How to Build a Fish Room by Rene Jez. First published in Tank Talk Volume 12 No 3 in 1987

Foreword by the editor: At the beginning of 2014 – 27 years after this article was first published - Rene's fishroom was still operating. Rene has been an active CDAS member throughout that period and has bred and raised countless species of fish and plants in his Fish Room. Although he has slowed down a little in recent years, the number of articles in our archives penned by Rene, and the number of Breeders Award points he has accrued, is a testament to both his skills as a fish keeper and the contribution he has made to the club. As an Honorary Life Member and Sage in Residence, there are many, many CDAS members, including me, who owe a large debt of gratitude for Rene's mentoring and example, not to mention his generosity.
Paul Garrett January 2014.

Rene Jez - circa 2012

How to build a Fish Room

by Rene Jez

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When I first started my building activities behind a backyard carport, a friend commented "everyone in our Society is building a fish room". I had not been aware of the mini-wave of garage conversions into a variety of fishrooms; the coincidence was just accidental.
Actually, I felt quite disturbed because my planning of a fish house stretched back many years.
The search for the right solution had been on and off. My relatively small haouse and yard, together with my wife's determination to maintain architectural harmony within our back boundary, was a real problem. Even my secret buys of scrap metal and hiding these treasures did not advance the final goal.
Then a C.D.A.S. tank tour and a visit to David Rentz's house started the real preparation for future works. David, a well known orchid grower and past C.D.A.S. president, has a glasshouse extension of a living room. It looks super and my wife was impressed. The minor mechanical gadgets such as automatic heating, ventilation and fan appealed to me. Seeing my chance, I started immediately to push for something similar, but technical problems such as relocation of a sewer and other minor

but irritating building regulations prevented my following David's way.
Having the advantage of being C.D.A.S. librarian, I dug through old magazines and found a similar fish house building wave had happened in Victoria ten to fifteen years ago. The great discussions in FINCHAT magezine produced excellent articles on approaches to fish house design. Such local 'big guns' as Messrs Merv Dunn, Ron Bowman, R. Turner and others looked at the pros and cons in great detail and, with some engineering background, I was able to appreciate the depth of the discussion. The present article aims to present ideas for a design, with subsequent evaluation, after two years practical experience.
Before a final design can be formulated a number of important points need to be considered. Let us list them and then discuss each in turn.
Decisions to be made:
1. Priorities, to keep fish or plants or both
2. Room internal dimensions (number of tanks, their arrangement, maintenance access, passages, future expansion etc.)
3. Location and orientation towards the sun
4. Light distribution through room
5. Temperature and humidity control (heating, ventilation, automation etc.)
6. Building materials
7. Floor and foundations
8. Walls, windows, doors
9. Roof and ceiling
10. Water supply and drainage
11. Electrical installation, aeration, filtration
12. Operation and maintenance

Par. 1
To begin with let us assume sufficient experience of the hobbyist, well beyond that of the novice. A very basic decision is whether the house is to be used for fish keeping, plant growing, or both. Fish keeping requires a narrower range of water temperatures (circa 20-30 degrees C for tropical fish), whereas plants (with some exceptions) can tolerate a range of 17-35 degrees C. Plants require higher and more evenly distributed lighting, so when fish keeping is the priority, plants should be selected to suit the particular conditions in the tank. Plants do not thrive in overcrowded or semi-shaded tanks.

Par.2
The internal dimensions of the room are determined by the operation level envisaged. Remember to cover the possibility of future extension as one's commitment often increases beyond initial estimates but, of course, the more tanks the more work!
There are many possible tank layouts. The fish room should maintain the highest possible ratio of water volume in tanks to total volume, thus maximising heat

capacity and buffering against heating-cooling extremes. Details will follow.
Within the confines of the design, the arrangement of the tanks and passages is a matter of personal preference. A table, work bench or tank cover should be available for maintenance work or food preparation but space for more than a few visitors would probably rank as a luxury for most of us. Note, however, that the vertical layering of tanks gives rise to significant differences in mean temperatures and light intensities between the rows.

