Formwork and finishes for cast in situ concrete

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CAFE CONCRETE @ COIN STREET

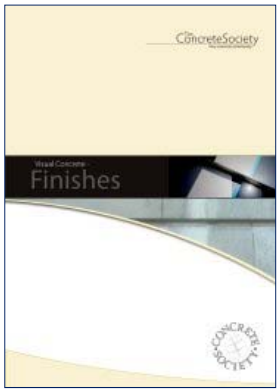
The Concrete Centre: Taking concrete forward

mpa The Concrete Centre

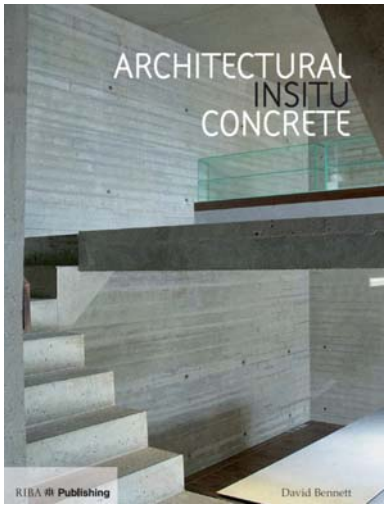
- Free resource for specifiers
- Concrete Quarterly
- Publications: general and technical
- Practice workshops
- Seminars and conferences
- Training courses
- Webinars
- Concrete Elegance Lectures

www.concretecentre.com www.thisisconcrete.co.uk
www.sustainableconcrete.org.uk

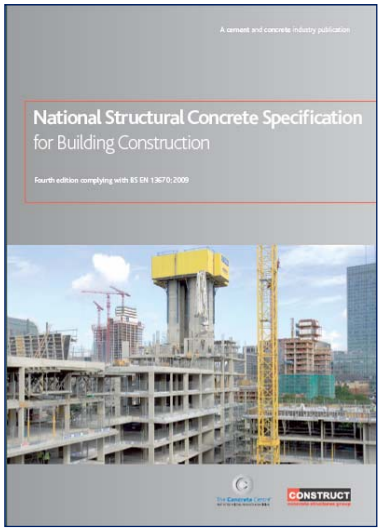
Various Concrete Society publications



Further reading

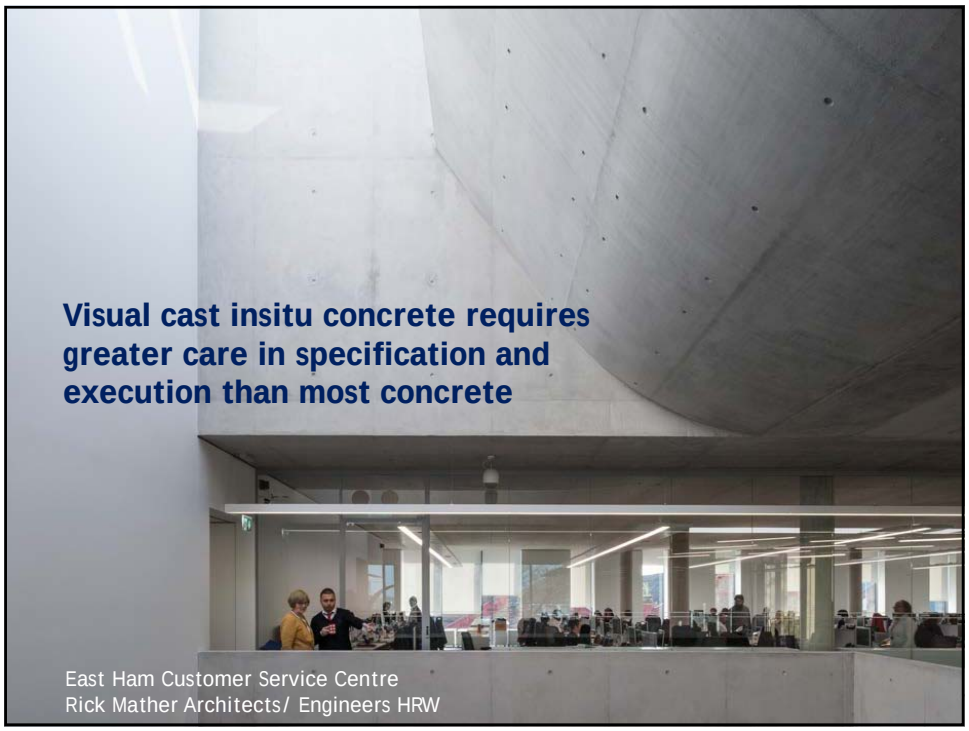


The National Structural Concrete Specification for Building Construction – NSCS v 4



