

Context	Potential problems that could lead to defects or failure
Steel	<p>The use of poor or substitute materials, for example thick plates with laminations or cracks, or cold formed tubes instead of tubes specified as hot finished, can result in critical latent defects. Occasionally, fabricators who are used to using material that exceeds the specified minimum by some margin are supplied with a barely-complying product. Unexpected problems can then occur, for example with welding.</p> <p>Traceability of material composition and properties back to the producer is important, and only certain inspection documents (previously termed test certificates) supplied by the producer provide sufficient details. Reliance on an established and competent producer can help to prevent such difficulties arising. However, a clear understanding of the product standards for the material involved is still important. For instance, BS EN 10025 includes specification options that are critical to weldability and ductility.</p>
Fit-up prior to welding	<p>The progenitor of a good weld is good fit-up between the parts before welding. An excessive root gap leads to secondary stresses due to eccentric load paths throughout the weld, and can cause lack of fusion, especially at unbacked joints.</p>
Distortion	<p>High heat inputs during welding can result in distortion of the weldment due to differential restraint conditions during thermal expansion and subsequent contraction. Heat treatment of the completed weldment will relax any residual stresses, but may not succeed in resetting the weldment back to its intended shape.</p>
Site welds	<p>Some welds are poorly executed because access to the weld is difficult. This is more common on site, where items are often fixed in orientation thus dictating, for example, the need for overhead welding. Another difficulty with site welding is that the joints can be fixed in position with a very high degree of restraint. As all welds shrink during cooling, pull-out of plugs of the parent material can occur (although this would rarely escape inspection).</p>
Erection method statement	<p>Without a clear and well thought-out method statement, serious problems can occur during erection. The most critical aspect is control of overall stability against collapse. In very rare cases, erection can be completed apparently satisfactorily, yet with serious incipient problems stemming from a 'meta-stable' structure. For instance, a large dead load could be balanced on a beam whose lack of robustness against lateral buckling could be precipitated later. Also, the installation of bracing is a critical activity. On tall buildings, bracing in the lower stories can be compressed as columns shorten, resulting in lateral bowing of the bracing. This can damage adjacent walls, as well as compromising the response behaviour of the structure to lateral loads.</p>
Symptoms of problems	<p>Experience during erection can often be used to prevent the incorporation of latent defects into the structure. For instance, columns which are difficult to plumb, column splices which do not seat properly, bracings which do not fit properly, or hips which require significant site remedial work may all be signs of deeper problems.</p>

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Selection of items for test	<p>Inspection and testing usually involves a sampling procedure, and hence relies for its efficacy on a predetermined pattern of sampling that concentrates on the most critical items. Some checks are of the functioning of the system, some are intermediate tests of work in progress, and some are final acceptance tests. A clear inspection and test plan specifies the method and accuracy required for the tests, the location and frequency of testing, the acceptance criteria, and actions to be taken when non-conformities occur - such as the procedure for dealing with requests for concessions. Without a clear plan, undetected defects are much more likely to have a significant effect.</p>
Maintenance	<p>Whilst lack of maintenance is not a cause of latent defects, regular maintenance may be valuable for their identification. Planned inspection and treatment is far less likely to be carried out where suitably easy access is not provided. Another essential is that suitable personnel undertake such inspections. For instance, the removal of relatively light restraint, or of system bracing members, might seem innocuous to the untrained eye, yet such members may be essential for stability against structural collapse.</p>
Change of use	<p>As with maintenance, change of use (together with refurbishment, renovation and adaption) can either help remove defects or introduce new ones. Incipient failure can be detected using the symptoms of distress. Alternatively, fatal flaws can be introduced, such as where the lattice bracing of a truss is removed to allow the passage of a new ventilation duct.</p>