
Structural Engineering Specification

for

The Proposed Alterations and Repairs to the Existing Barn Structure

at

Brook Farm, Brook Street, Cuckfield RH17 5JJ

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1.0 Preliminary Clauses

1.1 GENERAL

This specification is to be read in conjunction with all relevant Architect's and Engineer's drawings and specifications.

1.2 STABILITY OF STRUCTURES

Maintain the stability of all existing buildings, structures, and earthworks within and adjacent to the Works, from the date of possession of the site until practical completion of the Works. Take all necessary precautions to prevent damage to existing buildings and structures within and adjacent to the Works.

Ensure that the stability and structural integrity of the Works are maintained during the Contract. Design, install and maintain temporary support where necessary. Do not overload any completed or partially completed elements of the Works. If requested submit details of temporary support proposals together with the proposed sequence and method of construction.

1.3 SEQUENCE OF CONSTRUCTION

Devise and take responsibility for the sequence of construction together with associated temporary works. When requested, submit details of proposed construction sequence together with supporting documentation as required. Where drawings have been provided showing sequences, they are purely for information to inform the contractor of the sequence of construction assumed in the design of key aspects of the Works.

1.4 TOLERANCES

Ensure that sufficient tolerances are provided and integrated throughout all the elements of the Works. Take account of tolerances detailed elsewhere in the contract documents.

1.5 MATERIALS AND WORKMANSHIP

Materials are to be new unless otherwise specified. For materials and workmanship, comply with the appropriate current British or European Standards, where such standards exist. Obtain certificates from manufacturers when requested. Where this specification conflicts with the appropriate current British or European Standard, the requirements of this specification take precedence.

1.6 SETTING OUT

The setting out of the building is shown on the Architect's drawings. The Structural Engineer's drawings provide supporting information.

1.7 SITE MEASUREMENT/SURVEYING

Take all necessary site measurements to establish all dimensions necessary to fabricate new steelwork or other elements of structure.

1.8 INVESTIGATION / OPENING UP WORKS

The structural engineering drawings indicate the anticipated scope of the structural works. These have been prepared without full access to the building. The proposed alterations and repairs cannot be finalised until further investigations and inspections have been carried out by the contractor. It is anticipated some changes to the scope of the structural works will be required once these investigations are completed. In relation to the timber frame, section 6.0 should be referred to.

Allow for phased opening up works in sufficient time to allow the Design Team to assess the structure and prepare any further details. The preliminary requirements for these investigations are shown on the drawings.

Advise the Lead Consultant when the opening up has been fully completed in an area. Provide safe access to allow inspection of the existing structure. The area will be inspected by a member of the design team who will advise if additional opening up is required.

After full opening up has been completed, allow ten working days before issue of final repair details.

1.9 OPENING UP PROCEDURES

Remove finishes carefully by hand. Do not cut floorboards, panels, skirtings, etc. unless agreed with the Lead Consultant. Set aside all materials and protect for future replacement.

Do not open up areas not instructed.

Do not use machine tools for opening up work without prior written permission.

Trial pit excavations are to expose the full depth and profile of the existing foundations. Do not undermine existing foundations.

The builder shall take all necessary precautions to ensure live services are not damaged or effected by the proposed opening-up works. The builder shall allow in his price for all necessary investigations to check for the presence of services before works commence. Where services clash with proposed locations, alternative locations are to be agreed with the Engineer prior to commencing work in that area.

The builder shall review all relevant asbestos survey reports of the building. Where these are not available, the builder shall remain vigilant during the works and check for the presence of asbestos and ensure the works do not disturb existing asbestos contained within the building.

Protect all openings at all times.

1.10 PROGRAMME

Take account of requirements for opening up works and preparation of final construction details in the contract programme.

Allow sufficient time for taking site dimensions to complete fabrication drawings.