- Definitive, simple and straightforward
- Prepared by the industry – clients, designers, contractors and specialists
- Aims to benefit all, with information collected together in one place
- Download free pdf:

http://www.construct.org.uk/index.php/useful-stuff/publications



Achieving visual cast in situ concrete - a summary

- Correct and consistent mix
- Suitable facing, formwork and accessories
- Appropriate release agent
- Careful workmanship/process for all elements
- Adequate protection
- Test panel(s)
- Team work and communication
- A little bit of luck!

Specifying visual cast insitu concrete

- **It is a team effort**. Structural Engineers specification will require input from the architect. Concrete contractor input required for final details. Consult suppliers pre tender
- **Understand** the creation processes
- **Be realistic** about what is achievable
- **Describe** clearly the result you want to achieve (use benchmarks)

Understand the process

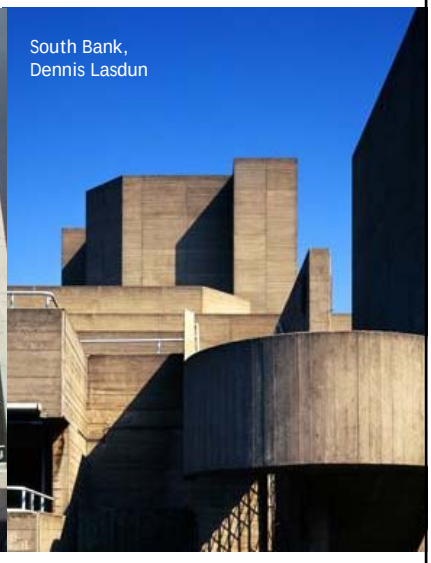
Local Materials
Ready-mixed in batching plant

Specific mix delivered to site

Bespoke formwork and selected facing

Visual cast insitu concrete - as struck finish

Persistence Works, Sheffield
Fielden Clegg Bradley Studios



South Bank,
Dennis Lasdun

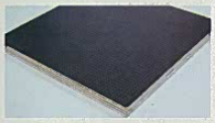
Efficient formwork systems

Many options of form facing materials

Form-face materials (in order of permeability)

Steel
- Completely impermeable
- Blow-holes likely
- Dark discolouration possible
- Blast cleaning needed before first use usually provides uniform light colour
- Several hundred uses possible

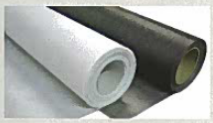
GRP
- Impermeability, longevity and finish similar to steel
- Double-curvature possible
- Ideal for waffle and trough floors



HDO (heavy duty overlay) all-birch plywood with bonded phenolic resin film
- Hardwearing
- Shiny surface can cause dark discolouration
- Blow-holes possible
- More uniform colour after first few uses
- 50+ uses possible

MDO (medium-duty overlay) Douglas fir plywood with resin-impregnated film
- Matt
- More uniform colour, fewer blow-holes
- Risk of dark lines in concrete
- Inspect overlay to avoid grain pattern
- Generally, consistently good
- 10-20 uses possible

Unsealed plywood and boards
- Darker finishes in more absorbent areas
- Grain sometimes pronounced
- More uniform colour after first few uses
- Few blow-holes
- 10-20 uses possible with care



CPF with microporous polypropylene sheet lining
- Requires structural backing
- One-directional curves
- Blow-holes and excess water from concrete eliminated
- Some types single-use
- Finely textured
- Normally darker

Understand form face qualities

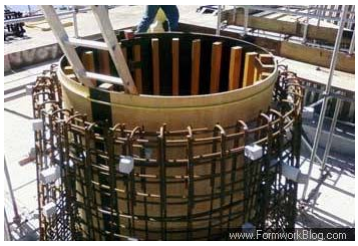
- Range of repeated use
- Cost
- Quality
- Potential shapes/forms

- Finish of concrete produced
- Size
- Fixing method
- Edge conditions
- Relationship with release agent

