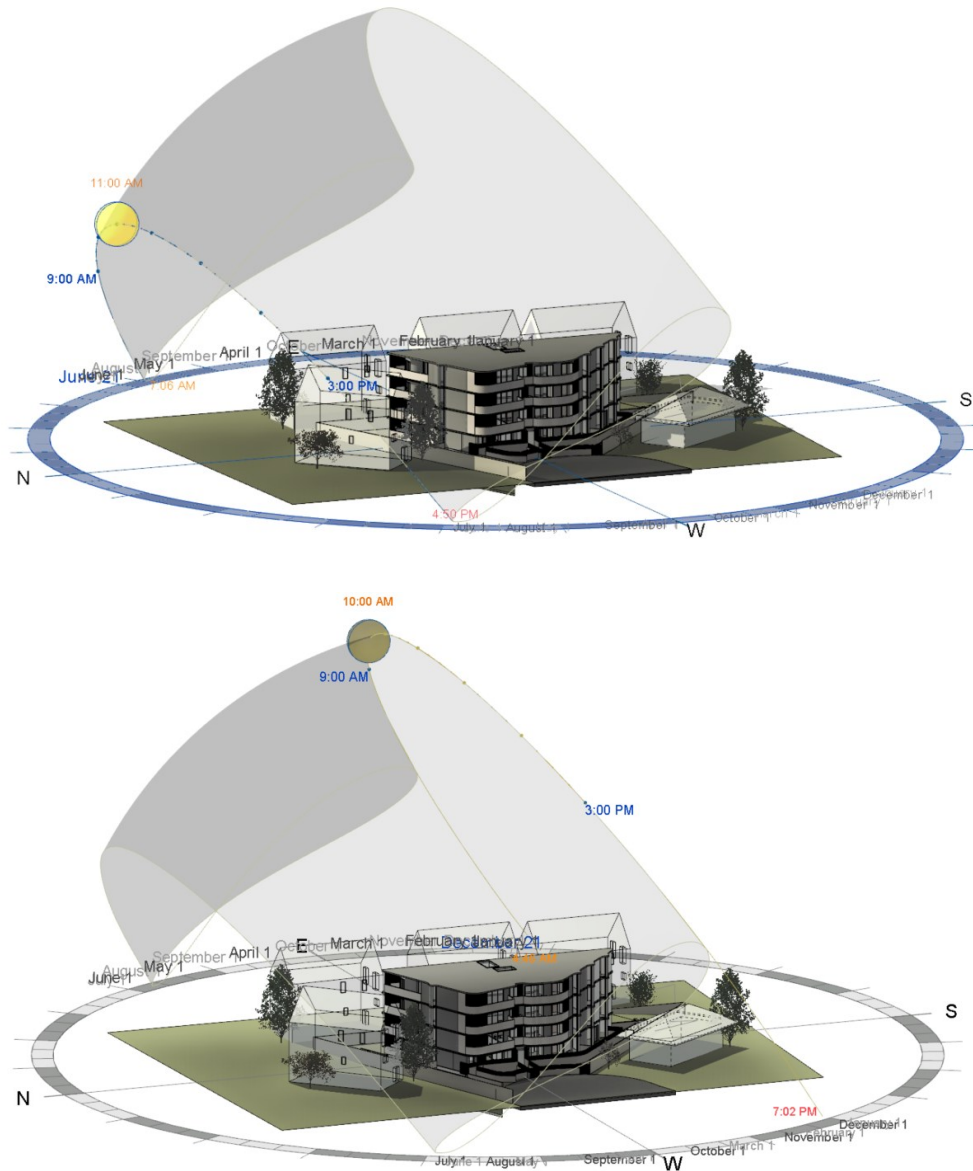


Figure 6: Winter and Summer Solstice Analysis (using Revit 2022)