Par.3
A most important and often neglected point is passive heating offered by our cheapest energy source, the sun. The orientation of windows or transparent panels thus needs to be based on technical considerations.
In trying to adapt an established house, room or garage, we need to bear in mind all logical consequences. Insect intruders particularly termites (white ants), true ants and spiders, as well as moulds and fungi (some with strong odours) will cause problems and may perhaps lead to family tensions. So in the long run, a specially built fish house is a better proposition.
It is important to note that European-style glasshouses are not suitable for Australian conditions, for they do not match the higher angles of the sun here, during the seasons, and the much lower incidence of cloudy days. These are of pivotal importance in the successful operation of a fish house.
The main cities of south-eastern Australia have similar latitudes (Canberra, Adelaide circa 35 degrees, Sydney 34 degrees, Melbourne 38 degrees). This has a bearing on the location of windows and the variation in performance of a fish house between these cities will depend largely on differing levels of overcast conditions. The performance of a room is not influenced greatly by outside temperatures. Thus Canberra has more sunny days than Sydney but much cooler nights and winters. Canberra has the highest space heating requirements of any Australian capital city.
All data mentioned are important to meet basic needs for a successful fish or plant house but the major requirements are light and temperature control. Full utilisation of both is necessary in winter, whereas in summer input of heat and ingress of direct sunlight must be restricted. The outcome is that windows of an ideally located fish house should face north. (Editor's Note: Our Northern Hemisphere readers must, of course, reverse this direction to south.)

Par.4
Should the windows be constructed in walls or roof? At Sydney's latitude the sun rises at 33 degrees above the horizon on 21st June, whereas in summer this is near to 80 degrees at midday. These angles of course vary greatly during the day, from low values at sunrise and sunset, to the maxima just mentioned. The average for winter would be around 19 degrees and this automatically

prescribes windows perpendicular to the sunrays. In practice, vertical wall windows are best in this season. By contrast, summer input of heat and light to the house need to be restricted to avoid excessive rises in temperature and the nearly vertical sun's rays at midday preclude any transparent roof structure, unless adjustable shading is available.
The sun's transverse renders east or west facing windows undesirable: they improve light distribution through the room but although the east window is a help in winter, in summer both (particularly the west) transmit too much heat.
The judicious planting of deciduous trees can to some extent offset these problems.
It is well known that direct sunlight not only causes rapid growth of algae in tanks but also affects the water chemistry, through changes in the micro-fauna. Thus, strong sunshine should be controlled by window shading and appropriately wide roof overlap. The width adopted should be based upon midday angles, when the power of the sun's rays is greatest; a little direct sunlight in the early or late hours is of little consequence because of it's low power and weaker penetration. Thin glass, incidentally, absorbs some 5-10 percent of sunlight, even when at right angles to the rays. I have had good results by allowing sunlight to strike the lowest part of the window in mid-march.
With large or deep rooms light intensities could be low at the far ends. Thus, large windows in one wall are not the answer. Rather, a multiple modular roof is the solution bringing the above-mentioned advantages of vertical windows.

Par. 5
The ultimate goal of a well designed fish house is low consumption of costly or labour intensive energy, with efficient use of passive solar heat. Minimal use of mechanical gadgets will restrict unwanted heat input and reduce the need for frequent maintenance.
Individually heated tanks in an otherwise unheated room cause all sorts of trouble with condensation on cold objects, particularly painted surfaces, and, most dangerous, on electrical installations. Subsequently, moulds with unpleasant odours may proliferate on the moist areas.
The long-time experience of many hobbyists calls for a room with independant heating, derived from passive solar energy, plus a supplementary source. For smaller rooms the choice is simple, for electricity offers easy installation and regulation and instant clean, labour-free energy. Burners of various kinds are not to be recommended as they produce draughts, consume oxygen (and may deplete a closely sealed room) and produce poisonous fumes. Gas-fired heaters are prone to flame out, with great danger of an electrically fired explosion of unburnt gas.
Humidity control poses difficult problems. The simplest method is by ventilation through air changes, either by

