Dysfunctional Design Top 10 – and still counting:

There is a relevant quote from George Orwell: “Some ideas are so stupid that only intellectuals believe them.”

There appears to be a new mentality of cut and paste design occurring in our current reservoir constructions. Old mistakes, unsuitable materials and poor building methods seem to be reappearing again, after a period of relatively good outcomes.

This can be put down to several issues:

Designers and engineers having no effective field experience.

Clients who do not understand or visit their existing tanks.

A lack of ‘fit for purpose’ guidelines on tank design and operational issues.

This has been a cyclic issue over millennia, as new staff take over from retiring members and knowledge is not passed on…or is ignored by the incoming generation.

A water storage tank is not like a normal industrial building, housing machinery, materials and people. It has many unique operational issues that impact on its ability to function effectively and to reach its expected design life. Stored water creates pressures on walls, floors and expansion joints. It accelerates corrosion to anything it contacts and also creates a humid and gaseous environment to materials and structures situated around and above it.

Tanks are often being treated like commercial buildings, using similar materials and construction techniques which are not suitable for their specialized application. Cost cutting, short term duty of care and outcomes based on modelling instead of real time experience, all contribute to the current problems facing our water industry today.

This now leads to a listing of ‘The 10 most stupid things seen to date’. It was difficult to settle on that amount, but time does not allow for everything to be presented in this document!

Number 1: Building a tank whose walls are designed to move in and out under pressure and then the client back-filling directly against those walls, to save money on a retaining wall. This leads to significant structural damage and a complete failure of the tank in some circumstances.

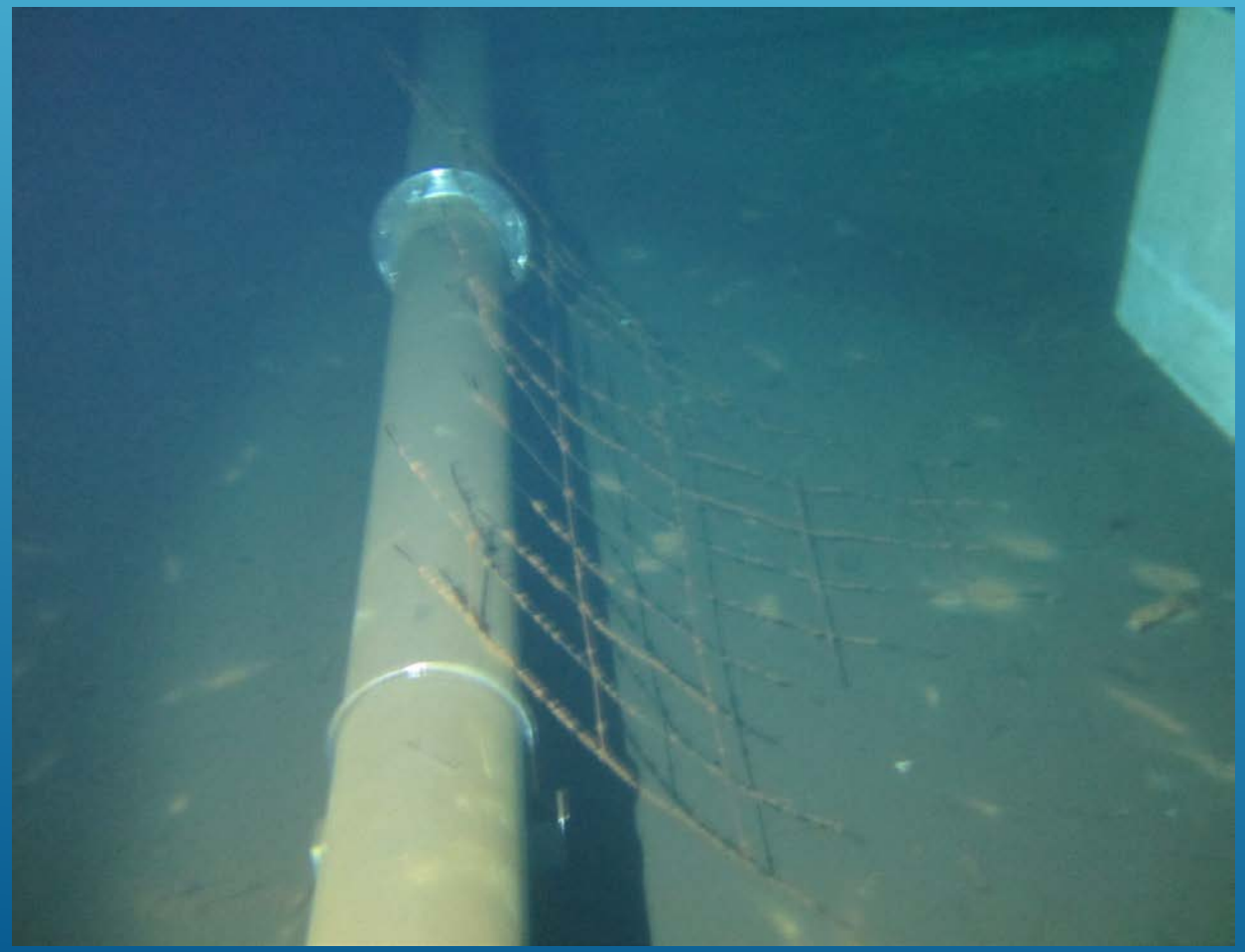
The backfilling has caused the walls on this tank to spall in the middle areas, after three years in service.