**Step 2: Shallow building for natural ventilation and light**

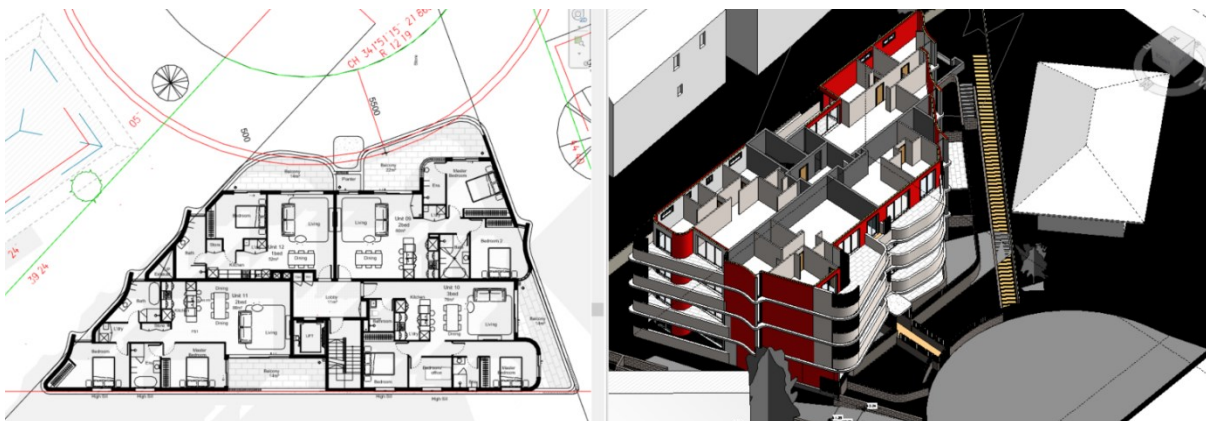


Figure 7: Geometrical considerations (using Revit 2022)



