

## REFERENCE PANELS

# GUIDANCE NOTES ON CONCRETE FINISHES to The Specification for Highway Works

## LONDON SOUTH (External Site)

(This site has been generously provided by The Medway School of Engineering)



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## Foreword

The Concrete Bridge Development Group (CBDG) is an association of member companies and organisations, dedicated to the task of improving efficiency in the design, construction and maintenance of concrete bridges.

The Group was incorporated on March 3rd 1992 and has over 120 members including bridge owners, consulting engineers, contractors, academic and research institutions, and suppliers.

For further information on CBDG contact:

Concrete Bridge Development Group  
Riverside House  
4 Meadows Business Park  
Station Approach  
Blackwater  
Camberley  
Surrey GU17 9AB

Tel: 01276 33777  
E-mail: [enquiries@cbd.org.uk](mailto:enquiries@cbd.org.uk)  
Website: [www.cbdg.org.uk](http://www.cbdg.org.uk)

CBDG responded to The Highways Agency approach to manufacture and install concrete panels demonstrating typical finishes for each geographical region as described in Clause 1708 of the Specification for Highway Works (SHW).

The contract also included the drafting of an Advice Note and amendments to the relevant clauses of the SHW. It is recommended that both documents be consulted.

The panels are located at strategic sites throughout UK and these guidance notes have been produced to complement physical viewing and assessment at each location.

## **Introduction**

These panels offer a realistic, consistently achievable standard of surface finish and act as a benchmark for the benefit of the construction industry. They provide examples of commonly used finishes to in-situ concrete used in highway structures and incorporate a range of common blemishes and defects.

It is impossible to produce panels with a perfect finish straight from the formwork. Neither is it practical to produce panels with a “just acceptable” range of blemishes such as blowholes, surface irregularities, colour variation and arris lines. The Steering Group which assessed the panels consisted of experienced, professional practitioners and the comments made in these Guidance Notes represent a unified, corporate view.

To obtain maximum benefit, the panels should be viewed from a standard distance of 3m (where possible) and the prevailing light and ambient conditions should be taken into consideration.

The information on materials and methods used are for background detail only. The panels are considered to be representative, irrespective of the types and sources of materials used.

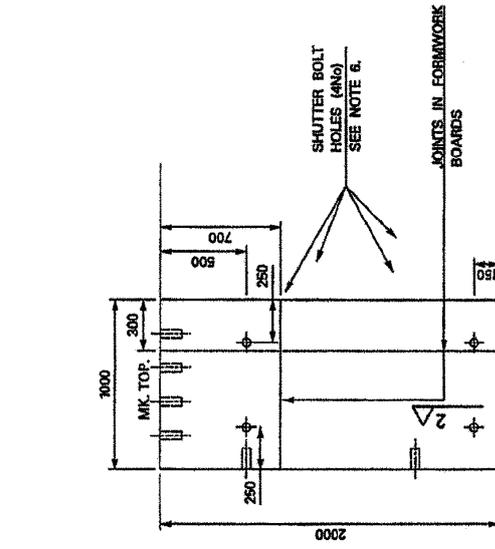
## **Acknowledgements**

The panels are provided by the Concrete Bridge Development Group (CBDG) under contract to the Highways Agency and were made and installed by TRL Ltd under a separate sub-contract with CBDG.

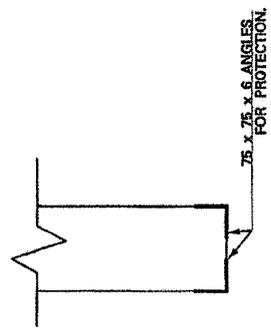
This site has been generously provided by The Medway School of Engineering. CBDG gratefully acknowledges their contribution to the project.

