

Fixing Failures - introduction

A series of articles for the
Construction Fixings Association

by Mark Salmon BSc

of Independent Fixing Consultants
General Manager - CFA



Fixing failures are rare but when they happen the consequences can be tragic for more than just the innocent victims. Those in the “fixings chain” from specifiers through suppliers to installers can be affected losing their careers, their businesses or their lives. In the three case studies accompanying this article Mark Salmon, an independent specialist in the technology of construction fixings, discusses the causes and how such failures can be avoided.

Introduction

Fixing failures are rare. This is partly because the fixings industry generally adopts high safety margins and goes to a lot of trouble to support its customers throughout the fixings chain with technical data and advice. But failures do happen and to help all involved in the fixings chain to understand their potential for contributing to an “accident” we will consider three different examples which highlight real factors which can affect any safety critical use of fixings.

A significant proportion of fixing failures take place during installation or commissioning,

as with one of the cases we will study here. Such failures rarely come to the attention of the industry as they rarely cause death or injury but when they do, as with our example, they get plenty of publicity and often lead to legal action. Failures which occur in service are, thankfully, few and far between but two of our examples took place well after commissioning, two and six years later in these cases. One caused the death of a passer by and is receiving plenty of attention with detailed examination of the causes and subsequent legal action; the other – purely by chance – caused no injuries so received little public attention. But it could well have injured several people, mostly children, possibly very seriously, and deserves examination as it involved three different potential problems. It is the wide variety of factors they highlight that makes these cases worth studying.

Conclusions

If well proven fixings are correctly selected and installed they don't fail. A series of steps which will help avoid failures and can be followed by all stakeholders in the fixings chain is set out below.

Case studies

The three incidents we have chosen to highlight are discussed in three separate articles under the titles:

Fixing Failures - Case Study 1 *Collapse of a concrete ceiling on Interstate 90 Connection Tunnel in Boston – July 2006.*

Fixing Failures - Case Study 2 *Collapse of a pre-cast concrete section – Ireland 2002.*

Fixing Failures Case - Study 3 *School ceiling collapse – West Midlands 2007.*

In all of these cases it is difficult to pinpoint a sole cause of the failure but potential problems have been identified and all could cause similar failures in other “Safety Critical” applications. Nothing stated in any of the case studies should be taken as a definitive statement of the cause of any of these incidents but merely as examples of what can happen if best practice is not followed. More case studies may be added as they come to light.

What constitutes a “Safety Critical” application? Essentially any where there is risk to life – be it injury or death. In practice very few installations are not safety critical, for more guidance on this issue see ^[1].

Steps to safe fixings.

All of the steps outlined here are described in more detail in CFA Guidance Notes: *Anchor Selection*; *Anchor Installation*; *Procedure for site testing construction fixings* and more – see Guidance Notes page at www.fixingscfa.co.uk.

Stakeholder	Action	Comment
Specifier	Know the application thoroughly	Nature of the load Magnitude of the load Direction of the load Nature and thickness of the base material Environmental conditions
	Select an appropriate fixing	Choose a fixing with an ETA ^[1] Check base material suitability Check suitability for environmental conditions Use the manufacturer's design data to select correct size Detail the exact fixing to be used in drawings and project documents with all necessary details ^[2] Accept an alternative fixing only if the full selection process is repeated for the proposed alternative.
Supplier	Supply the fixings as specified	Support the installer with necessary installation data, setting equipment and training. Only offer alternatives from a source that can match the original specification in terms of performance & design data and with recognised Quality Control procedures
Contractor	Ensure installers are fully trained and supervised using the correct tools to the correct procedure.	Ensure Method Statements ^[3] are to hand. Suppliers or manufacturers can arrange training.
Installer	Install the fixing correctly	Follow the manufacturer's installation instructions. Use the correct tools & equipment. Ask for guidance if problems arise e.g. hitting rebar.
Resident engineer	Ensure the installation is supervised. Arrange "Proof Testing" for selected jobs where installation quality is in doubt or advised by the manufacturer.	Supervision should check fixing against specification, correct tools used, correct procedure followed, correct locations etc. Proof testing is not needed for all jobs or for all fixings - take manufacturer's advice. Design test regime to suit the risk. Warn installers that testing will take place. Sampling rate can reduce as testing proceeds if no failures are found. Follow procedure in CFA Guidance Note ^[4] Treat results seriously and follow up ANY failures – determine cause and implement remedial action.

[1] CFA Guidance Note: *European Technical Approvals for fixings used in Construction*.

[2] CFA "Sample Specification Formats" are available to assist with this. See "Safer Installations" page of the CFA website.

[3] CFA Sample Method Statements are available for the common anchor types, they complement manufacturers instructions but do not replace them. See "Safer Installations" on the CFA website.

[4] See CFA Guidance Note: *Procedure for site testing construction fixing*.