2.0 Groundworks

- 2.1 EXISTING GROUND CONDITIONS: The ground conditions upon which the design has been assumed are noted on the drawings. An average pre-contract water level of 1.0m below ground level is to be assumed for costing purposes.
- 2.2 EXISTING SERVICES: carry out all necessary investigations to establish the extent and depth of any services potentially affected by the works. Make all necessary enquiries with the appropriate authorities to establish the routes of all services prior to commencing the works. Where services are affected and need to be removed temporarily or diverted, arrange with the appropriate authorities for disconnecting the services, where necessary. Protect all services from damage, including manholes and drains, and prevent debris from entering drains at all times. Make good any damage caused to services as a result of the works.
- 2.3 EXCAVATIONS: to be carried out as shown on the drawings. Give not less than 24 hours' notice of when excavations will be ready for inspection. Place concrete or other fill as soon as possible after inspection to prevent deterioration due to water, frost or other causes.
- 2.4 COLD WEATHER AND WATER: excavations are to be protected against freezing. Keep all excavations free from water and keep water from excavations clear of other construction work.
- 2.5 HANDLING AND DISPOSAL OF MATERIAL OFF-SITE: is to be carried out in a safe manner, in accordance with current legislation and as directed by the relevant authorities. Take note of any contamination information supplied with a site investigation report, if applicable. Allow for and carry out contamination tests in order to classify the material for handling and disposal purposes.
- 2.6 EXCAVATIONS FOR FORMATION OF FOUNDATIONS: excavate down to the natural bearing formation of undisturbed soil unless otherwise instructed. Obtain instructions if natural bearing formation of undisturbed subsoil is not obtained at a depth shown on the drawings.
- 2.7 EXCAVATIONS FOR GROUND BEARING SLABS AND RAFTS: The formation level for ground bearing slabs and rafts is to be inspected. Any soft spots and organic matter are to be removed and voids back filled with compacted hardcore. The formation level is to be compacted using plant methods suitable to the type of material.
- 2.8 UNKNOWN OBSTRUCTIONS: obtain obstructions before proceeding.
- 2.9 GENERAL BULK FILL shall be dry, clean subsoil free from vegetable material, topsoil, roots and rubbish.
- 2.10 COMPACTED GENERAL FILL: shall be dry, clean subsoil free from clay, vegetable material, topsoil, roots and rubbish.
- 2.11 COMPACTED HARD CORE shall be good, clean, hard brick (free from old plaster and timber), crushed cement concrete, hard tiles, stone or ballast broken before placing to pass a 75 mm ring, suitably graded to be capable of thorough compaction and free from all rubbish, contamination and having a low sulphate content.
- 2.12 COMPACTED SUB-BASE shall be granular sub-base material Type 1 or 2 as described in Section 3 of the Department of Transport Specification for Highway Works.
- 2.13 COMPACTION OF FILLING: spread material in layers not exceeding 225 mm thick and as soon as possible thereafter compact each layer using plant methods suitable to the type of material. Provide details of plant and minimum number of passes per layer. Power rammers are not to be used close adjacent to existing buried services pipe.

3.0 Foundations and Other In Situ Concrete Works

- 3.1 FOUNDATIONS: New mass concrete trench fill foundations shown on the drawings to bear minimum 150mm into natural ground and a minimum of 1.0m below ground level. Concrete to be as noted below if supplied ready-mixed, else to be batched on site using 1:2:4: by volume, sulphate resisting Portland cement (SRPC 42.5): sand : aggregate mix.
- 3.2 MATERIALS: Concrete and its constituent materials must comply with BS 8500 Part 2.
- 3.3 NATIONAL STANDARD: All concrete works is to be in accordance with all relevant parts of “The National Structural Concrete Specification for Building Construction” and as noted below. Reinforcement fabrication and supply to be CARES certified. The concrete supplier is to have QSRMC or similar approved certification.
- 3.4 CONCRETE MIXES: Table 3.1 sets out the concrete types to be used for different applications:

Table 3.1: Concrete Types for different applications				
Application	Concrete		Max Aggregate Size	Identify Testing Required
	Type	Designation		
Blinding	Designated	GEN1	20mm	No
Trench fill or mass concrete footings, and underpinning	Designated	FND2	20mm	Yes
RC substructures and ground floor slabs	Designated	FND2	20mm	Yes
RC internal superstructure	Designated	RC40	20mm	Yes
Garage floor slab	Designated	FND2	20mm	Yes

Notes:

- The contractor is to determine the consistence class appropriate for each part of the works to suit construction requirements.
 - The contractor is to determine any restrictions on cements or combinations to be used to suit construction requirements.
 - Identity testing is to be carried out in accordance with BS EN 206-1, annex B, unless otherwise specified.
- 3.5 IN SITU CONCRETE PADSTONES: where concrete padstones are to be cast in situ as noted on the drawings, concrete is to be 1:1¹/₂:3 by volume, Portland cement (PC 42.5) : sand : aggregate mix cast in situ.
- 3.6 CONCRETE ENCASEMENT TO STRUCTURAL STEELWORK: where structural steelwork is to be concrete encased, as noted on the drawings and Engineering Schedule, concrete is to be 1:1¹/₂:3 by volume, Portland cement (PC 42.5) : sand : aggregate mix cast in situ.
- 3.7 REINFORCEMENT: the design intent of any reinforcement requirements is set out on the drawings. The contractor shall complete the reinforcement detailing and scheduling to suit their method of working.
- 3.8 DEFORMED BAR REINFORCEMENT: All bars are to be Grade 500 high yield steel in accordance with BS 8666: 2005.
- 3.9 FABRIC REINFORCEMENT: to BS 4483: 2005, using Grade B500A bars to BS 4449: 2005.
- 3.10 COVER TO REINFORCEMENT: concrete cover shall be as noted on the drawings.