# DETAILS OF PANELS

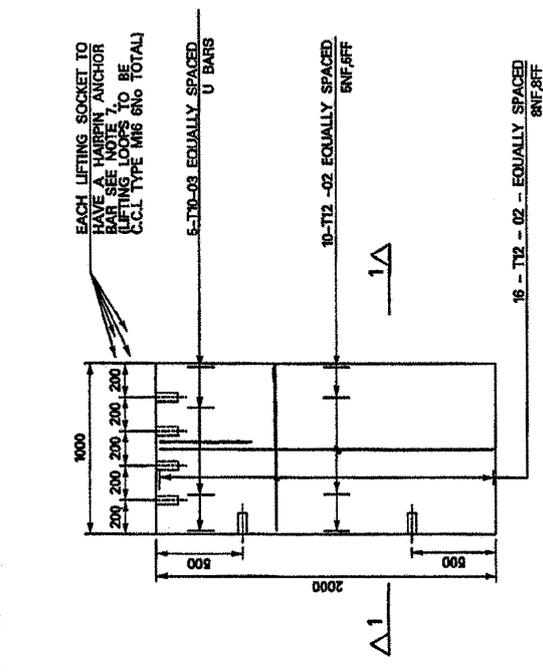
- NOTES**
1. CONCRETE TO BE GRADE C50 TO BS5208.
  2. REINFORCEMENT TO BE HIGH YIELD.
  3. COVER TO ALL BARS TO BE 40mm.
  4. MANUFACTURER TO PROVIDE SPACERS BETWEEN REINFORCEMENT MATS AS REQUIRED AND MAY TAKE THE FORM OF REINFORCEMENT U BARS. ALL THE WIRE ENDS MUST BE TURNED IN, AWAY FROM THE PANEL FORMWORK SURFACE.
  5. BOLT HOLES FOR FORMWORK TO BE PLASTIC WITH CONES.
  6. ONE BOLT HOLE TO BE FILLED FLUSH ON BOTH SIDES, AND ONE BOLT HOLE TO BE FILLED AND NEATLY RECESSED TO WITHIN 10mm BELOW SURFACE (ON BOTH SIDES).
  7. LIFTING SOCKETS TO BE C.C.L. MRS SOCKETS COMPLETE WITH 400mm LONG HAIRPIN T2 DIA. BARS ALL IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS OR SIMILAR AGREED.
  8. TOTAL PANEL WEIGHT APPROX. 1.00 TONNE.
  9. PANELS MUST BE CONSTRUCTED IN THE VERTICAL POSITION AS WALL PANELS WITH TOP AND BOTTOM POSITIONS AS MARKED.



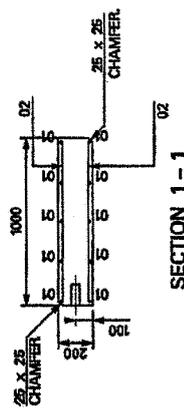
**FORMWORK ELEVATION**  
Scale 1:25



**SECTION 2-2**  
Scale 1:10



**WALL ELEVATION**  
Scale 1:25



**SECTION 1-1**  
Scale 1:25

DIMS. TO B.S.5966

MARK	TYPE & SIZE	TOTAL No.	LENGTH mm	SHAPE CODE	A mm	B mm
01	T12	10	900	00	STRAIGHT	
02	T12	16	900	00	STRAIGHT	
03	T10	5	900	21	400	110

T-TYPE 2 DEFORMED BARS, GRADE 460 COMPLYING WITH B.S.4449.