**Step 3: Lighting analysis**

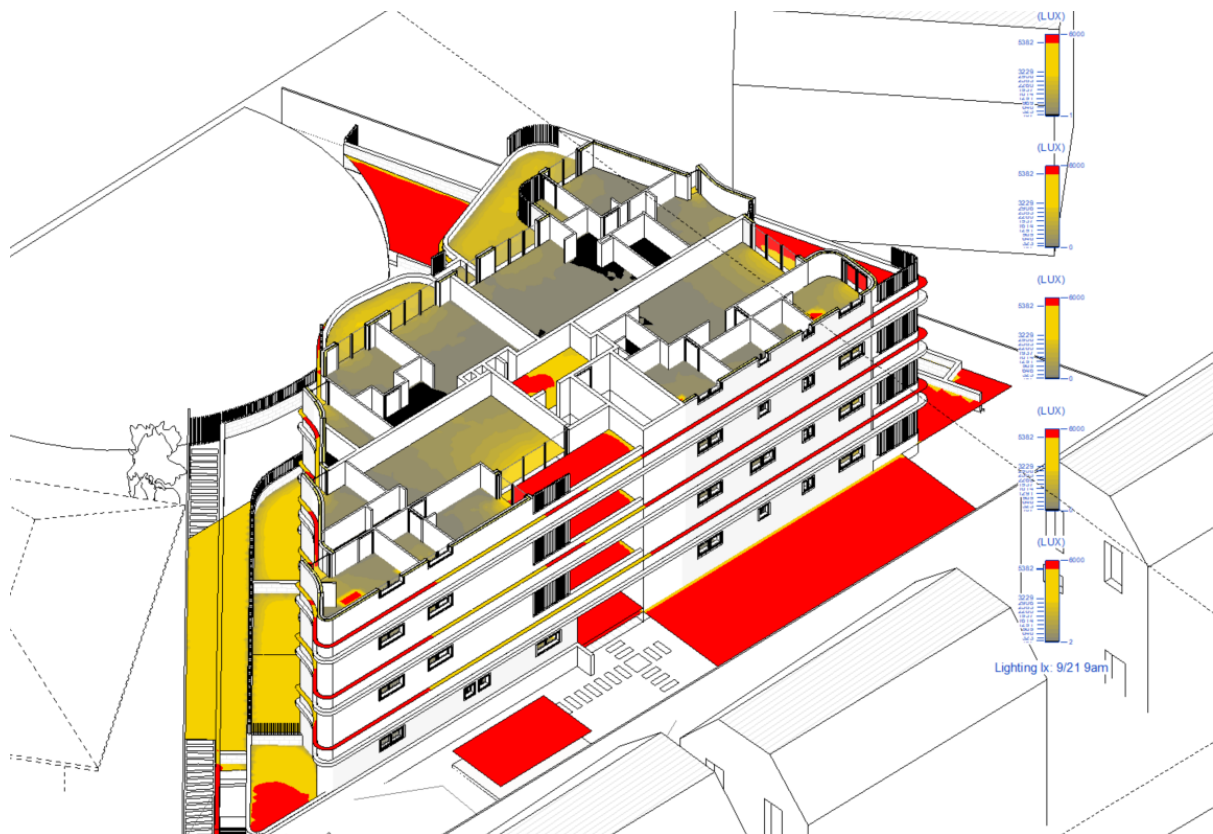


Figure 7: Lighting analysis using Autodesk Green Studio plug-in on Revit

**Step 4: Solar analysis**

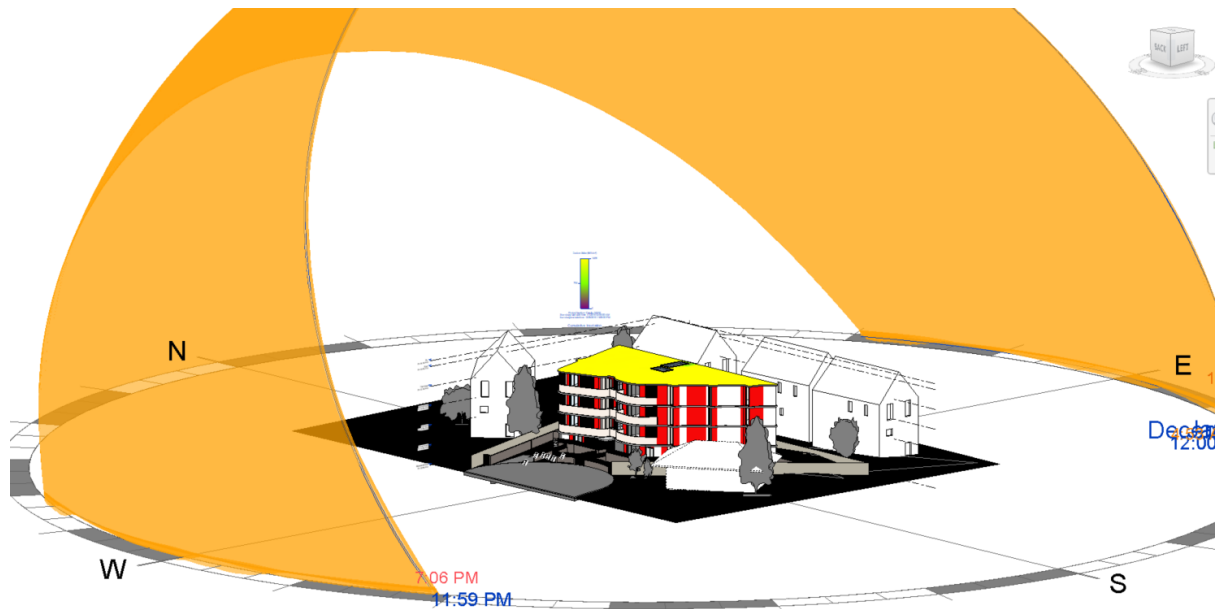


Figure 8: Solar analysis demonstrating that the entire roof is well exposed and has the potential of PV panels

The kit of parts approach which will be illustrated in the following section ensured an effective thermal bridging strategy as already mentioned earlier.

#### 4.0 The Kit of Parts approach

The term ‘kit of parts’ denotes “a collection of discrete building components that are pre-engineered and designed to be assembled in a variety of ways to define a finished building” (Brutting et al., 2021).