- 3.11 REINFORCEMENT IN NEW TRENCH FOOTINGS: where noted on the drawings, provide 3No. H20 straight bars in base of footings, with 900mm laps between separate lengths of bar, with nominal 100mm cover.
- 3.12 JOINTS: permanent joints to be as noted on the drawings. Temporary construction joints to be determined by the Contractor and are to be prepared such that the surface of the joint is thoroughly roughened to provide an exposed aggregate finish, which is clean and damp when fresh concrete is placed against it.
- 3.13 PLACING AND COMPACTION OF CONCRETE: Place concrete in one continuous flow and no thicker than can be effectively compacted with the equipment being used. Compact to full depth to ensure full compaction.
- 3.14 COLD WEATHER: the temperature of concrete at time of placing must not be less than 5°C. Do not place against frozen or frost covered surfaces. The shade air temperature at time of placing must not be less than 1°C rising or 3°C falling, measured on a thermometer sited adjacent to the proposed concrete works.
- 3.15 CONCRETE SURFACE: Concrete finish on ground floor slab to be chosen by contractor to be suitable for the proposed finishes that will be subsequently laid. Refer to the architect's details for floor finish build up.
- 3.16 CURING: Prevent surface evaporation from concrete throughout the curing periods by:
- a. Retaining formwork in position and, if necessary, covering exposed surfaces immediately after striking, and
 - b. Covering top surfaces of fresh concrete immediately after completion of placing and compacting each bay, removing covering only to permit any finishing operations and replacing immediately thereafter.
- Covering for curing may be suitable impervious sheet materials or suitable curing compound, that must be effective at preventing evaporation, must not disfigure permanently exposed surfaces, and must not increase the risk of frost damage.
- 3.17 PROTECTION: Prevent damage to concrete, including:
- a. Surfaces generally: from rain, indentation and physical damage.
 - b. Surfaces to be exposed in the finished work: from dirt, rust marks, and other disfiguration.
 - c. Immature concrete: from thermal shock, physical shock, overloading, movement, and vibration.

4.0 Rebuilding and Repairs of Existing Masonry Perimeter Walls and Piers

- 4.1 MATERIALS: Existing bricks and stone blocks within the existing walls and piers are to be reused in the new construction. The masonry removed from each area is to be reused in the same area where rebuilt and not placed in a different section of wall or pier.
- Where bricks are fractured, they are to be replaced with new clay bricks, matching the appearance, colour, and texture of the existing bricks. New materials and workmanship shall comply with the recommendations of BS EN 1996 Part 1 and 2, including the relevant National Annex. Where new bricks are required, they are to be a clay brick of minimum 20N/mm² strength, and of freeze/thaw resistance F2 and soluble salts content category S1 or S2.
 - Where facing stone blocks are fractured or are significantly weathered, they are to be replaced with new or reclaimed local natural Wealden stone, matching the appearance, colour, and texture of the existing facing stone, in accordance with Architect's details.
- 4.2 PHOTOGRAPHIC RECORD AND SURVEY: Prior to dismantling sections of wall and the piers to be rebuilt, prepare photographic record. Survey walls and piers to establish levels of stone coursing. This information is to be referred to by the Contractor during the works to ensure the existing details are matched as closely as possible.
- 4.3 DISMANTLE WALLS AND PIERS: Remove masonry by hand using techniques that will limit the damage to the existing bricks and stone blocks. Clean to be free of old mortar, dust and other debris to be prepared for reuse.
- 4.4 REBUILD WALLS AND PIERS: Rebuild walls and piers off new concrete foundations re-using existing brick and stone blocks, set in a lime mortar, 1:3 by volume, NHL3.5 lime : sharp sand mix. Architect to confirm mix proportions.
- Bonding pattern to match existing.
 - Incorporate stainless steel ties as noted on the drawings.
- 4.5 JUNCTION OF TIMBER FRAME WITH BRICK PLINTH: Rake out all hard cementitious mortar in contact with timber sill plate forming base of timber framed wall. Make good using lime mortar, 1:3 by volume, NHL3.5 lime : sharp sand mix. Architect to confirm mix proportions.
- 4.6 MASONRY REPAIRS TO BRICKWORK THAT IS TO BE RETAINED IN SITU: Inspect existing masonry and make good brickwork and mortar as necessary, to match existing construction.
- Existing masonry units within the existing walls are to be reused in the masonry repairs that are necessary, unless fractured. Where masonry units are fractured, they are to be replaced as Clause 4.1.
 - Make good masonry using existing bricks, set in a lime mortar, 1:3 by volume, NHL3.5 lime : sharp sand mix. Architect to confirm mix proportions.
- 4.7 STAINLESS STEEL TIES: Where rebuilt masonry walls are to be tied into the new floor slabs, as noted on the drawings, they are to be 6mm diameter Helibar by Helifix, min 150mm embedment into both masonry and concrete elements.

5.0 New Load Bearing Masonry

- 5.1 Materials and workmanship shall comply with the recommendations of BS EN 1996 Part 1 and 2, including the relevant National Annex.
- 5.2 NEW BRICKWORK BELOW DPC to be in frost resistant clay brick of minimum 20N/mm² strength set in a 1:3 (Class M12) sulphate-resisting Portland cement (SRPC 42.5) : sand mortar. Bricks to be of freeze/thaw resistance F2 and soluble salts content category S1 or S2.
- 5.3 NEW BRICKWORK ABOVE DPC to be in clay brick of minimum 20N/mm² strength set in 1:2:9 (Class M2) Portland cement (PC 42.5) : lime : sand mortar.
- 5.4 BONDING: Brickwork and blockwork to be laid properly bonded as agreed with the Architect. Where new solid 215mm solid brickwork is specified, it is to be laid in a Flemish bond unless agreed otherwise with the Architect and Engineer.
- 5.5 DRY PACK: to be 1:3 Portland cement (PC 42.5) : sharp sand semi-dry mix rammed hard into place where noted on the drawings to ensure masonry above proposed alteration is fully supported.
- 5.6 NEW WORK AGAINST EXISTING MASONRY: Where new masonry abuts existing masonry, new work is to be fully toothed and toothed to existing work where noted on the drawings.
- 5.7 NEW RETAINING WALLS: New brickwork to be in accordance with Clause 4.2 of this Specification and laid solid, bonded in an English or Flemish bond in accordance with Architect's details.