Job No.	
Client	
Contract No.	
Project Name	
Drawn By	
Checked By	
Scale	
Job No.	
Client	
Contract No.	
Project Name	
Drawn By	
Checked By	
Scale	
Job No.	
Client	
Contract No.	
Project Name	
Drawn By	
Checked By	
Scale	

**CONCRETE SAMPLE PANELS**

**ARUP** Ove Arup & Partners  
The City Centre, 100 Bank Street, London EC2N 2DX, UK  
Tel: +44 (0)20 7766 7600 Fax: +44 (0)20 7766 7601  
www.arup.com

Scale: AS SHOWN  
REVISED: SEP 10  
Project: CSP/100

### **Mix Specification**

Description C50 RMC Design + WRA

Target slump 75mm

Materials		Dry Batch Weights kg/m <sup>3</sup>
Type	Source	
PC	CASTLE KETTON	400
W.C.SAND	RMC ANGERSTEIN WHARF	640
20mm GRAVEL	RMC ANGERSTEIN WHARF	800
10mm GRAVEL	RMC ANGERSTEIN WHARF	340
WRA	GRACE WRDA 90	2000ml
WATER	TOTAL WATER	173

### **Casting Details**

Item	Panel 1		Panel 2	
Date Cast	20 September 02		18 July 02	
Striking formwork	72 hours		24 hours	
Material properties				
	Batch 1	Batch 2	Batch 1	Batch 2
Slump (mm)	60	140	50	60
28 day strength (Nmm <sup>-2</sup> )	70.0	67.0	66.5	71.5

## **INTERPRETATION OF SURFACE FINISHES**

### **The concrete**

The panels have been cast from concrete with constituent materials sourced from the region in which they are now displayed. The concrete had a target slump of 75mm and a characteristic strength of 50N/mm<sup>2</sup>.

No making good has been carried out to the panels other than to the upper two tie-bolt holes which have been filled with proprietary mortar, one flush to surface, the other only to the depth of the cone to create a shadow gap.

The finishes displayed are not perfect by any means. This was deliberate to show the types of blemishes and irregularities that may be acceptable, depending on their number and density, and the distance from which they will be viewed. It is the intention that any F2 or F4 finish on site should be better than those displayed.

### **Panel 1 Side 1**

A Class F2 finish as struck from a Birch ply form face, sealed with varnish. The butt joints between sheets were not filled. The screw heads were driven flush but not filled and the edge chamfer was not sealed against form. An imprint of the joints and screw heads is displayed as ridges and knobs, in a uniform pattern.

### **Panel 1 Side 2**

A Class F4 finish as struck from a Medium duty overlay (MDO) type form face. The butt joints between sheets were filled and sanded. The form joints were filled with a bead of silicon sealant, as was the edge chamfer. The screw heads were counter-sunk, filled and sanded. An impression of the joints and screw heads is flush and smooth. A colour variation exists due to the difference in absorption of fill material compared to that of form face.

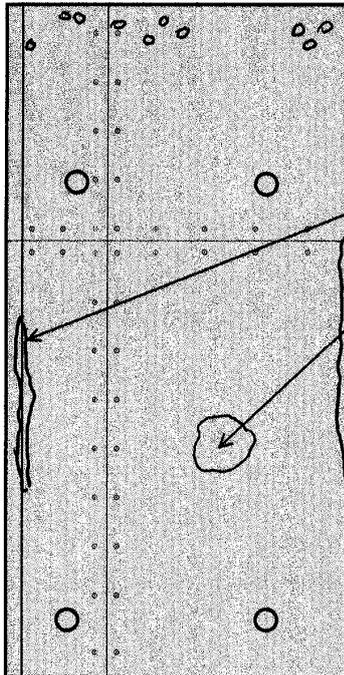
### **Panel 2 Side 1**

A Class F2 finish as struck from the Steel plate form face. The butt joint between the sheets were not filled. Screw heads driven flush but were not filled and the edge chamfer was not sealed against form. An imprint of joints and screw heads is displayed as ridges and knobs, in a uniform pattern.

### **Panel 2 Side 2**

A Class F4 finish as struck from the Steel plate form face. The butt joints between sheets were filled and sanded. The form joints were filled with a bead of silicon sealant, as was the edge chamfer. Screw heads were counter-sunk, filled and sanded. An impression of the joints and screw heads is flush and smooth. A colour variation exists due to the difference in absorption of fill material compared to that of form face.

