Problem:
1/ Australian eucalyptus forests have evolved and seem to require wild-fire ie “bush-fire” at a certain frequency; if the distribution of plant species is to be sustained.
2/ There is also a demand by non -indigenous Australians to build dwellings in or adjacent to such forrests; with the result that small towns and roads accessing them have come to exist in such areas.
3/As a result of human caused climate change; higher temperatures, dryer forests and more frequent droughts seem inevitable for the forseable future; or at least until an effective global abatement strategy can be put into effect. Realistically this is at least a human lifetime away and will at best reduce Australian bush-fire intensity and frequency to historical levels .
4/ If loss of life and property during such bush-fires is to be reduced
-back-burning and clearance of forest away from dwellings does offer some respite
- likewise designing dwellings which are less combustible and resistant to ember attack
BUT
- even costly back-burning seems unlikely to eliminate bush-fires entirely and seems likely if done yearly, to interfere with the lower frequency large scale fires, which these forests have evolved for. Even the indigenous technique of small controlled “cool-burns”; seems unlikely to eliminate large scale bush-fires entirely and would thus seem to offer no certain protection to houses , towns and vehicles on roads in Australian eucalyptus forests in summer.
-the main problem which: bush clearance, less combustible construction and design for ember attack;

see for example https://www.lunchboxarchitect.com/tag/bushfire-proof-houses/

fails to account, is the radiant heat flux; which in a worst case scenario with 20 m flames, can reach or exceed 50KW/m^2 across a 20 m cleared space.; perhaps for the 1000 or 2000 seconds it takes for the flame front to reduce and move on.

eg see graph P17 https://www.mdpi.com/2571-6255/2/1/4/pdf

Even with a fully steel construction which survives the fire; the inhabitants would be killed in such a situation due to the excessive air temperature in the house.

How to design a dwelling which will survive with minimal damage; a worst case crown-fire scenario and also protect it’s inhabitantants and their possesions; at minimal cost ?

The following design idea is tentative and since escape during a worst-case bush-fire, is not possible would need to be computationally and empirically tested against a series of worsening situations; eg radiant heat flux KW/m^2, ember rattack , CO and CO2 and even lower O2 levels; to establish a bush-fire rating .

1/ The dwelling will need to be for the greater part , ‘in-ground’
nb this is not an original idea see https://www.baldwinobryan.com/bush-fire-resistant-houses.html
but the hope is the cost can be much reduced by using ‘off-the shelf’ compoments and an iterative design process where by higher cost materials and building processes; are successively replaced by lower cost !