Galileo Satellite Control Centre, Oberpfaffenhofen, Germany

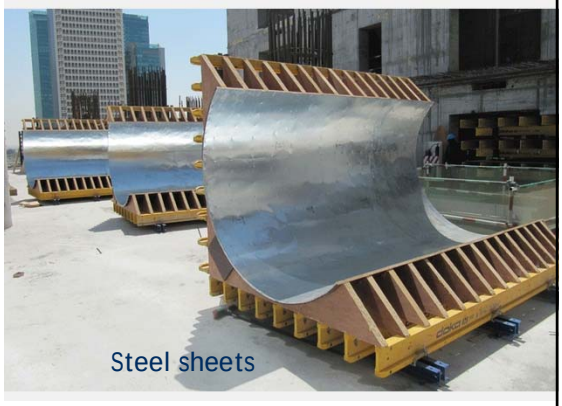
Image courtesy of Peri

Ability to be shaped

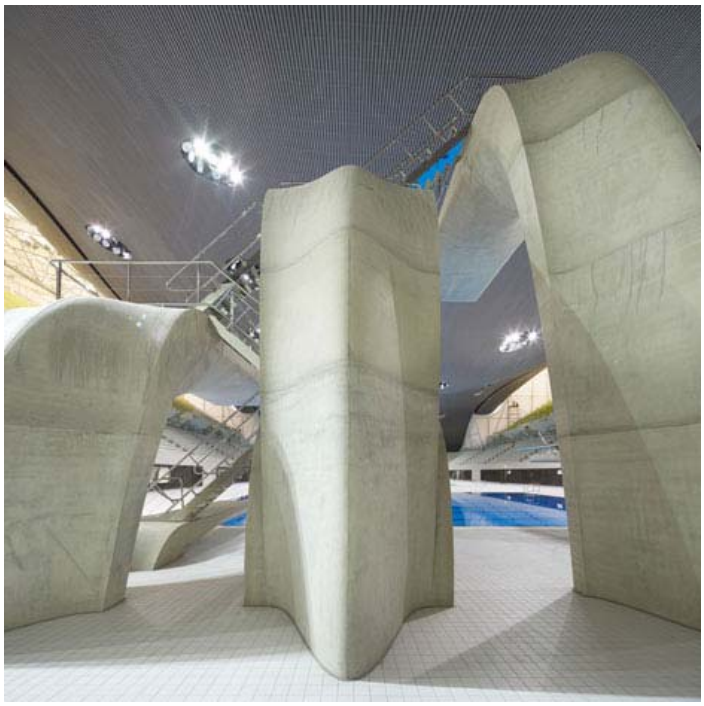


Bent ply

Plastic lined cardboard



- 2D curved shapes by casting against bent formwork
- Braced to support weight of concrete



The Aquatics Centre, London Olympics 2012
Zaha Hadid Architects

- 5 axis router to cut multi dimensional surfaces in polystyrene
- Subsequent processes included: Lining for rigidity, milled further & resin sealer
- Glass fibre forms created from curved mould, and stiffened for support

The Aquatics Centre, London Olympics 2012
Zaha Hadid Architects

Column form work

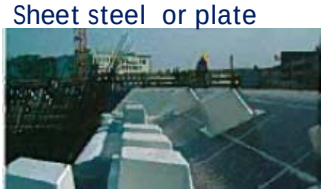
Prefabricated steel

Bespoke ply faced

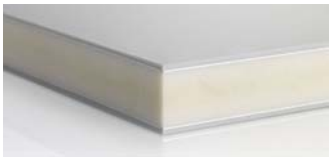
Prefabricated cardboard

Impermeable form liners

Sheet steel or plate



GRP

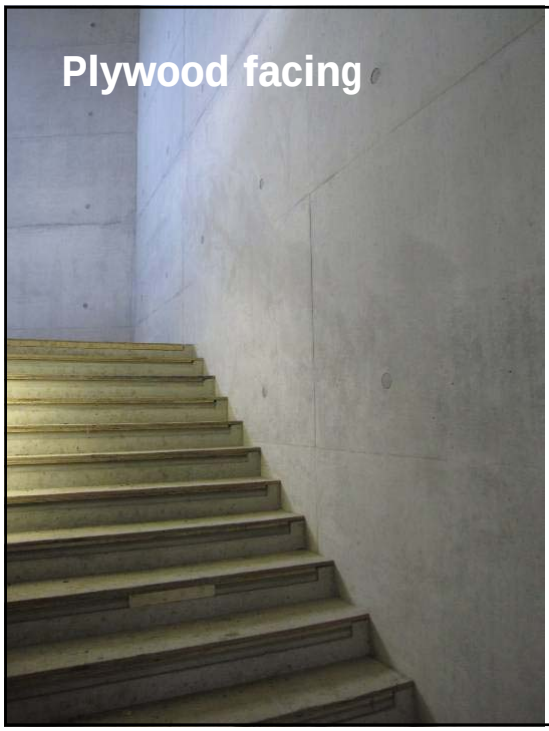


Polyurethane facing

- Impermeable materials: tend to give a smooth shiny finish
- Typically can be re-used many 100's of times (e.g cores/high rise)
- Blow holes are likely
- Tend not to 'add' colour to the concrete*