## PANELS LOCATED IN LONDON SOUTH



**Panel 1**                      Finish Class F2  
**Side 2**                      Birch ply formwork

Discolouration caused by moisture loss at chamfer/form interface – ensure form joints do not leak.

Area of small blow-holes

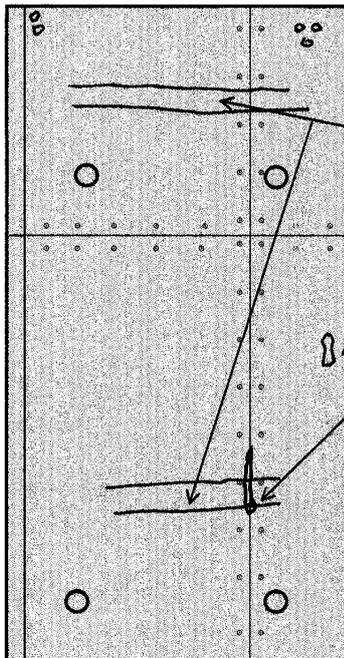
Chamfer clean and well defined.

Occasional irregular cavities lined with aggregate particles (at the top), aggregate bridging, a function of coarse aggregate grading. Re-vibration of upper third may have minimised this.

Colour variation and some fines loss caused by moisture loss between plastic tie-bolt cone and form face – ensure form joints do not leak.

Tie-bolt holes generally clean and well defined.

*Overall finish considered Class F2*



**Panel 1**                      Finish Class F4  
**Side 2**                      Medium Duty Overlay formwork

Discolouration caused by stacking of panels with timber spacers locally affecting the curing compared to the rest of the panel that was open to air circulation.

Minor damage to form face from vibrating poker – poker burn – poor workmanship.

Discolouration caused by moisture loss at butt joint interface – ensure form joints do not leak.

Chamfer clean and well defined. Concrete reflects the sealant shape and some residue sealant visible – poor workmanship.

Occasional irregular cavities lined with aggregate particles (at the top), aggregate bridging, a function of coarse aggregate grading. Re-vibration of upper third may have minimised this.

Tie-bolt holes generally clean and well defined.

*Overall finish considered Class F4*

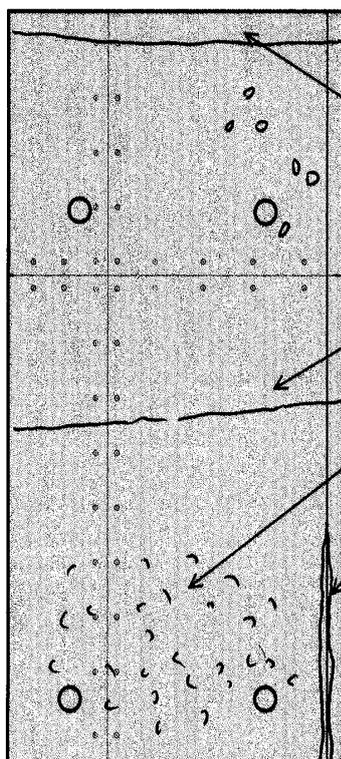


**Panel 1 - Side 1 - F2 finish**



**Panel 1 - Side 2 - F4 finish**

## PANELS LOCATED IN LONDON SOUTH



**Panel 2**                      Finish Class F2  
**Side 1**                      Steel plate formwork

Dusty surface caused by upper surface of wall not being covered to prevent moisture loss. Concrete shrinks away from form surface while immature, sometimes plucking concrete face, but leaving a dusty weakened surface – lack of early curing.

Delay between pouring each lift. Upper section lighter than heavily mottled lower – consistent with impermeable formwork and heavy vibration.