convection or by forced air currents from an exhaust fan. Such ventilation will also help to control undue rises in temperature during summer days. For adequate functioning, and particularly in the absence of a fan, air intake should be close to the floor and the outlet should be in the ceiling. Outlets should be set far apart to achieve effective air movement and avoid stagnant pockets in the corners of the room.
Humidity is less of a problem in the independantly heated room, provided insulation is effective and without 'shorts'. By 'shorts' we mean paths of rapid heat transfer, via materials of high conductivity. In winter the low temperatures of such 'shorts' cause local condensation of moisture, to be followed by fungus or rot as a later problem. Heavy condensation will occur even on double-glazed windows and periodic collection of the run-off is a wise precaution, to avoid discolouration of the walls below.
Regulation of temperature and humidity may be by manual control of of openings or by more sophisticated automatic systems. A simple plug-in time clock is usually adequate and reliable. Conditions in a well-designed fish house vary little and only minor compensations for lighting and seasonal changes at, say, one or two monthly intervals is all that is needed.

Par. 6
Although there is a wide range of materials available the choice can be the Achilles heel of the amateur builder. False early economy can result in a heavy penalty later, so one should opt for the long-term effective and maintenance free system. The tropical system inside the room favours all sorts of undesirables, such as moulds, rot and insects. These soon cause degredation of softwood, while unprotected steel will rust, swell and disintegrate.
Bricks, galvanised iron or steel and aluminium are resistant to these agents but they are poor insulators and should be backed with mineral wool batts, free wool or polystyrene wherever possible. The thickness needed will vary with local conditions but one should avoid the temptation to economise and err on the thick side. Precautions must be taken to avoid moisture saturation of these insulators and local building regulations wiill explain how to do this. Protection of the insulation by 'sisalation' (reflective silvery foils) is necessary. Cladding with fibro-cement is the best treatment for internal walls. Polystyrene sheets or similar materials are structurally weak (Editor's Note: Mice love to chew on polystyrene sheeting. One of our members regularly finds piles of their droppings where they have chewed right through his fishroom ceiling); others attract condensation and should be avoided. Concrete is the only suitable material for floors and foundations, despite it's poor insulation properties.
The structural frame and beams are the most important elements of the house. They should be constructed strictly according to building requirements and be

treated or rot and termite resistant. W.A. Jarrah is too expensive, despite it's strength and resistance but Cypress Pine timber is satisfactory, in terms of strength and hardness and it's natural resins deter rot and termites. I had problems in getting larger size beams but ultimately settled for treated hardwood. Softwoods such as Pinus radiata should be strictly avoided in any area that is hidden from inspection. Marine ply should be used for all thin straight parts such as doors and frames. Surfaces that are likely to attract condensation should be left unpainted and enamels and other non-breathing paints should be avoided.
Although fibro-cement sheets are recommended for cladding inner walls, they are supplied with printed markings that are unsightly and need to be obliterated. In the search for an answer, the old fashioned and almost forgotten whitewash came to mind. This is hydrated lime (still sold as a mortar base) and, mixed with water, it proved ideal for walls and ceiling. Application is easy (use a brush rather than a roller) and the layer should be thin, to avoid peeling off. In my house, the free-breathing, porous and disinfectant surface is still in perfect shape after two years of service.

Par. 7
With regard to the floor, a good solid slab 100 mm thick (minimum) based on a gravel bed is the right answer. Anything less robust will fail to support the great weight of tanks and will be adversely affected by inevitable water spillage. The slab should be poured above the surrounding ground levels on compacted gravel fill. It should have a gradient towards a drain (with an open outlet from the room) and pre-formed holes for utility services (water, electricity etc.) or ducts if necessary.