*steel can create dark mottling, especially if over compacted

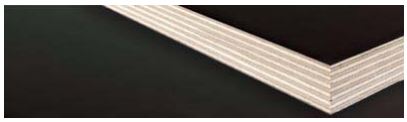
* High levels of GGBS create a temporary blue colour



Plywood facing

- Smooth, large format sheets
- Typically imperial ply sheet sizes (2440 x1220) but metric and oversized boards also available
- Shiny, matte or slight timber grain finish depending on ply facing

Ply facings for visual concrete

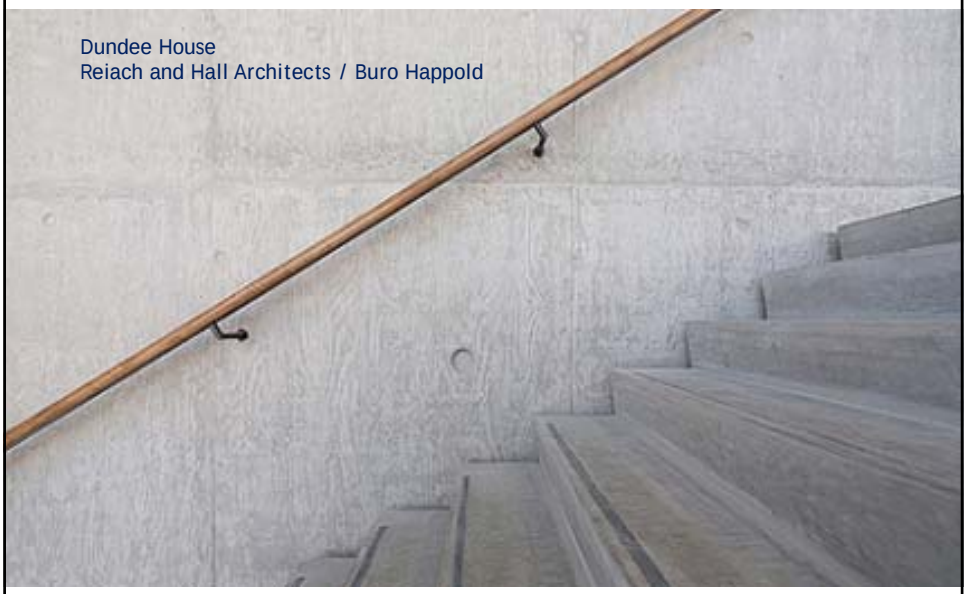


Phenolic Film Faced Panels and High Density Overlay (HDO)- Smooth Shiny finish to the concrete. (hard wearing – multiple re-use)

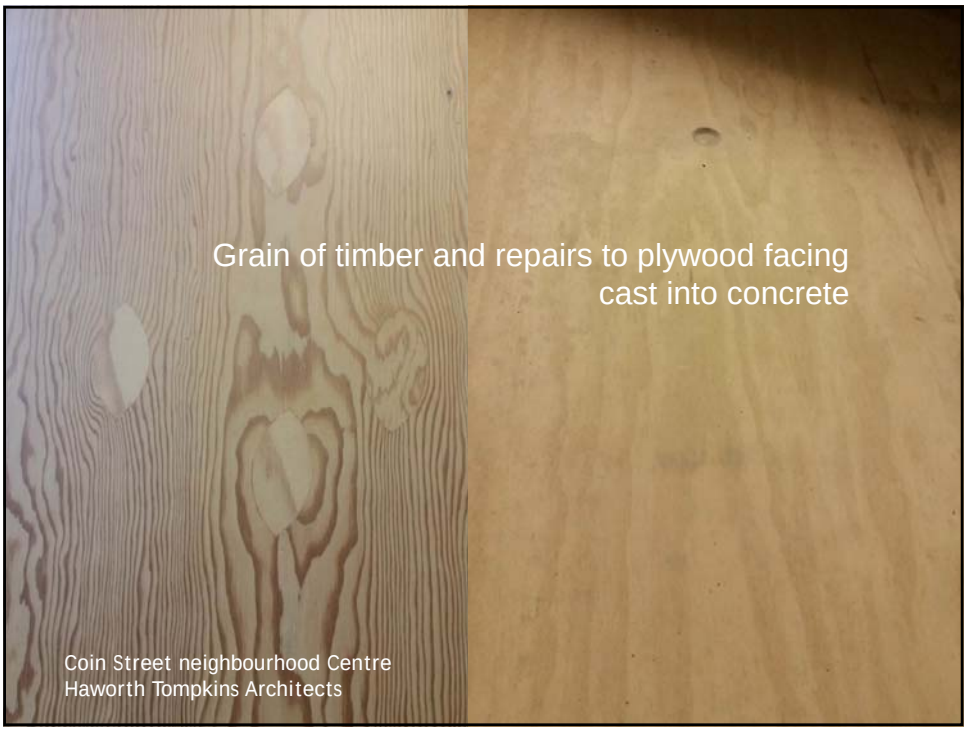
High quality medium density overlay (MDO) – Resin impregnated paper faced Panels. Matt non- shiny surface finish to the concrete –less re-use