Mottling discolouration caused by casting against smooth impermeable formwork with vibration

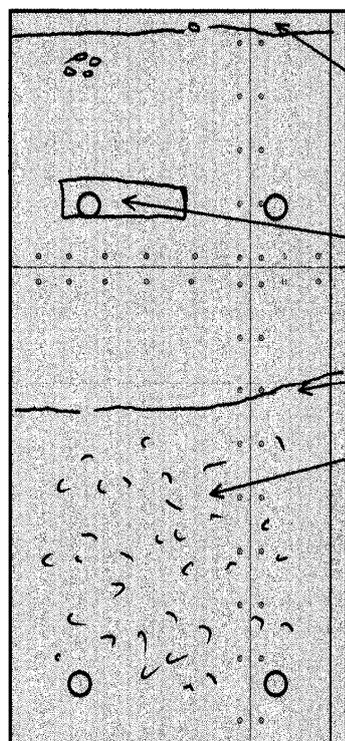
Discolouration caused by moisture loss at chamfer/form interface – ensure form joints do not leak.

Chamfer clean and well defined.

Tie-bolt holes generally clean and well defined.

Occasional irregular cavities lined with aggregate particles (at the-top), aggregate bridging, a function of coarse aggregate grading. Re-vibration of upper third may have minimised this.

*Overall finish considered Class F2.*



**Panel 2**                      Finish Class F4  
**Side 2**                      Steel plate formwork

Dusty surface caused by upper surface of wall not being covered to prevent moisture loss. Concrete shrinks away from form surface while immature, sometimes plucking concrete face, but leaving a dusty weakened surface – lack of early curing.

Discolouration caused by staking of panels with timber spacers locally affecting the curing compared to the rest of the panel that was open to air circulation.

Delay between pouring each lift. Upper section lighter than heavily mottled lower – consistent with impermeable formwork and heavy vibration.

Mottling discolouration caused by casting against smooth impermeable formwork with vibration.

Chamfer clean and well defined. Concrete reflects the sealant shape and some residue sealant visible – poor workmanship

Tie-bolt holes generally clean and well defined.

Occasional irregular cavities lined with aggregate particles (at the-top), aggregate bridging, a function of coarse aggregate grading. Re-vibration of upper third may have minimised this.

*Overall finish just considered Class F4, although marred colour variation. Improved attention to detail would rectify these blemishes.*



**Panel 2 –Side 1 - F2 finish**



**Panel 2 – Side 2 - F4 finish**

## Installation on site



## Location details

The Medway School of Engineering  
Medway University Campus  
University of Greenwich  
Chatham Maritime  
Kent ME4 4TB

OS Grid Reference:  
TQ767694



## **LOCATIONS**

The sets of two panels are located at the following sites and are available for viewing by arrangement with the named contact on every day of the year.

Guidance notes accompany each set of panels on every site and **must be read in conjunction with the physical assessment of the panels**. The ideal viewing distance is 3 metres.

### **London South (External Site)**

The Medway School of Engineering  
Medway University Campus  
University of Greenwich  
Chatham Maritime  
Kent ME4 4TB  
OS Grid Reference TQ767694  
Contact: Marc Van-De-Peer  
Tel: 0161 34 88 3461  
E-mail: m.t.van-de-peer@greenwich.ac.uk

### **Wales (Internal Site)**

Cardiff University  
Cardiff School of Engineering  
Queen's Building  
PO Box 925  
Cardiff CF24 0YF  
OS Grid Reference ST189768  
Contact: Prof Bob Lark  
Tel: 029 2087 6176  
E-mail: lark@cardiff.ac.uk

### **Scotland (Internal Site)**

University of the West of Scotland  
Paisley Campus  
Paisley PA1 2BE  
OS Grid Reference NS480638  
Contact: Minna Roebuck  
Tel: 0141 848 3280  
E-mail: minna.roebuck@uws.ac.uk

### **Central England (External Site)**

PERI Ltd  
Market Harborough Road  
Clifton upon Dunsmore  
Rugby CV23 0AN  
OS Grid Reference SP539782  
Contact: Heidi Farmer  
Tel: 01788 861 600  
E-mail: heidi.farmer@peri.ltd.uk