

Galvanised Reinforcing Steel and Accessories in Buildings – So Who Needs Them?

P Sanders, Principal, Building Knowledge

Paper first presented at the 6th Asia Pacific General Galvanizing Conference
Cairns, Australia – 29th May – 2nd June 2005

1. Abstract

Reinforcing steel makes up only perhaps 1.5% to 2.5% of the *structural* cost of any building project (less, if one considers the total project cost), yet inappropriate or improper use of the material in building projects results in accelerated deterioration of the structure, significant remediation costs, lowered expected life and increased customer dissatisfaction. Galvanising of certain steel reinforcing and accessories in appropriate locations, combined with proper design, detailing and construction practices offers advantages well in excess of the increased cost of the galvanising.

2. Building Defects

Considering the commonly reported causes of building defects (fig 1) gives a strong indication of the areas where potential durability problems lie.

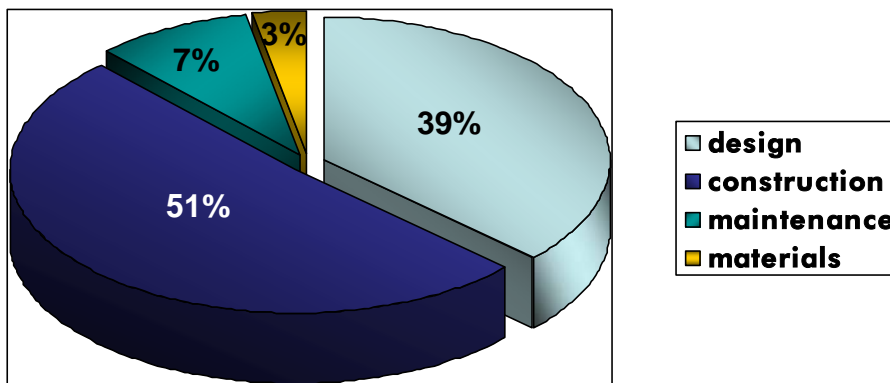


Figure 1: causes of defects in buildings¹

As we might expect, the manner of construction is responsible for just over half of all reported defects (note *reported*. It is the author's opinion that the contractor is probably being somewhat unfairly labelled here, and that other causes, or a combination of causes may well be responsible for a proportion of these). Building materials are generally of a very high order of quality and consistency and, as might be expected only account for 3% of reported construction defects. Maintenance of the finished structure causes defects in 7% of reported cases. The surprising result is that in almost 4 out of 10 cases, inappropriate design was responsible for the emergence of the defect. Putting it another way, it does not

matter how good the materials were, how well the structure was built and how diligently the building was maintained, the defect emerged because it was *designed in!* In the author's experience this usually stems from inadequate or inappropriate detailing, followed by inadequate specification. How might galvanising then assist in reducing the high cost of repairs and remedial works?

3. Common arguments against galvanising

Galvanising of reinforcing and accessories has been criticised for several reasons:

- a. it is unnecessary
- b. its cost;
- c. the lead-time required for supply;
- d. contribution to structural decay.

Considered in turn:

Necessity: proper design and construction obviates the need for additional protection of the reinforcing steel. However, the use of galvanised reinforcing is often misunderstood. Galvanising does not prevent steel rusting, in the way that stainless steels do not rust in the expected life of a building. The “just use black-steel” argument has some merit, but it requires a strong commitment to detailed design, consistently higher quality of site practices and monitoring that is difficult (and expensive) to maintain on even the best run sites. Minimum cover is especially difficult to maintain in modern, more slender structures, and yet is critical for long-term structural durability (see fig 2). Galvanising should be thought of as an “insurance policy” that along with good, common sense site and materials practices helps ensure good long-term structural performance in particular applications or environments.

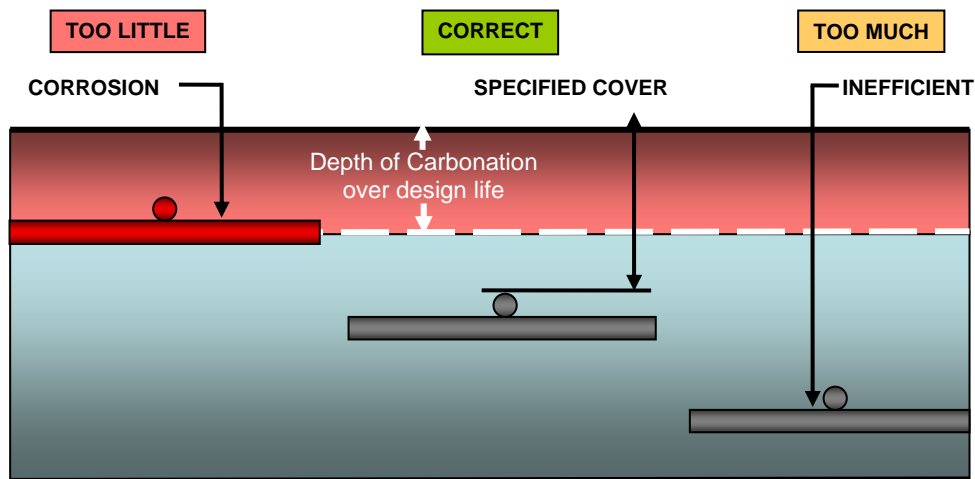


Figure 2: the importance of cover

Cost: the cost of the material galvanised is significantly increased. However, galvanised steel is usually used in specific areas of the structure and results in a small increase in total percentage costs, particularly when considering whole-of-life costs.