High Quality Birch faced (or other) ply – Matt finish, light timber grain expressed. Often little re- use possible

Chose finish



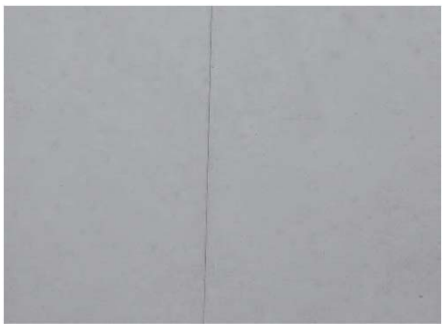
Dundee House
Reiach and Hall Architects / Buro Happold



Grain of timber and repairs to plywood facing cast into concrete

Coin Street neighbourhood Centre
Haworth Tompkins Architects

Grout tight joints



- Type and profile of edges
- Means of sealing
- Avoid exposing site cut boards

Dark staining – loss of water between formwork panels

Expressed board joints

University Square, Stratford
Make

Westminster underground station
Hopkins Associates

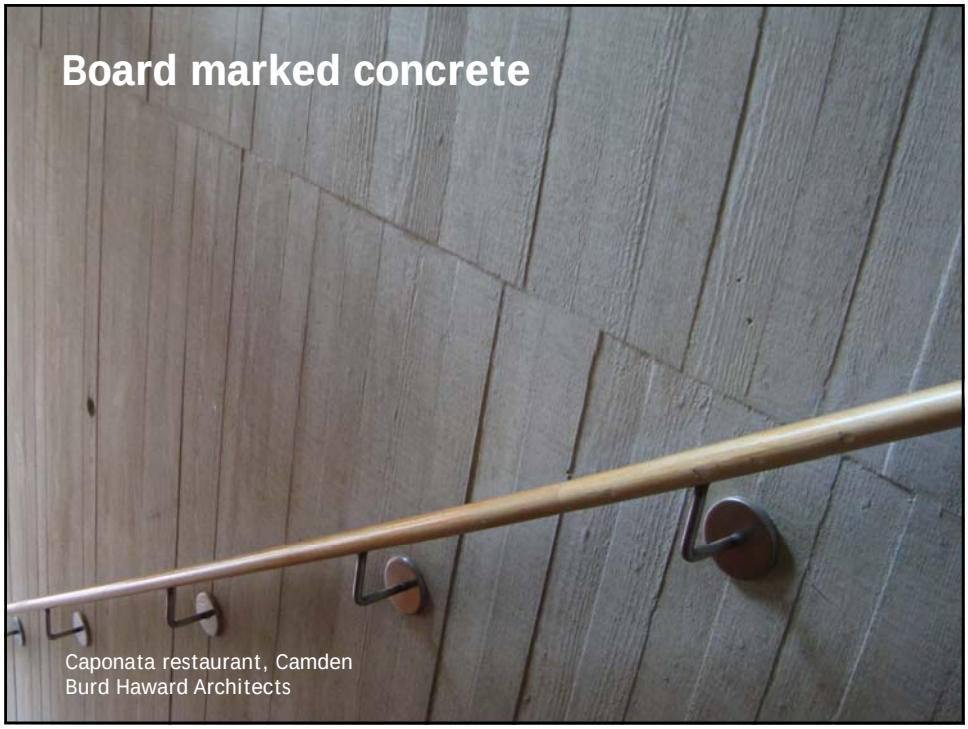
- Agree surface tolerances
- Establish board fixings (usually from behind so hidden and avoids damaging board facing)
- Requirements often refined during process of trial panels