6.0 Structural Repairs to Existing Timber Frame

- 6.1 INSPECTION AND REPAIRS: The structural engineering drawings indicate the anticipated scope of the structural works based on inspections to date. These have been prepared without full access to the building and since areas of the timber frame are concealed behind weatherboarded and other finishes. The proposed alterations and repairs cannot be finalised until further investigation is carried out by the timber framer / carpenter.
- 6.2 TIMBER FRAMER: All detailed inspections and repairs are to be carried out by a timber framer / carpenter who has knowledge and experience of working on similar traditional timber framed buildings.
- 6.3 INSPECTIONS: The timber framer is to carry out a detailed inspection of all elements of the timber frame. This is to establish the extent of decay, fractures and splits within the elements and connections of the timber frame to establish whether structural repairs need to be carried out. Key aspects which will determine this will be:

- The extent of decay, fractures and splits across the cross-section of the timber element.
- Whether the original pegged joints between individual timbers have decayed, are missing, or have been compromised.

The timber framer / carpenter will carry out these inspections initially based on the visual appearance of the exposed timber elements. Where evidence of surface decay or beetle infestation is noted, additional probing using a bradawl, a small diameter drill, or similar techniques will be adopted to establish the depth of any decay noted.

Where mortar or resin has been used to fill crevices and peg-holes in timbers, these are to be removed, to allow the full extent of decay to be established.

- The primary elements of the timber frame consist of the sill plate, primary posts, wall plates, tie beams and principal rafters. Where the extent of decay exceeds 10% of the cross-sectional area of the timber, or a connection is decayed, the Engineer is to be informed, and additional repair details agreed.
 - The secondary elements consist of the studs and braces within elevations, and the common rafters and purlins within the roof structure. Where the extent of decay exceeds 15% of the cross-sectional area of the timber, the exist timber is to be doubled up with a new timber in accordance with the drawings and this specification.
 - Connections between timber elements which are loose are to be enhanced with new metal brackets adopting the details shown on the drawings.
- 6.4 STRUCTURAL REPAIRS: The structural engineering drawings show the anticipated scope of structural repairs to the timber frame. Once the inspections by the timber framer have been completed, this scope may need to be adjusted. The repairs are to be carried out in accordance with the drawings and sketch book details accompanying the drawings, and as noted in Clause 6.5 below.
- 6.5 SKETCH BOOK DETAILS: These details have been prepared to show a range of structural repairs to timbers which have decayed over a certain threshold or are fractured, or where connections are lose. The details are intended to set the engineering strategy for how structural repairs are to be carried out. They are not exhaustive and if the Timber Framer has alternative solutions they feel are suitable for a particular situation, these are to be raised and agreed with the Engineer. The carpenter will review the details against the extent of decay found on site and adapt the details according to the existing arrangement.
- If the extent of decay within the timber element is greater than the threshold indicated, consult with the structural engineer.