Number 2: Roofing that allows rain water and associated contamination to enter into the tank. Platform and hatch areas are commonly unsealed and allow debris to accumulate on the upstream edges, causing ponding and roof sheet deterioration. It is often assumed that a bit of extra water will be a bonus in these dry times, but would tanks storing wine or grain allow water to flow in or would a house holder or factory owner accept rain water entering into their building?

Flashings on the edge of roof areas prevent rain water from draining off and ridge cap flashings are difficult to seal and allow all sorts of debris, bird nesting and vermin entry to occur.

Number 3: Placing safety mesh under the roof sheets to comply with OH&S during construction. This material is usually the cheapest available and corrodes quickly, causing the roof sheets to fail and then dropping the debris down into the tank and making regular cleaning of the floor difficult. In a factory situation, there would have been a layer of insulation between the mesh and the roof sheets.

The corroded safety mesh breaks away and drops down onto the floor area, making effective tank cleaning a near impossible task. It also corrodes the roof sheets from the underside, leading to structural failure and an unsealed roof surface.

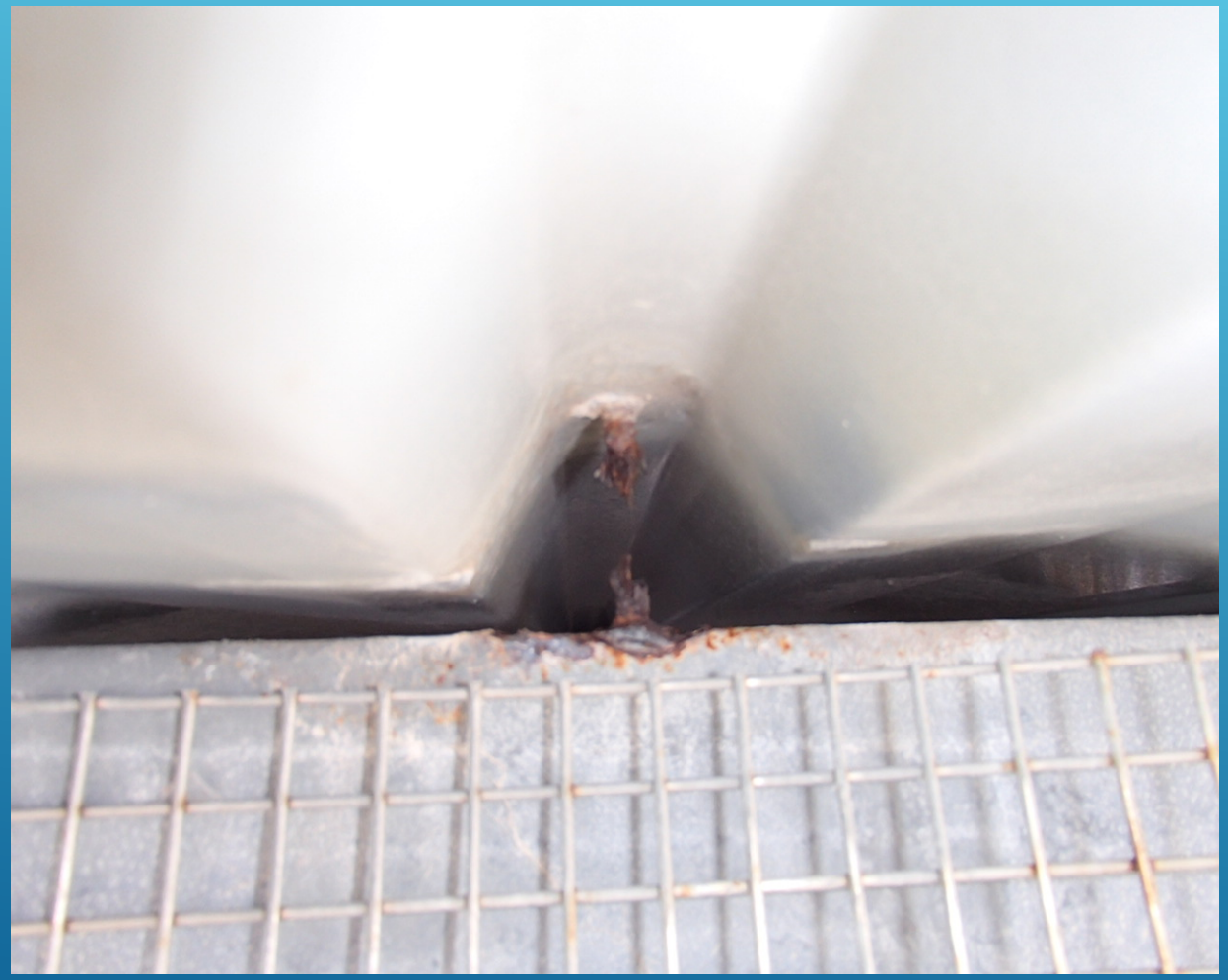


Number 4: Using roof framing materials that are not suitable for hot, moist and gaseous conditions. Zincalume coated purlins and rafters have a short life span in these situations and they also deteriorate quickly when roof screws puncture the surface coating.

Zincalume purlins and rafters corrode heavily in warm, moist conditions. They are also quick to break down when immersed, if the tank water level settings are not adjusted correctly as the image on the RHS indicates.

Number 5: Roof screws that are not rated for marine or extreme conditions. The roofing contractor often uses the cheapest type of screw to reduce costs, but corrosion failures are now occurring under five years in some environments.

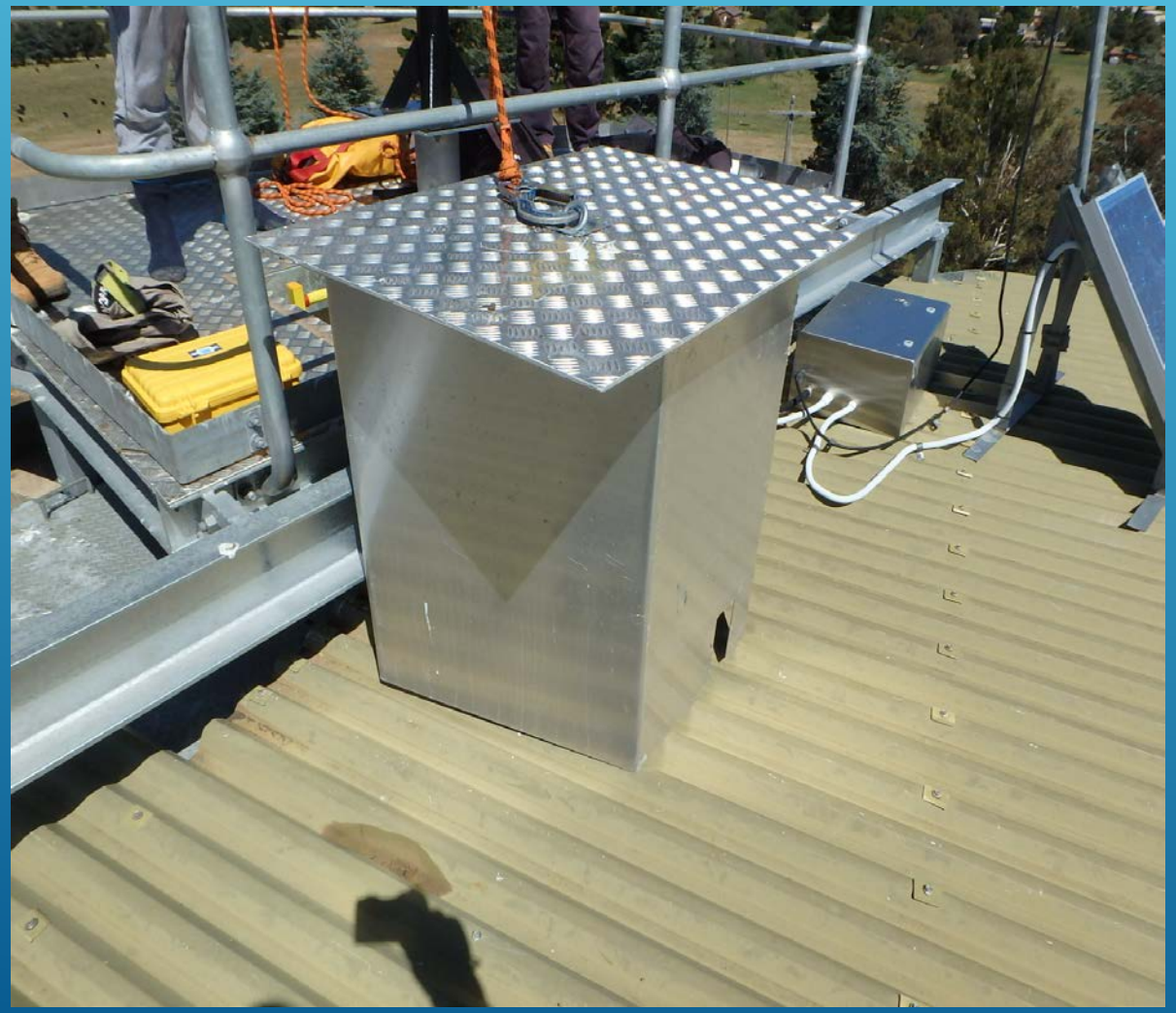
Cheap roof screws corrode away in warm, moist conditions. The roof sheets are then left unsecured as the image on the RHS indicates. Only category 4 Buildex type screws should be used in these conditions.



