NEWPORT CO-HOUSING
SUMMARY OF DESIGN FEATURES AND FINAL REFLECTIONS

CLIMATE CONTROL

Siting

- The site was selected by a group owner for its broad north frontage to street and parkland beyond.
- South and east property boundaries are now partially and soon to be fully built against as the neighbourhood transitions from predominantly industrial to residential use. This will minimise transfer of heat (beyond internal comfort range) across the bulk of the long south boundary wall.

Planning

- Building volumes are held tight against the long south boundary to maximise northern sun exposure for dwellings and their food producing north-facing gardens.
- Living and sleeping areas are arranged by ceiling height and eaves overhangs to enjoy generous north exposure to low winter sun and to achieve generous bi-lateral high-low daylighting and cross-ventilation.
- Living zones of substantial area are readily compartmentalised with flexible walls and doorways to avoid heating or cooling of unoccupied space.
- Dwelling 2 can comfortably accommodate two independent households within what is a compact site and building envelope. At its lower level, several non-loadbearing internal walls have been specially detailed (with ceiling plaster continuous above) for easy removal/relocation and services have been roughed in for installation of a kitchen there to allow for a range of future living options.

Natural lighting and ventilation

Clients have sought broad visual connectivity between indoor and outdoor living spaces. So expansive windows and external doors have been:

- Oriented predominantly north towards winter sun and garden outlook.
- Well insulated, with timber frames and double glazing (12 thick argon cavity and low-emissivity surface coatings).
- Made operable, via meticulously sealed sliding sashes, counter-weighted double-hung sashes and motorised double-glazed louvres, to optimise summer ventilation whilst minimising unsolicited winter drafts.
- Accompanied by correctly proportioned eaves projections, external blinds and deciduous canopy vines to invite winter sun into and exclude high summer sun from dwelling interiors.

Natural light and cross-ventilation is provided to the rear boundary wall side of dwellings:

- For lower level living and sleeping areas, via courtyard window openings, substantial light wells to electrically operable roof windows and shade systems, and large adjustable fan-assisted vent shafts.
- For upper level living and sleeping areas, via courtyard window openings and electrically controlled double-glazed louvre highlight windows.
- For utility spaces, via small proprietary light and vent shafts.

Thermal insulation

External brick walls are thicker than standard to accommodate 40 thick XPS foil board cavity insulation. Insulation of roof/ceilings is with sisalation and approx. 160 thick R3.5 polyester batts (polyester being the healthier and more resilient bulk insulation choice at this time), but reverts to R2.5 rockwool in 90 thick wall frames (rockwool being the most insulative batt material for more slender frame cavities). Upper floors are fitted with R2.5 polyester batts to reduce airborne noise transmission between upper and lower living spaces, and to reduce heat transfer between thermally controlled and uncontrolled room environments.

Thermal mass

Lower floors are concrete slab on ground construction and in Dwelling 2, concrete floor surfaces are directly exposed to optimise their thermal coupling with interior air spaces. In Dwelling 1, the installation of timber boards over the concrete slab greatly reduces this coupling potential. Where they're without large openings, substantial cavity service requirements or the prospect of removal towards future space reconfiguration, external and internal walls have been constructed in solid or insulated cavity brickwork with bagged/painted finish to increase thermal mass.

MATERIALS

Concrete

Concrete from demolition of a factory previously on this site was delivered for recycling to Alex Fraser Group in neighbouring Spotswood. The mix for new concrete slabs and footings included for:

- Coarse aggregate … 30% recycled crushed concrete.
- Fine aggregate … 100% recycled concrete crushing dust.
- Cement … 40% fly ash (from coal fired power generation) and/or slag (steel foundry waste).
- Water … recycled truck and batch plant wash-down water.

Bricks

Bricks from factory demolition (those not cleaned on site for reuse in construction of Dwelling 3) were delivered to Alex Fraser for recycling. Bricks for construction of Dwellings 1 and 2 are dry pressed reds cleaned and recycled from elsewhere.

Timber

Construction timbers were selected firstly for fitness to purpose (with regard to strength, durability and dimensional stability) and affordability. Shortlisted timber products were then reviewed according to:

- Ecological impact in timber sourcing (informing preference for recycled stock, over salvaged tree wood, over native species plantation wood, over exotic species plantation wood, over native regrowth forest wood. Australian old growth and/or rainforest wood as well as any tree wood harvested overseas was avoided.
- Environmental and socio/economic impacts in timber processing and distribution informed a preference for wood sourced directly from small local harvest, milling and distribution enterprise as well as product that relies less on capital-intensive engineering process like glue-lamination for strength or chemical treatment for durability. Such process invariably carries health risks, the severity of which depends on the type of chemicals used and the OH&S standards in the industrial facility and country where the timber processing takes place.

Timber products selected for this project included:

- Seasoned Radiata Pine (Pinus radiata) from Victorian plantation forestry for most wall and roof framing (LOSP treated where externally exposed).
- Green Monterey Cypress (Cupressus macrocarpa), exotic windbreak trees salvaged from Gippsland farm properties for balcony posts, pergola beams, weatherboards and decking.
- Tempered masonite hardboard, press-formed with pressure and heat only (no added glues) from sawmill waste and forest thinnings, for some external claddings and eaves linings.
- LOSP treated finger-jointed Hoop Pine (Araucaria cunninghamii) sourced from Queensland plantations, or select grade recycled Blackbutt (Eucalyptus pilularis) sourced from a NSW woolstore for windows and external door frames.
- Karri (Eucalyptus diversicolor), Messmate (Eucalyptus obliqua) and Kauri Pine (Agathis macrophylla) floorboards reclaimed from previous construction use.
- Select grade recycled Victorian Ash (Eucalyptus regnans and/or Eucalyptus delegatensis) for internal glazed doors and joinery.
- Hoop Pine (Araucaria cunninghamii) plywood for some external wall cladding, internal wall lining and cabinetry.