- If there is any doubt, or the details provided do not cover a particular situation found on site, consult with the structural engineer.
- 6.6 PREPARATION OF TIMBER SURFACES: Defrass existing decayed timber back to sound timber, leaving surface even and smooth, and cut square, to receive a new section of timber. Holes to be drilled for new oak pegs to be sized accordingly, so that the peg, once inserted is tight. Diameter of oak pegs to match existing.
- 6.7 NEW OAK in the works to be selected good quality oak heartwood not inferior to strength class D40 to BS EN 338, Grade THA to BS 5756, and free from wane.
- 6.8 SEASONING OF OAK: Where drawings require fully seasoned oak, it is to be kiln dried. Otherwise, all oak is to be air-dried. Where complete replacement of a component is required, and air-dried is not obtainable, timber to be at least one-year old winter felled.
- 6.9 NEW OAK SPLICES / INFILL PIECES: to be fabricated / cut to ensure a tight and secure fit into the existing timber section being repaired, matching grain to parent timber. New oak for use in scarfing and patching repairs is to be air-dried with grain matching that of parent material. New timbers in elevations and roof structures to be placed with heartwood facing the external face.
- Oak pegs, 19mm diameter, to be used where practical, to secure new section in place. Additional stainless steel wood screw, coach screw, or bolted fixings are to be used where necessary to ensure a secure fit, with fixing heads concealed behind oak dowels on external face of timber.
- 6.10 NEW OAK PEGS IN EXISTING JOINTS: Where the original pegged joints between individual timbers have decayed, are missing, or have been compromised, they are to be replaced with new oak pegs. If the size of the hole prevents a tight connection, steel cleats are to be used to tie the individual timber elements together, in accordance with the sketch book details.
- 6.11 STEELWORK IN TIMBER FRAME REPAIRS: The following principles will apply for timber repairs of a traditional hardwood timber frame requiring new timber elements, scarfing, and patching, together with steel flitch plates and fabricated brackets where traditional carpentered joints are not practical:
- a) Metal brackets, flitch plates, and fixings for connection of new and partially seasoned oak are to be made from stainless steel to BS EN 10088 Grade 1.4301 (304), with Grade 304 fixings. Black paint finish to be provided to all metalwork, in accordance with Architect's specification.
 - b) Metal brackets and flitch plates for connection to existing fully seasoned oak sections, free from tannin, to be mild steelwork. Material specification and corrosion protection to be in accordance with Chapter 8.0 of this specification, with additional black paint finish in accordance with Architect's specification.
 - c) Where proprietary products are shown on the drawings for connection of fully seasoned oak sections, they are to be used strictly in accordance with the manufacturer's recommendations and instructions and as shown on the drawings.
 - For fully seasoned oak, joist hangers, nail plates, straps, framing anchors, angle brackets are to be manufactured by Expamet Building Products Ltd. All components to be manufactured from hot-dip pre-galvanised mild steel with screw fixings as recommended by Expamet. All holes are to be used.
 - For green or partially seasoned oak, angle brackets are to be supplied by Simpson Strong Tie, with stainless steel screws fixings as recommended by Simpson Strong Tie. All holes are to be used.
- 6.12 EPOXY RESIN: To anchor stainless rod in timber post, use Sikadur 31+ epoxy adhesive (see appendix A). To be used strictly in accordance with the manufacturer's recommendations.

7.0 Structural Timber - Softwood

- 7.1 NEW SOFTWOOD TIMBER in the works to be selected structural timber free from wane and shakes and not inferior to strength class C24 to BS EN 338. Structural timber is to comply with BS EN 1995.
- 7.2 TREATMENT: New softwood timber to be treated with organic solvent preservative or double-vacuum treated, with cut ends to be thoroughly treated before fixing.
- 7.3 PROPRIETARY PRODUCTS for use with softwood timber are to be used strictly in accordance with the manufacturer's recommendations and instructions and as shown on the drawings.
- Joist hangers, nail plates, straps, framing anchors, angle brackets are to be manufactured by Expamet Building Products Ltd. All components to be manufactured from hot-dip pre-galvanised mild steel.
- 7.4 NOTCHES AND HOLES to be avoided wherever possible and to be the minimum sizes needed to accommodate services. Position well away from knots or other defects which significantly affect the strength of the timber.
- a) NOTCHES to be at the top of timber members and located between 0.1 and 0.25 of the span from the support. Notches must not exceed 0.125 times the depth of the rafter or joist.
 - b) HOLES to be drilled horizontally through the timber member and located equidistant from the top and bottom of the member. Hole diameters to be no more than 0.25 times the depth of the joist, spaced not less than three times the larger diameter apart and located between 0.25 and 0.4 of the span from the support.
- 7.5 TIMBER BLOCKING is to be used in roof, ceiling, and floor timber members, and as noted on the drawings. Fix all blocking tightly to timber joists and rafters by skew-nailing with a minimum four nails each end. Provide folding wedges between joists and adjacent construction unless otherwise noted on the drawings.

Table 5.1: Size of Blocking Pieces

Structural Element	Width of blocking	Depth of Blocking
Floor joists	47mm	Full depth of joists
Ceiling joists	47mm	25mm shallower than ceiling joists
Rafters & roof joists	47mm	50mm shallower than rafters / roof joists

Table 5.2: Position of Blocking Pieces

For spans up to 2.5m:	Fix blocking to rafters/joists within 100mm of supports.
For spans between 2.5m and 4.5m:	Fix blocking to rafters/joists within 100mm of supports and at midspan for spans between 2.5m and 4.5m.
For spans exceeding 4.5m:	Fix blocking within 100mm of supports and at one-third span positions.

- 7.6 HORIZONTAL RESTRAINT STRAPS: Incorporate 27.5 x 5.0mm heavy duty straps between floor and wall structures at max 2.0m spacing to enable timber floor structures to provide horizontal lateral restraint to the walls. Straps to be installed strictly in accordance with manufacturer's recommendations and with Engineer's drawings, where provided.