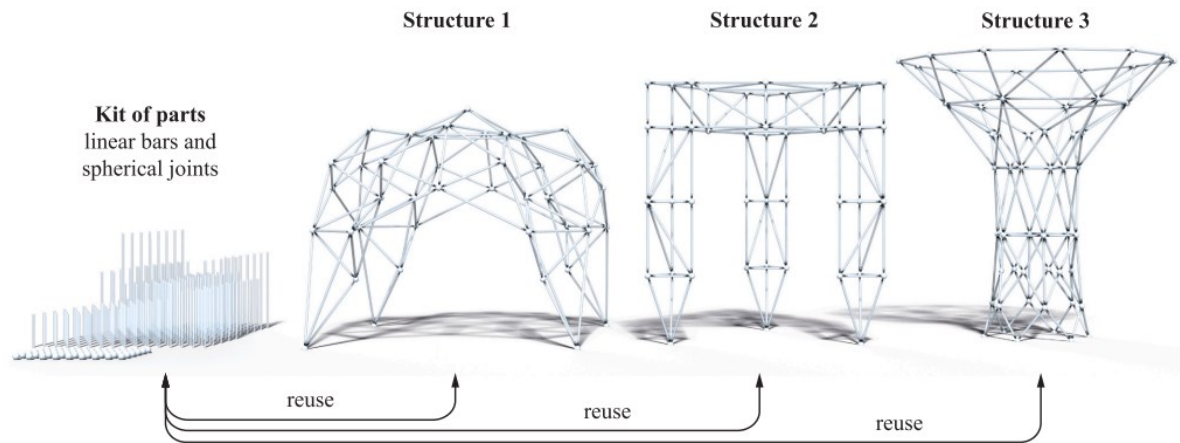


Figure 9: Understanding the concept of ‘kit of parts’ (Brutting et al., 2021)

The proposed development has been conceptualised as a ‘kit of parts’ instead of a ‘bill of quantities’ by using a combination of typical BIM software (Revit, Navisworks) as illustrated in Figure 10 and Table 1.

Table 1 – ‘Kit of parts’ as opposed to a ‘bill of quantities’

Category	Family	Nos
Metal	Fencing	59.5
Metal	Roof	1
Metal	Louver	786.9
Wet Area	Bathroom pods	27
Wet Area	Kitchenettes	16
Wet Area	Laundry	16
Wet Area	Balcony	12
Opening	Doors	101
Opening	Windows	34
Opening	Skylights	2
<b>Partitions</b>	<b>Walls</b>	<b>595</b>
<b>Partitions</b>	<b>Floors</b>	<b>49</b>
Facilities	Stairs	6
Facilities	Rails	6
Facilities	Solar Panels	36
Facilities	Lift	1