WATER SYSTEMS

Rainwater collected from the roofs of all three dwellings is directed via a large in-ground filter to two 10,000 litre underground reinforced concrete tanks centred equitably either side of an inter-allotment boundary. This water is available in-house, pumped on demand to toilet cisterns, laundry troughs, washing machines, and to irrigate what are intensive food producing gardens.

At Dwelling 2, wastewater from bathtubs, showers, hand basins and washing machines is directed to an underground untreated greywater diversion pit, from where this water can be pumped for reuse to toilet cisterns, washing machine and garden taps, or purged to the town sewer if in excess.

At Dwelling 1, wastewater from bathtubs, showers, hand basins and washing machines is transferred via a 1,000 litre underground concrete untreated greywater holding tank to a greywater treatment plant installed in garden/bike shed. Class A treated water leaving this plant is stored in a further 5,000 litre polyethylene underground tank ready for pumping on demand to toilet cisterns, washing machine and garden taps.

In their gardens, residents know to draw from and deplete available treated greywater ahead of rainwater stores. A water controller automatically diverts from rainwater to town water supply when stored rainwater is depleted.

ENERGY SYSTEMS

In each dwelling, a network of hydronic panel radiators warm living and sleeping areas on a winter's night. These radiators are connected via ring mains that supply also potable hot water to plumbing fixtures. High-efficiency instantaneous gas water heaters keep ring mains hot and water drawn from them is replenished with water pre-heated by circulation between rooftop solar water heaters and 400L insulated storage tanks.

Dwelling 1 has a 3kW grid-interactive photovoltaic power system installed and Dwelling 2 has all necessary rough-in wiring laid for future installation of a similar system. All artificial lighting is energy-efficient compact fluorescent or LED. And judiciously focused task lighting allows general room illumination to be subdued.

INTERIOR JOINERY AND LOOSE FURNITURE

Much of the interior joinery and loose furniture for Dwelling 1 was designed, constructed and installed by the owner-builder of Dwelling 3, creatively incorporating a broad range of recycled materials (often elements retained in their pre-constucted form) in the final product.

THINGS WE MIGHT HAVE DONE BETTER WITH HINDSIGHT

Concrete

The foundation soils on site were problematic, containing highly reactive clays and patches with excessive moisture. Ground floor slabs were therefore massive with deep edge beams and bored piers. Whilst the use of concrete with considerable recycled content was environmentally sound and no more expensive, the floor slabs still consumed a massive volume of "virgin" resource in crushed basalt and Portland cement. It may have been worthwhile to weigh up the cost savings achievable against the thermal mass lost (predictable via computer modelling) had the buildings instead been anchored on steel screw piles and bearers with suspended timber floors constructed above.

Sliding timber door and window sashes

Despite considerable effort on behalf of the window joiner, we were unable to seal sliding timber door and window sashes against air ingress to the satisfaction of the residents. This was particularly the case with the large multi-slide door that opens onto the balcony from the upstairs living area of Dwelling 2, where the exposure to NW winds from across the park (commonly strong in Melbourne through winter and spring) can be a problem. In retrospect, should we have reverted here to more easily sealed swing doors and casement window sashes?

Water systems

Whilst ungelded in their commitment, the owner group was certainly challenged and frustrated by the technical complexities, many authority constraints and the overwhelming cost associated with design and installation of a state-of-the-art collective water management system for the three dwellings. The sheer quantity of tanks, pipes, pumps, pits, valves and meters required to achieve the outcomes detailed above was extraordinary. Preserving precious garden space by installing large water tanks underground came at a very high cost. Every attempt was made to rationalise pipework to shared trenches for minimal impact on garden layout. But minimum cover and fall requirement for many drainage pipes over lengthy runs made this not always possible.

Based on their concern that the passage of potentially contaminated water across allotment boundaries can pose serious public health risk, local water authorities would not permit the greywater from the three dwellings to be cleansed by a single communal treatment plant then reticulated back to the same three dwellings for reuse. The full installation costs for the greywater treatment plant and associated tanks, pipes, pumps, valves, etc., together with the running costs for electricity and regulated periodic maintenance of domestic-scale greywater treatment systems approved by government for in-house re-use, are extremely high. And for a single household, it would remain economically unjustifiable even if town water rates increased tenfold. Regulations need to be amended and technologies tweaked so these systems can be commissioned and their costs shared in a communal/neighbourhood network. Even the small system now installed for Dwelling 1 could comfortably treat also greywater from Dwellings 2 and 3. And with regulated maintenance regimes and fault alarms tied to a shared system, the quality of greywater, treated (ostensibly to drinking class) for flushing poos and washing clothes for three water-smart households, surely wouldn't pose an unmanageable public health risk.

Having said that, we've also been disappointed by the frequent breakdown of submersible pumps installed as standard system components. These failed pumps (invariably still under warranty) are more commonly replaced than repaired, and already three warranty replacements of two pumps in an untreated greywater diversion pit (being a standard proprietary product still awaiting its first commissioning) have been fraught with complexity and denial of responsibility by both the product supplier and the installer, a previous Green Plumber of the Year.

Had we known in advance that pushing the envelope in sustainable water management as we have would come at such a price, would we have lowered our aim and simplified?

New technologies

Since the time of construction, plasterboard with considerable recycled plaster content and affordable high-output LED lighting systems have become readily available. Today these can be included at minimal extra cost.

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