Number 6: Platform and entry hatch designs that limit working space and safe access into and out of the tank. What may be suitable for a factory environment is different to an elevated, confined space application, where diving and rescue equipment is commonly used. Platforms mounted high over the entry hatch area, instead of being level with the roof.

The worst platform outcome identified to date! A new platform was constructed over the top of the existing one, which was partially removed, leaving a large unsealed area leading directly into the tank.

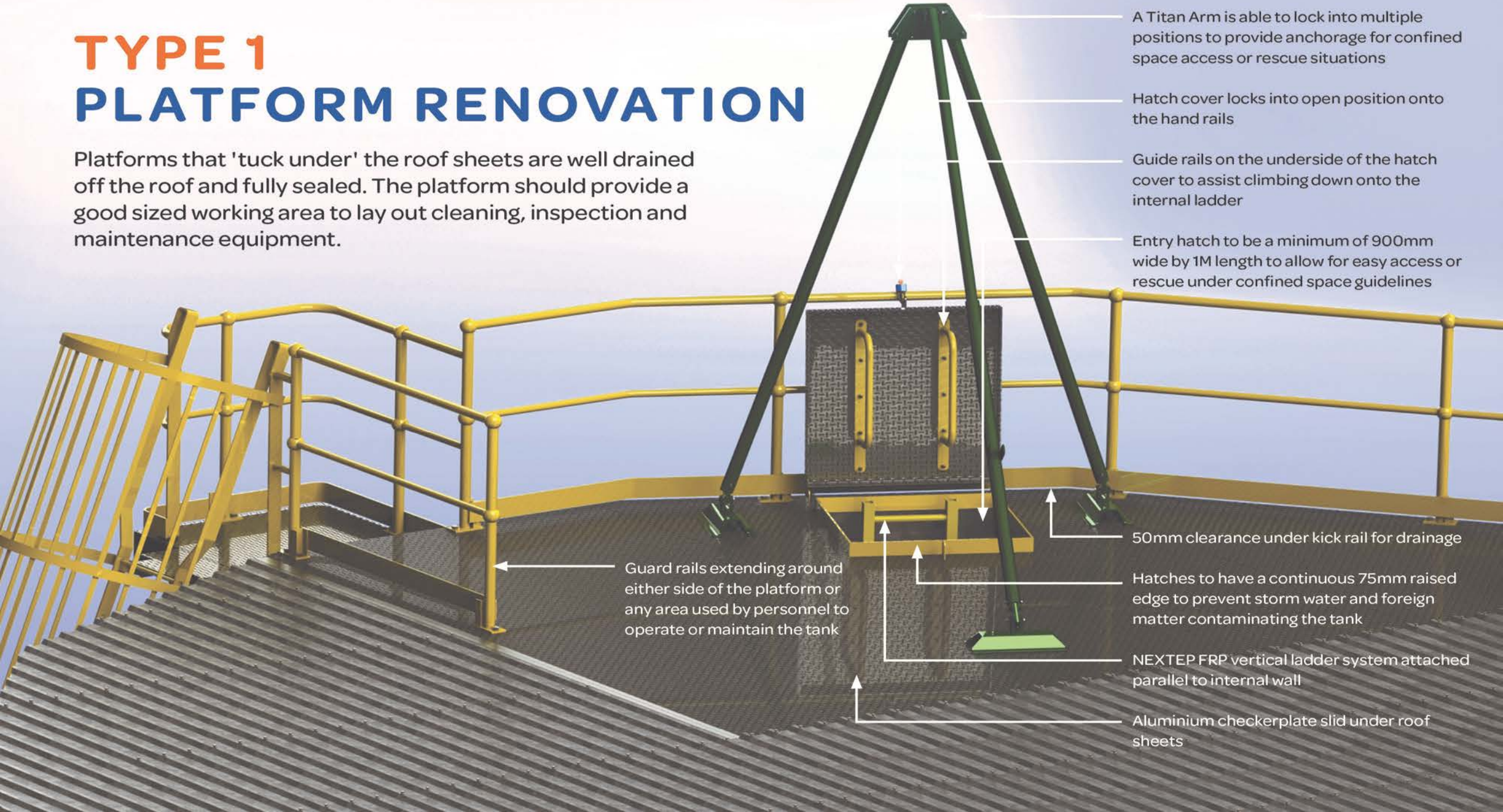
The entry hatch cover was then made up as an extended section and dropped down into the open roof hole. It wasn't sealed onto the new platform area around the edges, but below the platform was a far worse sealing issue!