8.0 Structural Steelwork

- 8.1 STRUCTURAL STEELWORK: All structural steelwork is to be drawn, fabricated and erected in accordance with The National Structural Steelwork Specification for Building Construction 7th Edition.
- 8.2 MILD STEELWORK GRADE: Mild steelwork is to be to BS EN 10025 Grade 355JR excluding hollow box sections which are to be to BS EN 10210 hot rolled Grade S355J2H. Cold rolled and Grade S235 will not be accepted for any structural members.
- 8.3 STAINLESS STEELWORK: All sections to be made from stainless steel to BS EN 10088 Grade 1.4301 (304).
- 8.4 STEEL-TO-STEEL CONNECTION DESIGN: The detailed design of the steel-to-steel connections is to be carried out by the Fabricator, in accordance with the outline details provided. Where details are not provided, the Fabricator is to design beam-to-beam and beam-to-column connections for a minimum ultimate shear load of 75kN plus an axial load of 25kN.
- Bolts for steel-to-steel connections to be Grade 8.8 and not less than 16mm diameter, unless noted otherwise on the drawings. Not less than 2No. bolts to be used in any connection. All bolts to have washers.
 - HSFG bolts are not permitted.
 - Minimum weld size to be 6mm continuous fillet weld unless specifically noted otherwise.
 - All butt welds are to be full penetration. Welds to be ground flush.
 - Site welding is not permitted.
 - Seal ends of all hollow sections, ensuring that the inside faces of the sections are dry and clear of debris before sealing ends and openings.
- 8.5 SERVICE HOLES: No holes are to be drilled through steelwork, unless agreed with the Engineer.
- 8.6 STEELWORK PROTECTION: Provide steelwork protection in accordance with Table 6.1 below:

Table 6.1: Corrosion Protection of Structural Steelwork (mild steel)		
TYPE 1	Internal steelwork	a. Blast clean to Sa 2½ to BS EN ISO 8501-1. b. Paint, post fabrication with 85µm of Zinc Phosphate epoxy primer.
TYPE 2	Steelwork in cavity of external wall	a. Blast clean to Sa 2½ to BS EN ISO 8501-1. b. Paint, post fabrication with 85µm of Zinc Phosphate epoxy primer. c. For steelwork within the cavity (touching both the internal and external leaves: steelwork to be additionally painted with two coats of bituminous paint.
TYPE 3	External steelwork	a. Blast clean to Sa 2½ to BS EN ISO 8501-1. b. Paint, post fabrication with 85µm of Zinc Phosphate epoxy primer. c. Paint with 100µm of High Build Epoxy MIO paint.
TYPE 4	Galvanized steelwork	a. Blast clean to Sa 2½ to BS EN ISO 8501-1. b. Hot-dip galvanize to BS EN ISO 1461 with a minimum average coating thickness of 85µm after fabrication. c. Should architect require paint finishes, additionally treat steel with a mordant wash followed by 40µm vinyl primer. Recommended architectural finish: 60µm Re-coatable Polyurethane. The fabricator is to ensure the compatibility of the primer with the Architect's chosen finish.
TYPE 5	Steelwork below ground level	a. Blast clean to Sa 2½ to BS EN ISO 8501-1. b. Concrete encase with 100mm cover.

- 8.7 FIRE PROTECTION: of steelwork to architect's details.

Appendix A: Data Sheet for Proprietary Products

Sikadur 31+ epoxy adhesive

PRODUCT DATA SHEET

Sikadur®-31+

2-part Low VOC Epoxy Adhesive for Structural Bonding and Concrete Repair

DESCRIPTION

Sikadur®-31+ is a 2-part, low VOC epoxy based, moisture tolerant, thixotropic, structural adhesive which bonds most construction materials. It has high mechanical strengths and can also be used for structural concrete repairs, joint filling and crack sealing. Sikadur®-31+ can be used in do it yourself (DIY) applications, in addition to the traditional professional applications.

USES

Suitable for structural concrete repair (Principle 3, Method 3.1 of EN 1504-9). Repair of spalling and damaged concrete in buildings, bridges, infrastructure and superstructure works.

Suitable for structural strengthening (Principle 4, Method 4.3 of EN 1504-9). Bonding plate reinforcement

Suitable for structural strengthening (Principle 4, Method 4.4 of EN 1504-9). Adding mortar
The Product can be used for interior and exterior use.

STRUCTURAL ADHESIVE FOR BONDING:

- Concrete elements
- Hard natural stone
- Ceramics, fibre cement
- Mortar, Bricks, Masonry
- Steel, Iron, Aluminium
- Wood
- Polyester, Epoxy
- Glass

REPAIR AND REPROFILING FOR:

- Structural (beams, columns, walls, etc...) and non-structural concrete elements
- Small patches and edges
- Honeycombs
- Metal profiles
- Bonding slip bricks

FILLING AND SEALING FOR:

- Joint and crack repair
- Sealing non-structural static cracks
- Holes and voids

CHARACTERISTICS / ADVANTAGES

- Easy to mix and apply
- Very low VOC (GEV Emission EC1^{PLUS})
- Very good adhesion to most construction materials
- High initial and ultimate mechanical strength
- Suitable for structural concrete repair, class R4
- Good adhesion to dry and damp concrete
- Thixotropic: non-sag in vertical and overhead applications
- No primer needed
- Good abrasion and chemical resistance
- Different coloured components (for mixing control)
- Impermeable to most liquids and water vapour
- Hardens without shrinkage
- Application up to 30 mm thickness in one layer
- Temperature application range +10 °C to +30 °C

SUSTAINABILITY

- Conforms with LEED v4 MR credit: Building product disclosure and optimization — Environmental Product Declarations (option 1)
- Conforms with LEED v4 MR credit: Building product disclosure and optimization — Material ingredients (option 2)
- Conforms with LEED v4 EQ credit: Low-emitting materials
- Environmental Product Declaration (EPD) in accordance with EN 15804. EPD independently verified by Institut für Bauen und Umwelt e.V. (IBU)
- VOC emission classification GEV Emission EC1^{plus}

PRODUCT DATA SHEET

Sikadur®-31+

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THIS DOCUMENT SERVES ONLY AS AN ILLUSTRATION OF A SIKA PRODUCT DURING THE SALES PROCESS AND THEREFORE, IS NOT BINDING FOR LOCAL SALE. PLEASE CONSULT THE LOCAL COUNTRY PRODUCT DATA SHEET FOR SPECIFIC TERMS AND CONDITIONS.

