ATKINS LTD

FORTH ROAD BRIDGE

SURVEY OF COATING CONDITION

ACCESS REPLACEMENT STEELWORK

ON SECTIONS S1 TO S9

1. BACKGROUND

Following initial telephone discussions between of Atkins, Epsom office and of the Steel Protection Consultancy Ltd (SPC) a site visit was arranged to the Forth Road Bridge, Scotland, where Atkins Edinburgh office were acting as the Consultants for the access replacement steelwork contract.

The main contractor for this project was Raynesway Ltd and the Raynesway Project Manager was Graham McAlpine. The site engineer for Atkins was Dave Bishop, who was away on vacation at the time of the site survey and Michael Doody, David Keracher and Katy Brown were able to supply support and information for the paintwork site survey, on this project.

2. INTRODUCTION

The site survey was carried out on 20th July 2010 and it was required to assess the condition of the existing coatings, which had been subject to mechanical damage and areas had been heat affected where steel brackets had needed to be cut away for replacement fittings.

Once the condition and composition has been established a patch repair methodology and specification can be prepared.

3. SITE TESTING

3 (i) General

A series of micro destructive subjective tests and non-destructive tests were made at various locations to establish the condition of the coating and the effectiveness of the recommended patch repair coating specification.

The tests that were carried out included some or all of the following:-

i) Non-destructive film thickness readings using a PosiTector 6000 gauge.
(ii) Careful visual examination where necessary with the use of a convex extending angled mirror.
(iii) Destructive adhesion tests (St Andrews X)
(iv) Destructive abrasion tests to identify the number of coats.
(v) Destructive film thickness tests to measure each paint layer.
(vi) Destructive solvent tests as appropriate, to identify coating cure
(vii) Examination by various magnification x10 x30 and x50, of the condition of the coating of the outer surface and on the destructive test areas above.
(viii) Chemical spot tests for toxic pigments and coating type
(ix) Removal of small samples for further laboratory examination.
(x) Photographs of selected test areas for report illustration and records

3.ii Site Testing

A series of tests were carried out on sections S1 to S9 inclusive and in addition to the tests, samples of the coatings where considered appropriate, were removed for subsequent laboratory testing.

Areas, which had been necessarily damaged by destructive testing or to remove samples to test the properties of the coating, were only selected adjacent to areas of mechanical damage, where repair work would already need to be carried out.

A typical example of a test and sampling area adjacent to an edge with mechanical damage can be seen in ***Figure 1*** and in close up on the underside in ***Figure 2***

Figure 1

Figure 2

At this location it was noted that the access scaffold clips had been fixed with tightening bolts, direct to the coated steel and without any spreader plate to prevent damage. The scaffold clips were also positioned so that only one end of the clip was located on the edge of the steel and the remainder of the clip was separated progressively away from the contact point.

A typical view of a fixing bolt can be seen in ***Figure 3***. a misaligned clip in ***Figure 4*** and confirmation of the depth of spacing using a steel ruler can be seen in ***Figures 5.***

Figure 3

Figure 4

Figure 5

On section S2 there was a heat affected area, where a bracket had been removed by cutting, see ***Figure 6***, and testing of the surrounding heat affected paint showed that the spread of thermal degradation from the source of the heat appeared to average about 4 cms away from the burnt and cut steel.

This was more significant on the underside of the flange where clearly heat transfer had been greatest, but this was confused by the fact that the paintwork in this area had rusted back to bare steel and the coating had generally lost its protective properties.

This coating would need to be removed 100% back to bare metal to prevent any further pitting of the steel, a close up of the underside of the flange in question, can be seen in ***Figure 7***.

Figure 6

Figure 7

On the web of the beam at the same location, a series of adhesion tests and sampling were carried out progressively away from the flame cut edge and this confirmed that again the extent of spread on the web was approximately 5 cms.

One of the adhesion test areas and the sampling of the coating can be seen in ***Figure 8*** and it was clear that again all of this paint had thermally degraded to a point where it would all need to be removed before a sound bevelled edge could be achieved.

Even the most distant St Andrews cross cut test showed degradation of the intermediate layers over the zinc metal spray, illustrating the atmospheric degradation of the aged coating, see ***Figure 9*** and in close up ***Figure 10***.

Figure 8

On section S3 a small area adjacent to the repair work showed that a white paint had been applied over a patch of zinc rich primer (not zinc metal spray) and the condition of this paint, which had significantly degraded, appeared to be 15 to 20 years old.

On section S4 it was noted that, a soft pliable filler had been applied over unsound paint around at least two of the bolt fixings. On section S5 the runway beam sample showed that the coating was “soft and cheesy” over the zinc metal layer.

On section S6 on the north side there was sound paint on the web of the beam, very similar to the coating on S2, see ***Figure 9,*** but on the flange the coating was breaking down as well as the zinc metal spray at the edges and on the soffit, see ***Figure 10*** and ***Figure 11***. It can also be seen in close up in ***Figure 12,*** where corrosion of the substrate was occurring beneath the degraded paint and metal spray layers.

Figure 9

Figure 10

Figure 11

Figure 12

In section S7, the zinc breakdown and associated substrate rusting can be seen in ***Figure 13*** and this breakdown was repeated on sections S8 and S9, see ***Figure 14.***

Figure 13

Figure 14

4. LABORATORY EXAMINATION OF REMOVED PAINT SAMPLES

Nine paint samples were removed from sections S1 through to S9 and apart from two, the runway beam on S5 and the white patch paint on S3, all were similar in composition and condition.

There were varying layers of paint removed with traces of zinc metal spray and in some instances zinc corrosion products and the number of layers of paint on the various flakes in cross section showed that there were between 7 and 10 layers of paint in alternating colours.

On all of the flakes the top two or three coats were non-convertible coatings, (chlorinated rubber) and the remainder down to the zinc metal spray were oleo resinous coatings, which only partially softened when solvent tested under the microscope. Four flakes with traces of zinc metal and zinc salts showed that there were rust particles within these areas, which confirmed the examination of the site area after removal of the samples.

All of the more recent coatings (non convertible) were degrading, indicating the possibility of excessive thinning at the time of application (which would be normal if the coatings were spray applied, as appears likely) and the two oleo resinous layers beneath the non convertible coatings had also degraded and were cohesively weak when tested under the microscope.

5. SUMMARY AND CONCLUSIONS

It is clear from the limited site testing around the areas, which are to be patch repaired due to mechanical or thermal degradation it will be possible to establish a firm edge, when feathering back over the existing coating.

There has been significant deterioration since the 2002 major coating survey and it would be sensible to discuss complete blast cleaning and recoating with a long life (25 year system) on the areas not only affected by the positioning of the new steel supports, but also preparing the accessible areas adjacent to this patching. When major maintenance occurs, this should be within the next two or three years, the overblast damage will remove all the patch painted sections and the recoating will need to be repeated.

It is recommended to mechanically clean the damaged areas and the thermal degradation, then mechanical cleaning by grinding, wire brushing (without burnishing), should be carried out and a surface tolerant primer (item 115), overcoated with two build coats of contrasting colour (item 116) and each patch then overcoated with the finish coat (item 168 – a re-coatable acrylic modified polyurethane).

Lead pigment was found on the internal box surfaces only no lead was found on the external box surfaces. The difficult access for safe removal of this toxic coating makes the use of an environmentally friendly, paint remover, a consideration. A trial of likely “chemical strippers” should be considered when the repair methodology and repainting specification is being prepared.

The repainting specification can be reviewed together with the contractors method statements, if it is decided not to carry out the full blasting and recoating in these sections, with the access available at the present time.

Director