Double boarding

- **Tighter tolerances**
- **Working platform**

Library , Dun Laoghaire
Carr Cotter & Naessens / Horganlynch

Board marked concrete

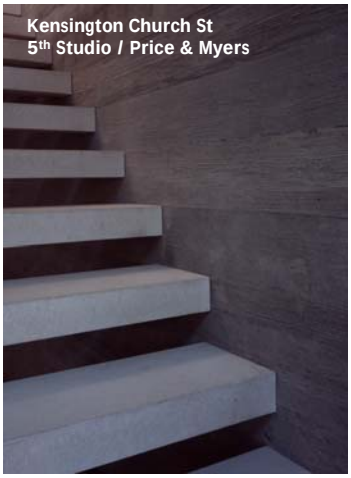


Caponata restaurant, Camden
Burd Haward Architects

Timber as formwork liner

1 Centaur St
dRMM /AKT

Saw cut timber facing



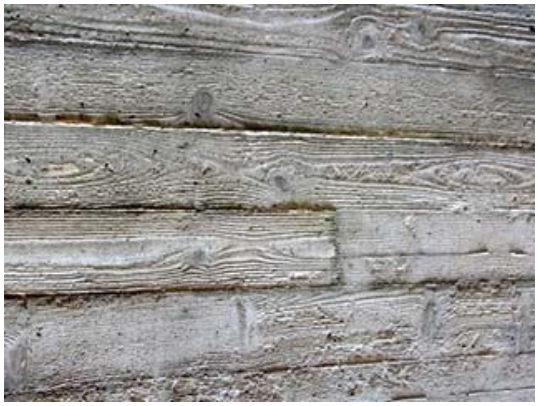
Kensington Church St
5th Studio / Price & Myers

Scaffolding boards pressure washed and wire brushed to expose grain

- Sandblasted SW timber
- 'cut throughs' are hand burnished

Oriel mostyn gallery

Llandudno : EWA Architects



- 100mm boards lining plywood formwork
- Limited reuse of boards possible
- Could be re-sandblasted to remove concrete out of grain with a harder wood e.g. Oak

Oriel mostyn gallery

Llandudno : EWA Architects

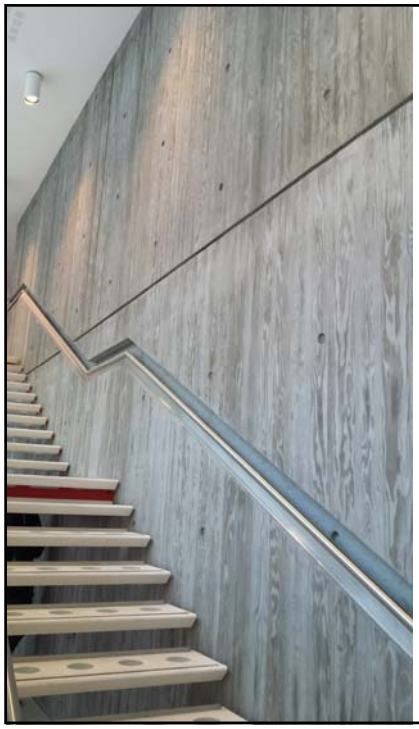
- Planed redwood boards of differing thicknesses
- Self compacted concrete

Lincoln museum

Panter Hudspith

Re-using formwork

Pear Tree House
Edgley design



- Canadian grown douglas fir
- Sand blasted timber face to expose grain
- Self compacted concrete with fly ash
- Dark colouring enhanced by sealant