APPROVALS / CERTIFICATES

- CE marking and declaration of performance based on EN 1504-3:2005 Products and systems for the protection and repair of concrete structures — Structural and non-structural repair
- CE marking and declaration of performance based on EN 1504-4:2004 Products and systems for the protection and repair of concrete structures — Structural bonding

PRODUCT INFORMATION

Product declaration	▪ Complies with the general requirements of EN 1504-3: Class R4 ▪ Complies with the general requirements of EN 1504-4: Structural bonding for bonded plate reinforcement and bonded mortar or concrete	
Composition	Epoxy resin and selected fillers	
Packaging	1.2 kg (A+B) container	
	8 x 1.2 kg carton box	32 boxes per pallet - 256 pieces
	6 kg (A+B) container	
	Pre-batched container	72 containers per pallet
	20 kg (A) container	22 containers (A) per pallet
	10 kg (B) container	44 containers (B) per pallet
Shelf life	24 months from date of production	
Storage conditions	The product must be stored in original, unopened and undamaged sealed packaging in dry conditions at temperatures between +5 °C and +30 °C. Always refer to packaging.	
Colour	Part A	White
	Part B	Dark grey
	Part A+B mixed	Concrete grey
Density	Mixed resin (2.00 ± 0.1) kg/l Density value at +23 °C.	
Volatile organic compound (VOC) content	Compliant with VOC emission classification GEV-Emicode EC1 ^{PLUS}	

TECHNICAL INFORMATION

Compressive strength	Class R4	(EN 1504-3)		
	~75 MPa	(EN 12190)		
	Curing time	+10 °C	+23 °C	+30 °C
	1 day	-	50 MPa	50 MPa
	3 days	50 MPa	65 MPa	70 MPa
	7 days	70 MPa	75 MPa	78 MPa
Tensile strength	Curing time	+10 °C	+23 °C	(EN ISO 527-2)
	1 day	-	8.5 MPa	
	3 days	6 MPa	16 MPa	
	7 days	16 MPa	20 MPa	
Modulus of elasticity in tension	9 GPa (7 days at +23 °C)			(EN ISO 527-2)
Tensile strain at break	0.3 % (7 days at +23 °C)			(EN ISO 527-2)

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Shear strength	16 MPa				(EN 12615)
	50°		35 MPa		(EN 12188)
	60°		30 MPa		
	70°		25 MPa		
Tensile adhesion strength	Pass				(EN 12636)
	Curing Time	Substrate	Curing Temperature	Adhesion strength	(EN 12188; EN 1542)
	7 days	Concrete dry	+23 °C	> 5 MPa *	
	7 days	Concrete mat damp	+23 °C	> 5 MPa *	
	7 days	Steel	+23 °C	> 20 MPa	
	* 100% concrete failure				
Shear adhesion strength	50°		≥ 60 MPa		(EN 12188)
	60°		≥ 70 MPa		
	70°		≥ 80 MPa		
Shrinkage	~0.01 %				(EN 12617-1)
	3.0 MPa (Restrained shrinkage / expansion)				(EN 12617-4)
Coefficient of thermal expansion	4.8 × 10 ⁻⁵ (± 0.2 × 10 ⁻⁵) 1/K				(EN 1770)
Glass transition temperature	50 °C				(EN 12614)
Thermal compatibility	Freeze and thaw		3.00 MPa		(EN 13687-1)
	Durability		Pass		(EN 13733)
Chemical resistance	Resistant to many chemicals. Contact Sika Technical Services for additional information.				
Resistance to moisture	Sensitivity to water		Pass		(EN 12636)
Reaction to fire	Class C-s1, d0 Class B _f -s1				(EN 13501-1)

APPLICATION INFORMATION

Mixing ratio	Part A : Part B = 2 : 1 by weight or volume		
Consumption	2.0 kg/m ² per mm of thickness. Note: Consumption data is theoretical and does not allow for any additional material due to surface porosity, surface profile, variations in level, wastage or any other variations. Apply product to a test area to calculate the exact consumption for the specific substrate conditions and proposed application equipment.		
Layer thickness	30 mm max. For non-structural adhesive or other applications, if layer thickness's of > 30 mm are required, apply in successive 30 mm layers or once the previous layer has hardened. The surface of the freshly applied intermediate layers should be scratched to form a key for subsequent layers. If layer application is to be longer than 2 days, the wet applied adhesive must be blinded to excess with quartz sand immediately after application		
Sag flow	Non-sag up to 20 mm thickness on vertical surfaces		
Material temperature	Maximum	+30 °C	
	Minimum	+10 °C	
Ambient air temperature	Maximum	+30 °C	
	Minimum	+10 °C	