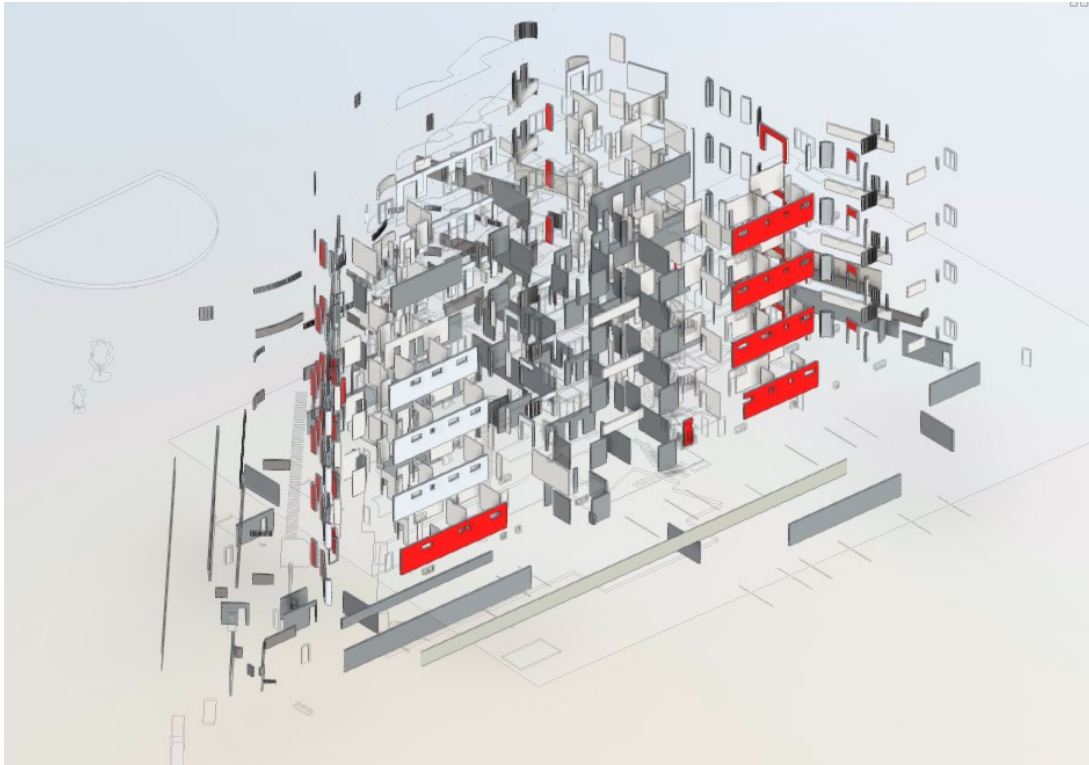


Figure 10: The commonality of **walls** in the proposed development (Autodesk Fusion 360)

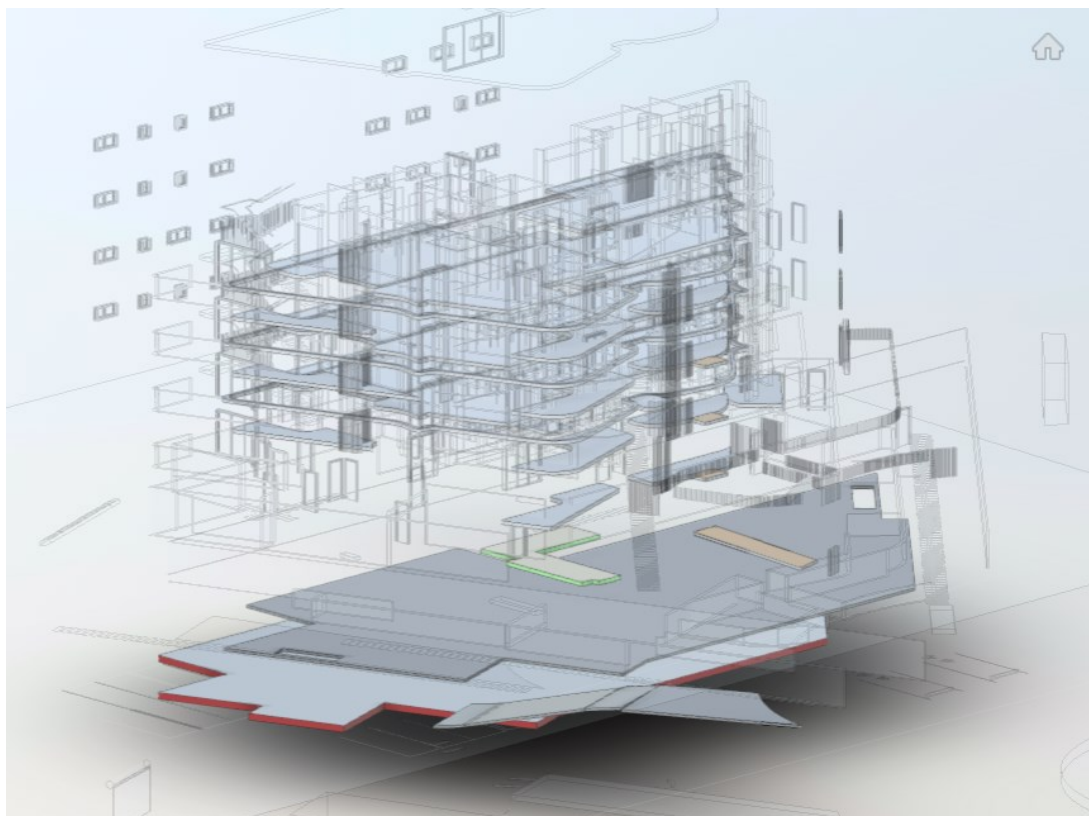


Figure 11: The commonality of **floors** in the proposed development (Autodesk Fusion 360)