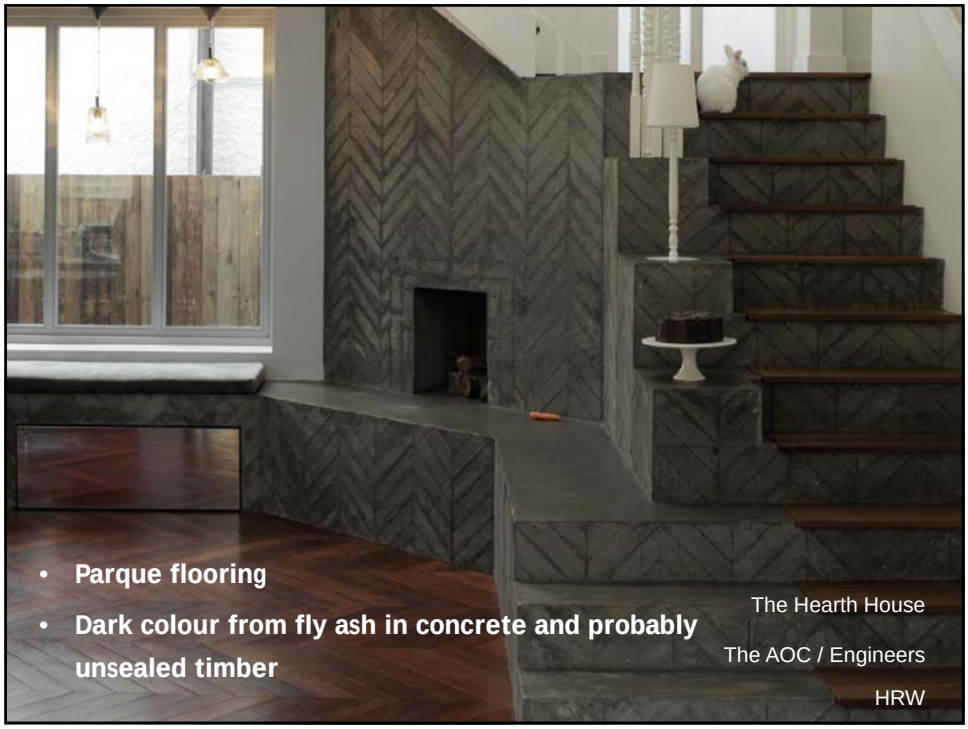
IStrcutE offices, London

Hugh Brougton Architects/ Expedition engineering,

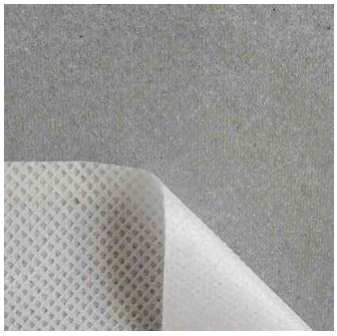
- Smooth faced boards
- Self compacted concrete with fly ash
- Dark colouring enhanced by sealant

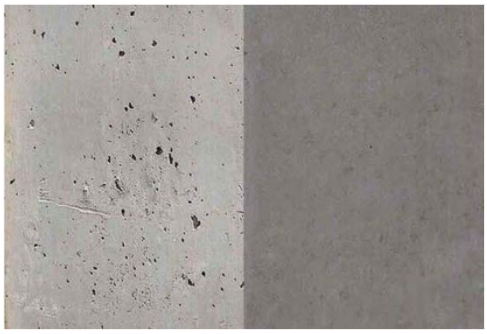
IStrcutE offices, London, rear wall

Hugh Brougton Architects/ Expedition engineering,



Fabric faced form liner





Images courtesy of Max Frank - Zemdrain,

Appropriate Release Agent



Right quantity applied

Too much agent applied

- Not essential to be specific at tender
- Specify ‘to suit concrete mix and facing material’ but also to test on site before use
- Correctly applied to manufacturers guidance - other wise will be visible on the concrete

Describe details







Set tie bolt positions (design intent only)