Dew point	Beware of condensation. Steel substrate temperature during application must be at least +3 °C above dew point.	
Substrate temperature	Maximum	+30 °C
	Minimum	+10 °C
Substrate moisture content	Substrates must be dry or matt damp (no standing water). Brush the adhesive well into the substrate if matt damp.	
Pot Life	Temperature	Pot Life (ISO 9514)
	+23 °C	~60 min
	+30 °C	~45 min
Open Time	Temperature	Open Time (EN 12189)
	+23 °C	~75 min
	+30 °C	~45 min

BASIS OF PRODUCT DATA

All technical data stated in this Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

IMPORTANT CONSIDERATIONS

- Sikadur® resins are formulated to have low creep under permanent loading. However, due to the creep behavior of all polymer materials under load, the long term structural design load must account for creep. Generally the long term structural design load must be lower than 20–25 % of the failure load. A structural engineer must be consulted for load calculations for the specific application.

ECOLOGY, HEALTH AND SAFETY

User must read the most recent corresponding Safety Data Sheets (SDS) before using any products. The SDS provides information and advice on the safe handling, storage and disposal of chemical products and contains physical, ecological, toxicological and other safety-related data.

APPLICATION INSTRUCTIONS

SUBSTRATE QUALITY

CONCRETE / MASONRY / MORTAR / STONE

Concrete and mortar must be at least 3–6 weeks old. Substrate surfaces must be sound, clean, dry or matt damp. Free from standing water, ice, dirt, oil, grease, coatings, laitance, efflorescence, old surface treatments, all loose particles and any other surface contaminants that could affect adhesion of the adhesive.

STEEL

Surfaces must be clean, dry, free from oil, grease, coatings, rust, scale, all loose particles and any other surface contaminants that could affect adhesion of the adhesive.

WOOD

Substrate surfaces must be sound, clean, dry and free from dirt, oil, grease, coatings, all loose particles and

any other surface contaminants that could affect adhesion of the adhesive.

SUBSTRATE PREPARATION

IMPORTANT

Reduced adhesion performance

Surface contamination such as dust and loose material, including that caused during substrate preparation can reduce the Product's performance.

- Thoroughly clean all substrate surfaces before application of the Product by vacuum / dust removal equipment.

CONCRETE / MASONRY / MORTAR / STONE

1. Prepare substrates mechanically using suitable abrasive blast cleaning, needle gunning, light scabbling, bush hammering, grinding or using other suitable equipment to achieve an open textured gripping surface profile.

STEEL

1. Prepare surfaces mechanically using suitable abrasive blast cleaning, grinding, rotating wire brush or other suitable equipment to achieve a bright metal finish with a surface profile to satisfy the necessary tensile adhesion strength requirement.

Avoid dew point conditions before and during application.

WOOD

1. Prepare surfaces by planing, sanding or using other suitable equipment.

MIXING

IMPORTANT

Maintaining workability and handling time.

When using multiple units during application, do not mix the following unit until the previous one has been used.

PRE-BATCHED UNITS

1. Mix only the quantity which can be used within its pot life
2. Prior to mixing all parts, mix part A (resin) briefly using a mixing spindle attached to a slow speed electric mixer (max. 300 rpm).
3. Add part B (hardener) to part A and mix parts A+B continuously for at least 3 minutes until a uni-

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BUILDING TRUST



formly coloured smooth consistency mix has been achieved.

4. To ensure thorough mixing pour materials into a clean container and mix again for approximately 1 minute. Over mixing must be avoided to minimise air entrainment. Mix full units only. Mixing time for A+B = 4.0 minutes.

APPLICATION

IMPORTANT

Provide temporary support for heavy components positioned vertically or overhead

ADHESIVE

1. Apply mixed adhesive to the prepared surfaces with a spatula, trowel, notched trowel or by gloved hand.
2. For optimum adhesion apply adhesive to both surfaces that require bonding.
3. For heavy components positioned vertically or overhead, provide temporary support until the Product has fully hardened /cured. Hardening and curing will be dependent on ambient temperatures.

REPAIR

1. Apply mixed adhesive to the prepared surfaces with a spatula, trowel or by gloved hand.
2. Use temporary formwork as required.

JOINT FILLING AND CRACK SEALING

1. Apply mixed adhesive to the prepared surfaces with a spatula or trowel.

CLEANING OF EQUIPMENT

Clean all tools and application equipment immediately after use with Sika® Colma Cleaner. Hardened material can only be removed mechanically.

LOCAL RESTRICTIONS

Note that as a result of specific local regulations the declared data and recommended uses for this product may vary from country to country. Consult the local Product Data Sheet for exact product data and uses.

LEGAL NOTES

The information, and, in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions in accordance with Sika's recommendations. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The user of the product must test the product's suitability for the intended application and purpose. Sika reserves the right to change the properties of its products. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local Product Data Sheet for the product concerned, copies of which will be supplied on request.

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