Time: Lead-time for supply is never, in the author's experience, a real consideration - unless galvanising is implemented as an afterthought. If specified early and included on contract drawings there is no excuse for galvanising to delay the program.

Contribution to structural decay: Some reports have suggested that nitrogen outgassing from the galvanising can cause deterioration of the concrete. The author has yet to see significant evidence that this may occur to an extent deleterious to a working concrete building structure.

4. Why Galvanise?

Having looked at the "against" arguments, when should we seriously consider galvanising reinforcing steel products? Essentially there are three situations why galvanising a part or even the whole makes strong economic sense

Environment: The location of our building structure gives a very strong indication as to when galvanising should be seriously considered. Exposed building structures in more aggressive environments, e.g. buildings adjacent to the coast (fig 3), or where industrial pollutants may cause accelerated concrete deterioration, such as dairies should be considered for galvanising. Additionally, galvanising should be considered where:

- a) deterioration is a possibility, but future access will be problematical, e.g. and
- b) particularly slender structures minimise effective cover (fig 4)



Figure 3: balconies on beach-side apartments showing severe rusting and delamination from high-level salt exposure



Figure 4: slender tilt-up panels in a coastal region - a candidate for galvanised reinforcing?

Insurance against quality inconsistencies: Quality inconsistencies (or defects) in construction are a fact of life. With the introduction of "performance-based" design (that is, design based on the desired end performance of the

building structure, rather than compulsory Code requirements) has changed the traditional balance between design accuracy, construction quality and materials performance in design. Building contractors are under ever increasing pressure to reduce construction times, leading to limited curing after concrete placement. The major reduction of regular engineers' inspections has made it more difficult to spot simple errors, such as reduced reinforcement cover, improper concrete placement techniques (such as too little agitation time by the mixer or adding water at the point of delivery) and, durability and hence life of concrete structures by a large margin (see fig 5, below for potential cumulative reduction of concrete surface layer strength due to poor concrete practices). The effect of any and all of these reduces the strength, durability and life of building structures.

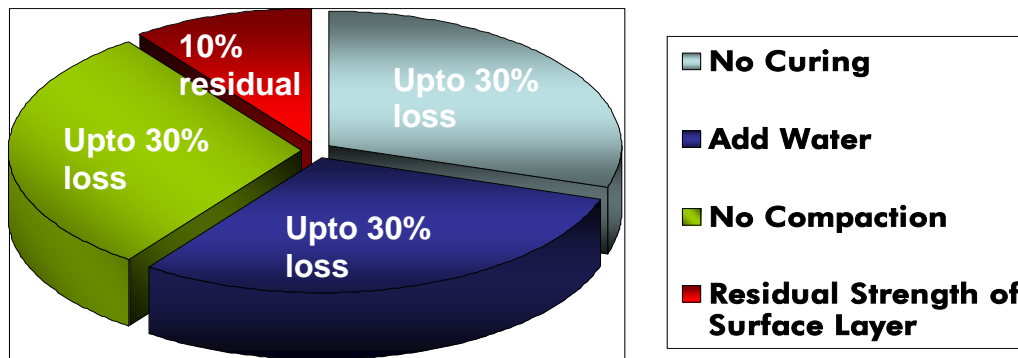


Figure 5: potential loss of strength of concrete surface from poor practice¹

Longer design life and whole-of-life costing: Where the structure requires a long (greater than 50-years) design life, e.g. public buildings, such as Parliament House, Canberra, Galvanised reinforcing should be seriously considered. Again, not only is the cost a marginal increase in the total structural cost, but on a whole of life analysis, taking into account reduced structural maintenance, galvanising may even prove the cheaper option, overall.

5. Conclusions

Galvanising of steel reinforcement and accessories would not be required if design and construction practices were perfectly applied. Unfortunately, this is not always the case. Where the environment is aggressive (e.g. coastal or industrial), the application is appropriate (e.g. balconies, dairy floors or where future access is limited) and whole-of-life costing is applied, galvanising is a cost-effective and sensible solution, offering a high level of risk mitigation over non-galvanised reinforcing materials.

¹ Cement, Concrete and Aggregates Association of Australia