2/ Windows will need to be coverable by metal fire-shutters

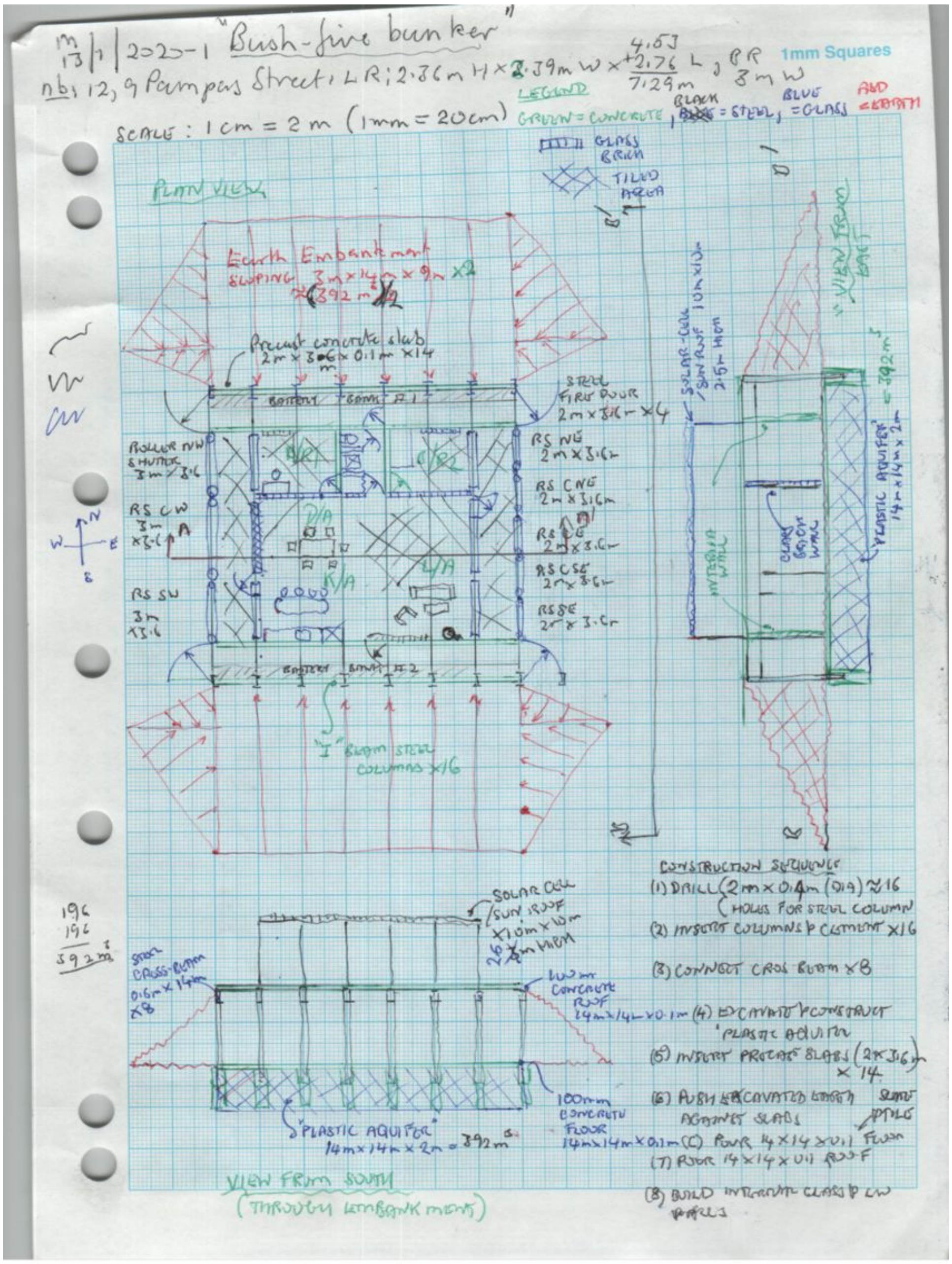
3/ Fire shutters and any other exposed features will need to be protected by a spray irrigation system

4/ The spray irrigation system will need to be supplied from an independent radiant heat insentsitive water supply; since shire water supply may be compromised.

5/ All pipes and pumps and motors of the irrigation system will need to be radiant heat insensitive; probably also inground.

6/The irrigation system will need to be powered by an independent radiant heat insensitive energy source; probably also inground, since grid-power may be compromised

7/ The storage capacity of the irrigation system for exposed area 'A’ [m^2'] (window shutters plus other features)and fire exposure duration of say 2000 seconds =2 x10^3 [sec] would seem to need to be AT LEAST;
- given latent heat of vaporisation of water = 2.256 x10^3 [KJ/kg] and 1 KJ = 1KW x 1 sec
which implies we need 1/ 2.256 [kg/sec/KW] = 4.43 x10^-1 [kg/sec/KW] of water ;
-now with the design illustrated the exposed area = 2 x 3.6 [m] x 14[m] = 102 [m^2] = 1.02 x10^2 [m^2];
thus the total radiant flux =5.0 x10^1 [KW/m^2] x 1.02 x 10^2 [m^2] = 5.1 x10^3 [KW]
-thus required water flow = 5.1 x10^3 [KW] x 4.43 x10^-1 [kg/sec/KW] = 221.5 [kg/sec]
= 2.215 x 10^2 [kg/sec] ;
-now this may need to be maintained for 2 x10^3 [sec];
thus required storage capacity = 2.215 x 10^2 [kg/sec] x 2 x10^3 [sec] = 4.43 x 10^ 5 kg;
and 1[m^3] of water with density 1x 10^3 [kg/m^3] = 1x 10^3 [kg];
thus required storage capacity = 4.43 x 10^ 2 [m^3] ;
-notice conservative assumptions : - radiant flux from two sides (more likely just one)
-fire exposure for 2000 seconds ~ half an hour which may be unduly pessimistic



Notes on the first design iteration:

1/ The 'worst case' situation above reveals a shortage of stored water ie 392 [m^3] versus 443 [m^3] required; this might be rectified in a second iteration; by increasing stored water and/ or decreasing exposed window area , eg by increasing east-west length and /or decreasing north-south width.

2/ The extreme open plan design with large 3 m x3m folding door window on the west side is intended to provide access and protection to motor-vehicles in a bush-fire crisis.

3/ The large combined 10 x10 [m^2x 2.5 m high] solar collector and sun-deck is intended to be protected by spray irrigation but in a the bush-fire crisis; will obviously have lower priority than window shutters,