Entry hatches mounted too far off the wall, so that ladder supports have to be extended to accommodate the excessive distance.

TYPE 1
PLATFORM RENOVATION

Platforms that 'tuck under' the roof sheets are well drained off the roof and fully sealed. The platform should provide a good sized working area to lay out cleaning, inspection and maintenance equipment.



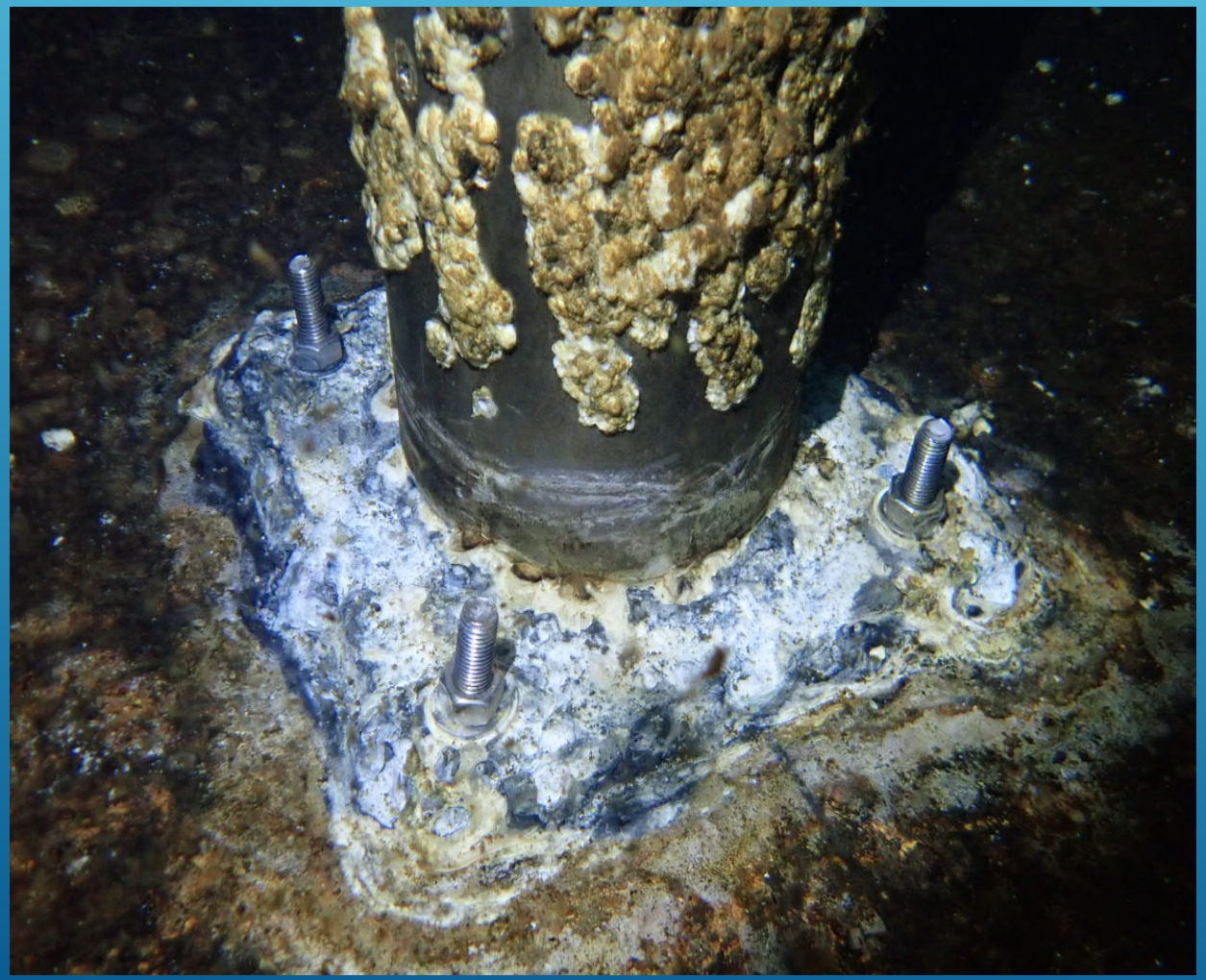
No7: Aluminum roof framing that is not securely fixed. While aluminum is a good corrosion resistant material, it has a lot of flexing movement and will loosen off the fixing bolts unless nylock type nuts are used. Being a softer material to steel, extra thickness is also required for edge flashings, as fixing screws are prone to pulling out in windy conditions.