The ‘kit of parts’ approach has enabled the designers to identify manufacturers within a radius of 50 kilometres that would potentially supply the repeatable components of the building thereby integrating the entire construction value chain and ensuring design for manufacturing and assembly. The designers of the Western Residences have gone beyond just design to understand the ‘who’, ‘where’ and ‘when’ of each building component through a multi-disciplinary mindset as illustrated in Table 2 and Figure 11.

Table 2 – Identifying manufacturers for the kit of parts

Category	Family	Manufacturer	Lead distance
Metal	Fencing	Fence Magic	30
Metal	Roof	CK Roofing Solutions	43
Metal	Louver	Arcadia	43
Wet Area	Bathroom pods	Builder Express	30
Wet Area	Kitchenettes	Builder Express	30
Wet Area	Laundry	Builder Express	30
Wet Area	Balcony	Austral Precast	20
Opening	Doors	B&W Aluminium Windows and Doors	30
Opening	Windows	B&W Aluminium Windows and Doors	30
Opening	Skylights	Natural Lighting	25
Partitions	Walls	Peri	30
Partitions	Floors	Peri	30
Partitions	Curtain walls	Peri	30
Facilities	Stairs	Steele Stairs Sydney	40
Facilities	Rails	Austral Precast	20
Facilities	Solar Panels	Sunboost	30
Facilities	Lift	Lift Shop	30



Figure 11: Location of manufacturers with respect to site location



## 5.0 Building Statutory and Regulatory Compliance

The proposed development complies with the apartment design guide. Table 3 illustrates the design objective and criteria.

Table 3 – Compliance to the Apartment Design Guide (Sections 4A – 4E)

Part 4 – Designing the Building					
<b>4A Solar and Daylight Access</b>	<b>Objective 4A-1</b> To optimise the number of apartments receiving sunlight to habitable rooms, primary windows and private open space.	1. Living rooms and private open spaces of at least 70% of apartments in a building receive a minimum of 2 hours of direct sunlight between 9am and 3pm at mid-winter in the Sydney Metropolitan Area and in the Newcastle and Wollongong local government areas	Complies	12 (=75%) of apartments receive min 2hr direct sunlight to living rooms and private open space.  Living rooms and POS areas receive a minimum of 1m <sup>2</sup> of direct sunlight, measured at 1m above floor level for a minimum of 15 minutes.  Zero apartments receive no direct sunlight between 9am and 3pm mid-winter.	
		2. In all other areas, living rooms and private open spaces of at least 70% of apartments in a building receive a minimum of 3 hours direct sunlight between 9am and 3pm at mid-winter	N/A		
		3. A maximum of 15% of apartments in a building receive no direct sunlight between 9am and 3pm mid-winter.	Complies		
	<b>Objective 4A-2</b> Daylight access is maximized where sunlight is limited		Complies	Full height balcony windows/ doors to maximize daylight access.	
	<b>Objective 4A-3</b> Design incorporates shading and glare control, particularly for warmer months		Complies	Awnings / overhangs and external screens assist with diffusing glare and providing shade	
<b>4B Natural Ventilation</b>	<b>Objective 4B-1</b> All habitable rooms are naturally ventilated		Complies	All habitable rooms are naturally ventilated	
	<b>Objective 4B-2</b> The layout and design of single aspect apartments maximizes natural ventilation		Complies	Openings in single aspect apartments have full height operable doors and windows to a balcony to allow maximum natural ventilation.  Living and bedroom rooms are offset to create difference in pressure regions and promote airflow.	
	<b>Objective 4B-3</b> The number of apartments with natural cross ventilation is maximized to create a comfortable indoor environment for residents	1. At least 60% of apartments are naturally cross ventilated in the first nine storeys of the building. Apartments at ten storeys or greater are deemed to be cross ventilated only if any enclosure of the balconies at these levels allows adequate natural ventilation and cannot be fully enclosed  2. Overall depth of a cross-over or cross-through apartment does not exceed 18m, measured glass line to glass line	Complies	16 Apartments achieve cross ventilation. Deemed to comply at 100%  Overall depth of a cross-over or cross-through apartment does not exceed 18m, measured glass line to glass line	
<b>4C Ceiling Heights</b>	<b>Objective 4C-1</b> Ceiling height achieves sufficient natural ventilation and daylight access	Measured from finished floor level to finished ceiling level, minimum ceiling heights are:	Complies	Ceiling heights proposed are consistent with ADG recommendations: - 2.7 habitable - 2.4 non-habitable Services to be maintained in non-habitable spaces to maximise ceiling heights in habitable areas.	
		Minimum ceiling height for apartment and mixed-use buildings			
		Habitable Rooms			2.7m
		Non-Habitable			2.4m
		For 2 Storey Apartments			2.7m for main living area floor 2.4m for second floor, where its area does not exceed 50% of the apartment area
	Attic Spaces	1.8m at edge of room with a 30-degree minimum ceiling slope			
	If located in mixeduse areas	3.3m for ground and first floor topromote future flexibility			
	<b>Objective 4C-2</b> Ceiling height increases the sense of space in apartments and provides for well- proportioned rooms		Complies	Habitable rooms are located directly adjacent openings and private open spaces where ceilings are maximized. Bulkheads are minimised where possible and services occupy ceiling spaces of	