Par. 8
Decisions about composition of walls, windows and doors are based on cost analysis, structure design, heat loss, and other 'architectural' requirements; they should not be determined on 'ad hoc' or price criteria. The proportional heat 'resistivity' of various materials (for a given thickness) are shown below.
Concrete 0.69
Brickwork 0.87
Glass 0.97
Steel 0.021
Timber 7.2
Gypsum Plasterboard 5.9
Masonite 21
Polystyrene 29
Mineral Wool 30 (depends on compaction density)
For those interested, insulation abilitiy and it's functioning can be explained on the basis of thermodynamical Fourier's law.
I have found some misconception among hobbyists about the insualting quality of polystyrene. In effect, still air has the highest insulation rating. Even small cavities

or fibres and their connecting walls transfer heat towards the edges. Thus, the more compacted the insulating layer, the greater the heat loss. The heat loss coefficients of polystyrene and mineral wool (batts) are very close. Therefore cost would be a critical criterion, but for a given thickness, polystyrene is very expensive.
Windows and doors are integral parts of the walls but are weak points in terms of insulation. Windows must be at least double-glazed but triple-glazing is best for Canberra's conditions. Permanent silicone sealant should be used to fix glass to structure, thereby reducing draughts. The air gap between glass should be 20-25mm, not more than 50mm and not less than 15mm. This inhibits air movement within the gap, which would reduce the insulation rating. From my experience, a removable outer, rather than inner, panel is more convenient in maintenance, for less humid air from outside then floods the gap.
Doors are an obvious necessity for access, but these constantly used 'nuisances' require heavy hinges, thick insulation, rigid construction and perfect double-seals. Any flimsy masonite door is quite unsuitable.
Penetration of moisture through small openings to the area between seals results in large drops on any painted or metal parts. In particular, elaborate door knob locks will develop moist spots and rust and be troublesome after about two years. A simple door handle is often far superior.
Although some hobbyists recommend a double door entry chamber to reduce warm air losses, this is unnecessary if doors are always closed promptly. Theory suggests an exchange of 1m cubed of air per entry and its rewarming from 10 degrees C to 20 degrees C would require only 3kcal. Since 1kwh equals 860 kcal and 1 litre of water needs 1 kcal for a rise of 1 degree C, the loss of heat per quick entry is quite low compared to the heat capacity of the house and its tanks.

Par. 9
Roof and ceiling construction parallel that of wall design. Building regulations set rates for sizes of beams and roof-frames, attachment of roofing and wind-load resistance. Choice of roof covering is a matter of preference. Galvanised iron sheets are easy to handle, whereas tiles require heavy structural support and fibreglass has limited life in Canberra weather; aliminium sheets are too expensive. Any roof requires sisalation, with a chicken-wire mesh support to stop inner face sweating. Insulation should be thicker than for walls to counter the greater potential heat loss. An opening for ventilation, properly rainproofed, double sealed and preferably with an automatic open and close system, should be part of the roof construction. The ceiling should be painted brilliant white (lime is appropriate) to reflect and distribute light.

One of the last operations is the fitting of lights. Mark the position of the beams beforehand to avoid poorly anchored fittings.

Par. 10
Planning of water supply and drainage is most important. Managing with buckets is not an easy option, in view of the number needed for even small water changes.
Connection of a supply from the residence requires either pressurised PVC pipes (class 18) as an easy and self-made job or copper pipe and soldered fittings. Stop valves and flexible hose leads within the room lead to simple, quick and easy handling. A high-located tank for warming up and maturing is desirable as mains temperatures in winter are too low for tanks. Automatic float valves are a more sophisticated option.
Room drainage, to cope with water changes or spillage can be by simple floor gradient towards a wall opening or floor sump. Water discharge onto a backyard lawn is an easy solution if the outlet is not connected to a sewer. The floor of the fish house should not remain permanently wet.