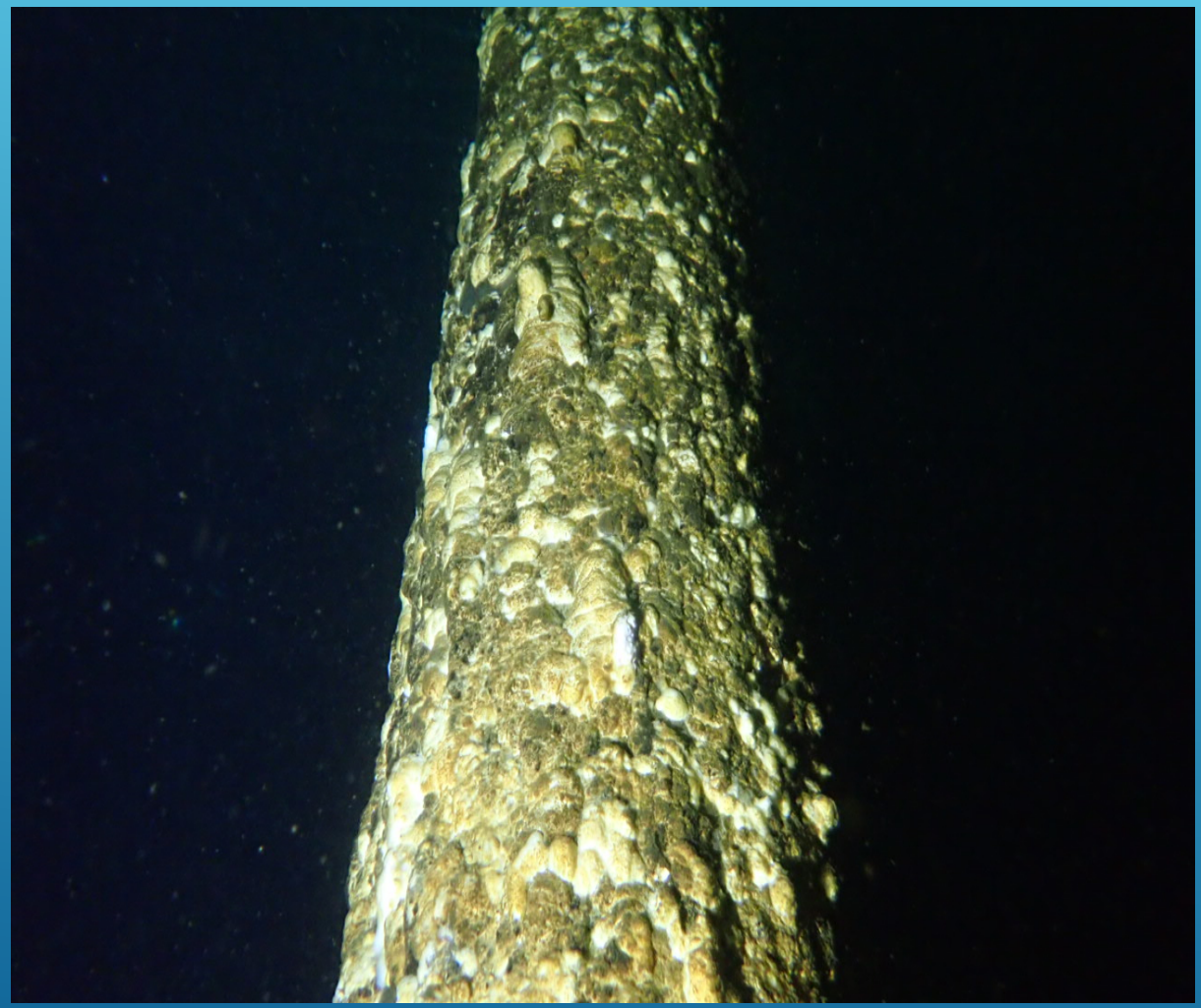
Connection bolts are missing completely in some areas.

Roof edge screws fixed into thin aluminum fascia's, pull out in areas of high wind loadings.