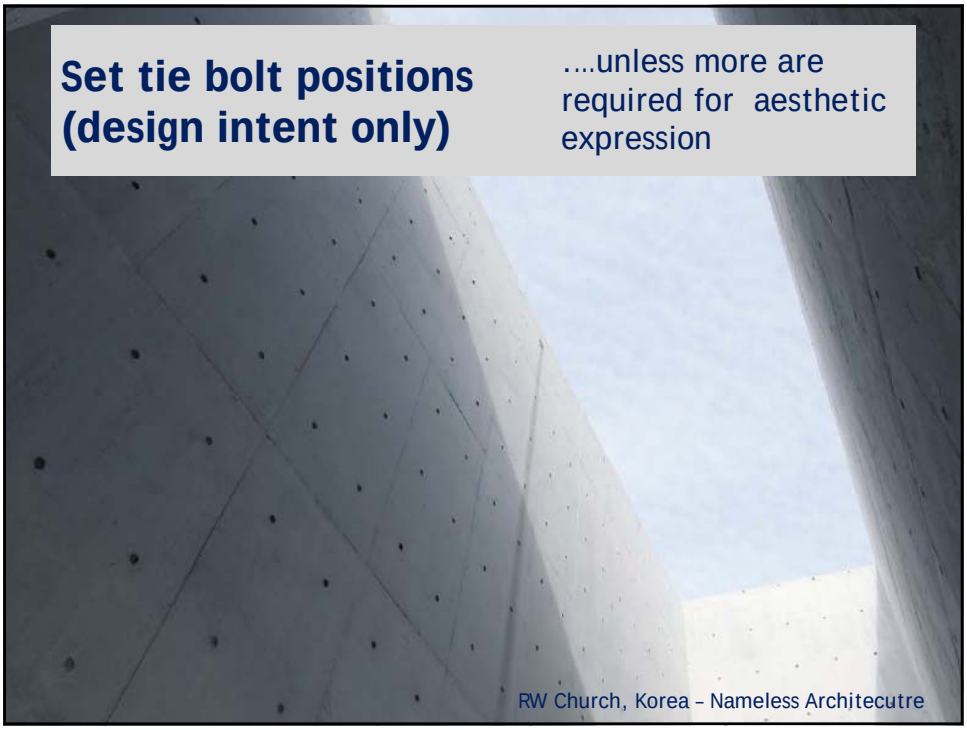
Indicative layout
Eg: Subject to structural req

- Aligned with each other
- Equal number per board
- minimum number required unless…..

The Forum
ADP / AKS Ward

Set tie bolt positions (design intent only)

….unless more are required for aesthetic expression



RW Church, Korea – Nameless Architecutre

Consider location Of day work joints

- Describe/agree where day joints are to be avoided
- Consider expressing joint for large areas

Angel building, London
AHMM/ AKT

Horizontal boards

Day joint at mid board position

John Henry Brookes Building, Oxford
Design Engine

Appropriate tie bolts, covers and spacers

- Specify types appropriate for visual concrete. I.e. with minimal appearance on face of concrete
- Similar colours where possible

Proprietary form liner products

- Polyurethane or plastic mats bonded to inside of formwork
- Designed for single or multiple use
- Bespoke or ready made designs

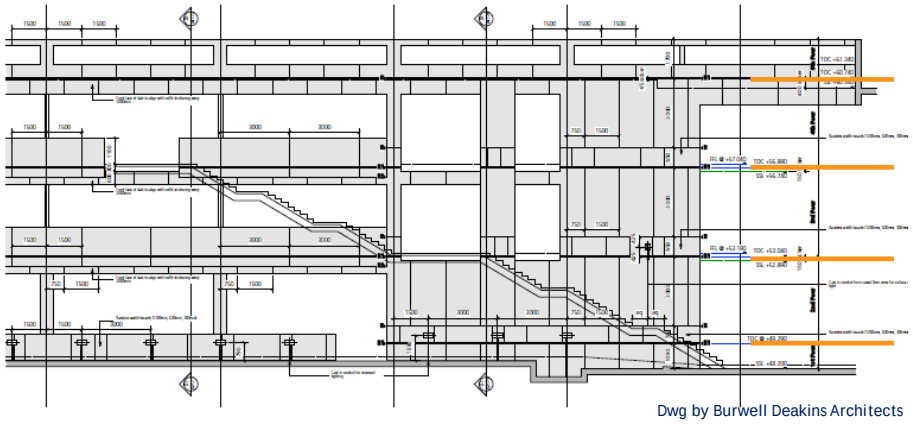
Manchester School of Art
FCB Studio

Plastic dimpled drainage board used as a mould

Camden Square Adventure Playground, Peckham

Eger Architects and Margret Higginson

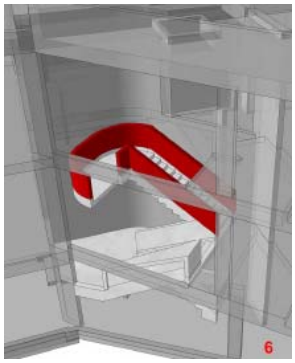
Set out formwork



Dwg by Burwell Deakins Architects

- Design intent drawing by architects
- Contractors proposals agreed before construction

Design and describe elements in 3D



East Ham Customer Service Centre
Rick Mather Architects/ Engineers HRW

Precast formwork for Experian Data Centre
Sheppard Robson

Understand and describe the forms to improve buildability and optimise formwork

Sculptural retaining wall, Redruth
Walter Jacks Studio