Part 4 – Designing the Building						
			non-habitable rooms to prevent unnecessary reduced ceiling heights.			
	<b>Objective 4C-3</b> Ceiling heights contribute to the flexibility of building use over the life of the building	N/A	The development is designed as residential accommodation situated in a residential area.			
<b>4D</b> <b>Apartment Size and Layout</b>	<b>Objective 4D-1</b> The layout of rooms within an apartment is functional, well organised and provides a high standard of amenity	1. Apartments are required to have the following minimum internal areas:	Complies	All apartments comply with minimum internal areas		
		Apartment Type			Minimum Internal Area	
		Studio			35m <sup>2</sup>	
		1 Bedroom			50m <sup>2</sup>	
		2 Bedroom			70m <sup>2</sup>	
	3 Bedroom	90m <sup>2</sup>				
		The minimum internal areas include only one bathroom. Additional bathrooms increase the minimum internal area by 5m <sup>2</sup> each. A fourth bedroom and further additional bedrooms increase the minimum internal area by 12m <sup>2</sup> each				
		2. Every habitable room must have a window in an external wall with a total minimum glass area of not less than 10% of the floor area of the room. Daylight and air may not be borrowed from other rooms	Complies	All habitable room have a minimum glass area of 10% of the floor area of the room.		
	<b>Objective 4D-2</b> Environmental performance of the apartment is maximised	1. Habitable room depths are limited to a maximum of 2.5 x the ceiling height	Complies	All habitable room depths are less than 2.5x the ceiling height		
		2. In open plan layouts (where the living, dining and kitchen are combined) the maximum habitable room depth is 8m from a window	Complies	Window to kitchen dimension in open plan living are kept less than 8m.		
<b>Objective 4D-3</b> Apartment layouts are designed to accommodate a variety of household activities and needs	1. Master bedrooms have a minimum area of 10m <sup>2</sup> and other bedrooms 9m <sup>2</sup> (excluding wardrobe space)	Complies	Master bedrooms to all apartments have minimum area of 10m <sup>2</sup> and other bedrooms 9m <sup>2</sup> .			
	2. Bedrooms have a minimum dimension of 3m (excluding wardrobe space)	Complies				
	3. Living rooms or combined living/dining rooms have a minimum width of: <ul style="list-style-type: none"> <li>3.6m for studio and 1-bedroom apartments</li> <li>4m for 2- &amp; 3-bedroom apartments</li> </ul>	Complies		Living spaces to all apartments have minimum width of 4.0m		
	4. The width of cross-over or cross-through apartments are at least 4m internally to avoid deep narrow apartment layouts	Complies		All cross through apartments have minimum dimension of 4.0m.		
<b>4E</b> <b>Private Open Space and Balconies</b>	<b>Objective 4E-1</b> Apartments provide appropriately sized private open space and balconies to enhance residential amenity	1. All apartments are required to have primary balconies as follows:	Complies	All apartments have been provided with appropriately sized private open space and balconies.		
		Dwelling Type			Minimum Area	Minimum Depth
		Studio			4m <sup>2</sup>	-
		1 Bedroom			8m <sup>2</sup>	2m
		2 Bedroom			10m <sup>2</sup>	2m
		3+ Bedroom			12m <sup>2</sup>	2.4m
	The minimum balcony depth to be counted as contributing to the balcony area is 1m					
2. For apartments at ground level or on a podium or similar structure, a private open space is provided instead of a balcony. It must have a minimum area of 15m <sup>2</sup> and a minimum depth of 3m	Complies	Generous private open spaces proposed to ground level apartments.				
<b>Objective 4E-2</b> Primary private open space and balconies are appropriately located to enhance liveability for residents	Complies	Private open space is directly to a living space, orientated to allow for maximized solar access and ventilation				
<b>Objective 4E-3</b> Private open space and balcony design is integrated into and contributes to the overall architectural form and detail of the building	Complies	Balconies and private open spaces are integrated with the building form and facade				
<b>Objective 4E-4</b> Private open space and balcony design maximises safety	Complies	Metal screening provide additional protection.				