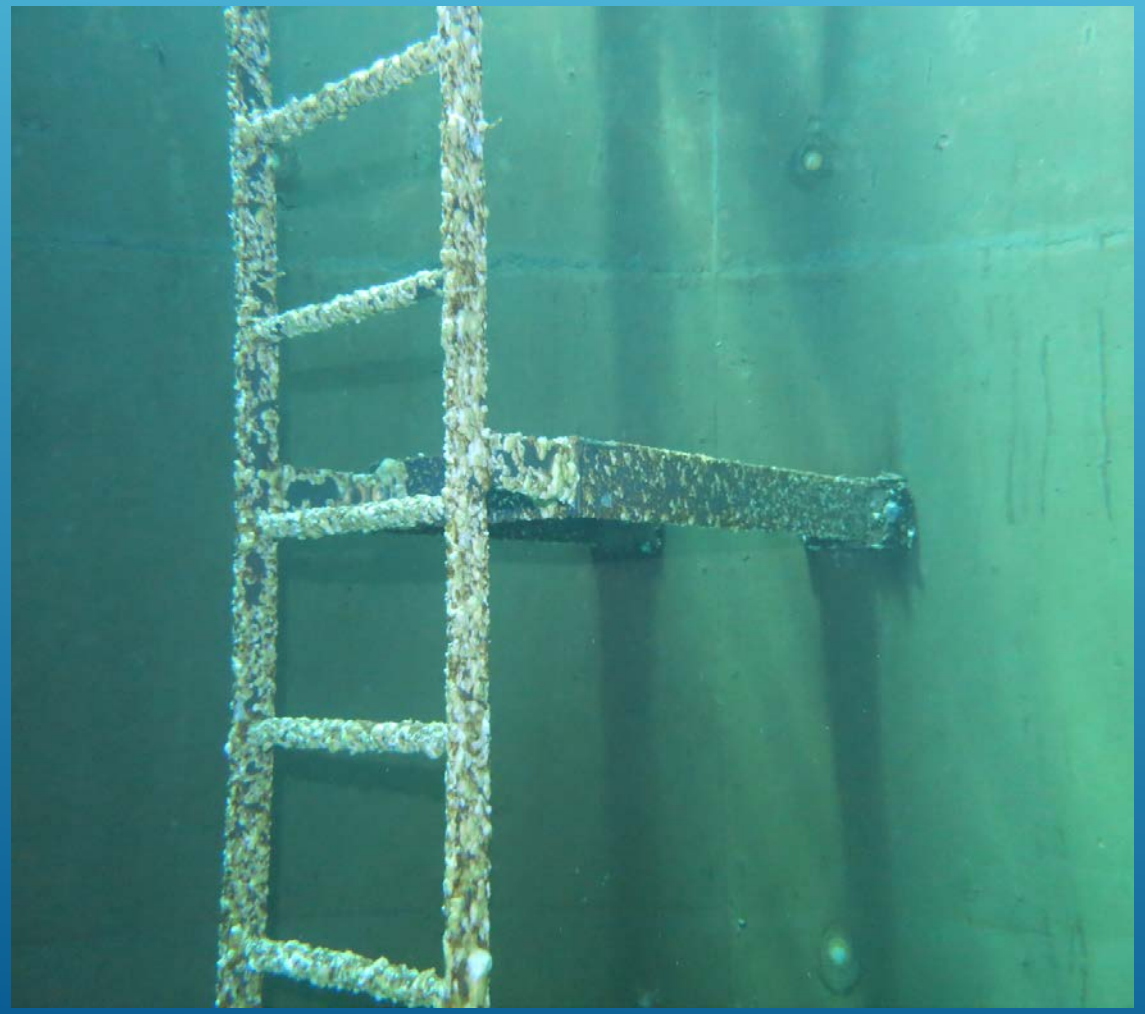
Number 8: Internal pipework and other fixture materials that are not suitable for constant immersion. Concrete tanks often have ductile iron pipework that is uncoated and this leads to accelerated corrosion. Fixing bolts and supporting brackets are often not insulated or are made from dissimilar metals, which will also contribute to corrosion issues.

Aluminum posts corrode quickly in some waters, depending on pH levels. The SS bolts also contribute to the aluminum deteriorating. Another factor is the posts not being isolated from the floor fixings and roof framing, as they quickly become an anode to protect the reinforcing steel in the concrete walls and floor.





Aluminum ladders corrode quickly in some waters, depending on pH levels. The SS bolts also contribute to the aluminum deteriorating.