Par. 11
Proper installation of electrical wiring and power outlets must be undertaken by a qualified electrician and then checked by the local electrical authority. Outlets must be located above any likely level of water spillage. There is no trouble with condensation if outlets, etc. are in a warm part of the room, at ambient temperature, but problems develop if they are cooled, perhaps through poorly insulated connections with the outside. All parts of the wiring should be controllable and preferably visible. Plug in connections are also trouble-free but problems can be expected in unheated rooms with large numbers of tank heaters. Remember, the only real life-threatening danger (apart from mechanical accidents) is electricity. We cannot avoid it's use but safe planning is a must. All tanks with metal frames and or metal stands must be earthed, via a wire and a copper plate buried in the ground.
Portable lights, often used in detailed examinations of spawnings, etc., need to be no more than 24 volt, to reduce dangers from frayed connections. A simple transformer plugged into a power point and cheap car accessories with banana-plugs are easy to install and safe.
Air pumps also require electric power but are relatively safe. Noise level is not critical in a fish room but reliability and air volume matter. Note that the whole volume of air in the room may be sent through the tanks one or more times a day.
The location of air pumps should be near the floor, where it is cooler, in order to prolong the life of the rubber membranes. Any danger of siphoning water from tanks is obviated by the use of back-flow preventing valves.
Power filters are a similar story; safety and economy are important considerations.

Par. 12
In order to avoid unforeseen problems after start-up, the primary rule is that everything should be accessible, removable and preferably visible. The lowest tanks should be high enough to allow for cleaning and drying out. Ventilated storage areas are needed for daily use (but long term storage should be outside) and a flat area (table) should be available for maintenance activities. Other needs include rust-proof hooks for nets and hoses, and a light step-ladder with anti-slip feet, for reaching the upper tanks.
Windows will need shading cloth, preferably weather-proofed and the floor surface should be smooth for easy cleaning. Wooden stands will need metal or plastic footing to limit ingress of moisture and cardboard boxes should be kept off the floor to avoid rot and stains. Heaters and fans should be securely fastened with spring-locked nuts and kept clear of all flammable materials. Door locks will need frequent greasing and occasional checks of remote corners and shelves are desirable. A stock of spares for air pumps, filters, etc. should be on hand.

MY FISH HOUSE: DESCRIPTION AND EVALUATION

The item numbers follow the main text.
1. The room is intended for keeping tropical fish (mainly tetras), equally with growing and flowering water plants (*Cryptocoryne* species). A secondary role is growing tropical orchids.
2. Room internal dimensions: 2.7m x 2.1m x 2.4 m high.
10 tanks 1.2m x 0.375m, height 0.45m (x3), 0.3m (x4) 0.25m (x3)
4 tanks 0.45m x 0.25m x 0.25m (high)
4 tanks 0.20m x 0.35m x 0.45m (high)
8 tanks 6 litre, located in any free spaces and a number of small containers of plants
Passage central, circa 1.3m wide, future expansion possible but not under way.
3. Main window wall facing due north.
4. Light through vertical windows 2m x 1.3m x 1m high. Higher and lower tanks get reduced light intensity but the plants grow well (winter better than summer, with direct sunshine on windows.
In winter 50 % shading SARLON GREEN shadecloth with 0.3m gap at upper window; shading removed in summer. (Editor's Note: As seen above, Rene's fish room is so efficiently designed that it is hotter in winter than in summer, which is the way it should be with Canberra's long cold winter. Rene told me the other day that daytime temperatures reach 35 degrees C in the upper part of his fish room, which is phenomenal for an outside fishroom in May) Artificial light from sunset till 9 pm (summer and winter), 30w fluorescent (normal domestic white) tube on ceiling. A handheld torch (12v) for detailed spot searches.