The proposed design complies with sections 3, 4 and 5 of the Apartment Design Guide. However, due to the restriction of 10 Pages, only Section 4A – 4E has been illustrated.

## 6.0 Stakeholder Engagement

One of the key enablers of design for manufacturing and assembly is collaboration and engagement. The team has used Fusion 360 as a common data environment during the design development. Access to the model is available through the link <https://a360.co/3aPrYN2>. A QR code is available for the judges and organisers of the Fleetwood challenge to interact with the model and provide feedback to the team even from the comfort of their mobile devices.

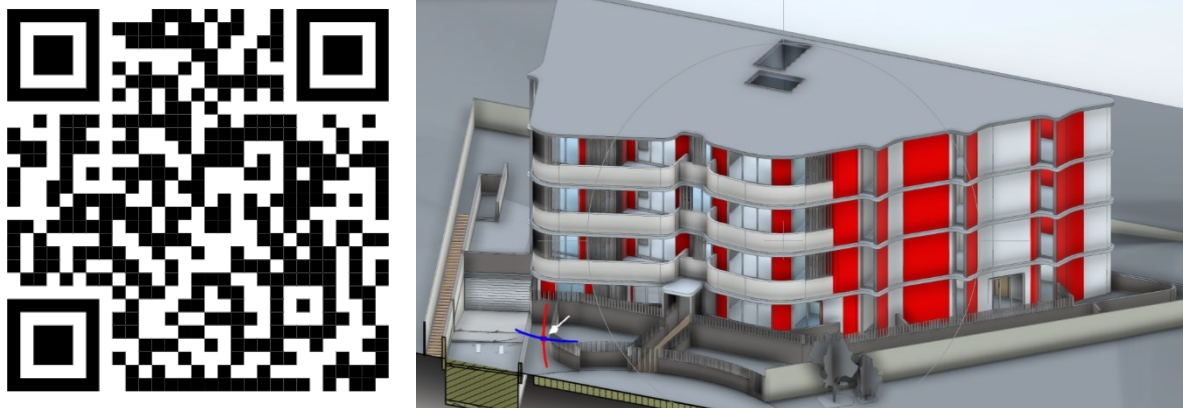


Figure 12: QR Code and Fusion 360 view for the proposed development

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