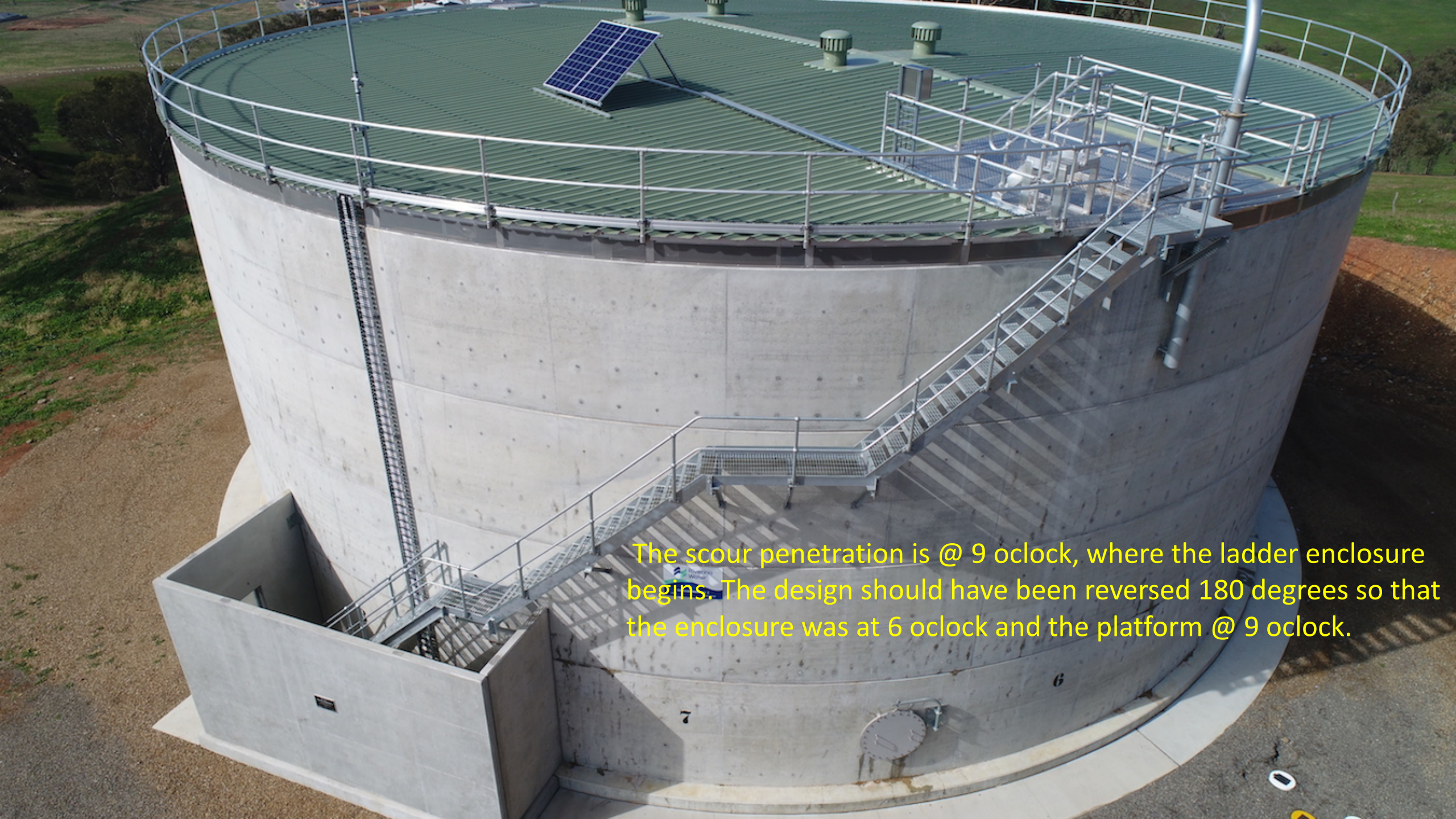
Number 9: Not thinking about how internal pipework will affect the stored water quality. Inlets placed next to outlets lead to short circuiting issues. Outlets close to the floor allow sediments to be drawn into the downstream reticulation system. Scours not being fitted in the lowest area of floor will not allow for effective draining of the tank.

The scour penetration is 120mm up off the floor area, which makes it impossible to fully drain the tank.

The scour penetration is 80mm up off the floor area, which makes it impossible to fully drain the tank. This is a new tank, so cut and paste must have occurred in the design.

Number 10: Having no understanding of short and longer-term maintenance requirements. Just because a tank is new, does not mean it will require no maintenance. Good external access for EWPs, cranes, service vehicles and larger trucks is often necessary for roof repairs after storm events. Steel tanks will need to be recoated after 30 years of service, so a good-sized flat area for parking the necessary heavy equipment should be factored in.

The following images show a tank design that has not allowed for the most basic of maintenance requirements – regular cleaning of sediments. The external ladder system runs in the wrong direction, so that the platform area is directly above the inlet and outlet pipework, instead of the scour penetration. This means a diver runs the risk of lowering his gear down over the outlet and then having to walk a distance around through the accumulated sediment to access the scour penetration. It also has an excess of safety rails that clutter up the working area without providing any additional benefits to workers performance outcomes.


The scour penetration is @ 9 oclock, where the ladder enclosure begins. The design should have been reversed 180 degrees so that the enclosure was at 6 oclock and the platform @ 9 oclock.

There are too many unnecessary handrails around the entry hatch and platform areas.

For further information on the inspection details and images, log into:

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