5. Temperature control by electric heater 500w (radiation), with timeclock. Winter setting 1 a.m. to 5 a.m., overcast day (winter) 8hr daytime heater on. No ventilation used except that from entries and exits of curator.
Room temperatureequalisation: a fan blowing air vertically from floor level, operating noon to 4 p.m. Without the fan temperatures of upper tanks exceeded 32 degrees C, while the lower row were only 20 degrees C. The fan reduced the differences to upper, 26-28 degrees C, lowest 22 degrees C.
Humidity very high all year round. Probably a few quick forced air changes per day would be ideal, left for future works. Moisture tends to condense on cold objects but is not a major problem.
6. Building materials: outside, Lysaght's Stramit colour-bond galvanised iron sheets (including roof), internal Hardie fibrocement sheets 6mm thick, brass-screwed to frame. Main roof beams and corner posts building grade hardwood, painted with old engine oil, all other timber cypress pine without treatment. Insulation, 'pink' batts 100-150mm thick; between batts and galv. cladding, reflective foil used on walls and roof. Polystyrene 'bridge' breaking insulation layer 10mm thick between inner fibrocement sheets and contacts with timber frame.
7. Floor and foundation, formed concrete slab 120mm thick, with reinforcing mesh around walls to carry tank load; bricks in two layers above floor to provide base for timber structure.
Cast-in polythene pipes for future solar heating; a sump with outlet for drainage. All water released via bucket and flexible hose; floor insulated in winter by thick woollen carpet and 'easy clean' carpet strip giving rise to very little smell in four months use per year.
8. Wall, windows and door as described in par. 6. Windows double-glazed (outside glass fixed), inner glass in aluminium frames. This will be changed to fixed inner glass. Door frame of radiata pine, with 100mm cavity filled with 'pink batt' wool; a window (double glass) permanently fixed. Windows are a source of some water condensation, but will be modified as above. The door as constructed had a slight twist in it's frame that did not straighten after final mounting in the jambs; such work needs maximum care and accuracy. Also, water pools develop inside the door-lock and condensation within the double-seal above door top. Marine plywood recommended for door construction and unpainted cypress pine for door frame.
9. Roof and ceiling construction similar to wall; insulation layer is 150mm thick, a ventilation opening 300mm x 200mm is not used.
10. Water supply from garden tap through buried PVC 20 diameter pipe; a sop valve in front of fish house, internal distribution via flexible hose with terminal stop valve. Water used for tanks without aging (Editor's Note: Canberra's water comes to us with a minimal amount of chlorine, no chloramines, and is of a good quality)

are thus limited to 10-20% of tank volume.
Drainage normally via transferable buckets with screen and flexible hose to outside outlet, but a release pit provided in corner of room for emergencies, it's outlet plugged with filter floss to stop insects.

11. Electrical connections split into 1 x 6 socket and 2 x 4 socket Kambrook boxes to service heaters, lights, etc. seperately as individual plug-in units. Maximum electricity consumption not above 1600W, with all units on (lowest tanks have own heaters set to minimum temperature of 19 degrees C.
Low-wattage heaters recommended, as the 'on-off' type at 2000W can cause overload if smaller units cut in as well. The rapid wearing of contacts is another risk with them. Fuse failure can stop aeration and any overcrowded tank is soon a write-off.

CONCLUSIONS

My little fish room has performed superbly. There have been no major problems and running costs are around $15 per month in winter and well under $5 in summer. Essential maintenance is little beyond the mopping up around wet windows and door areas, when condensation is excessive; little time is lost from hobby activities. The fish room is no encumbrance to family life and I feel its design and construction were the right answer to all earlier problems.

Editor's Note: It is five years since this article was written, and Rene's fish room still continues to work efficiently. He still manages to find new species of fish to breed every year, and breed large numbers of healthy specimens.
Passive solar energy is something to keep in mind. It can save you thousands of dollars over the course of your hobby and save quite a few tons of coal being burnt to supply electricity for inefficient systems. Ecology and economy can go hand in hand, and have in the fish room of Rene Jez. I have plans to build along similar lines, and will be experimenting with windmill-driven 12 volt power for lights and solar heating through convection-driven saline solution running through pipes in the floor and back up to solar collectors. The technology is available now, but is still expensive. Home-made windmills powering car-alternator-generators with second hand UPS batteries don't cost much, so I'm told. Only extensive research and time will tell.