

Cross Laminated Timber (CLT) Construction

(May 2024) (Second issue – supersedes August 2022)

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Question

What types or forms of CLT panel construction are acceptable to NHBC?

Considerations

- Cross-laminated timber panels typically have an odd number of layers (three, five, seven etc) stacked on one another at right angles and glued together in a press over their entire surface area. Each layer is composed of softwood boards of varying lamination thickness glued together.
- CLT panels generally perform well as load bearing elements and can support significant vertical load as well as provide adequate mechanical and racking resistance to lateral loads. They can also perform well as floor plates capable of spanning in two perpendicular directions, although they are mostly designed as one-way spanning elements
- CLT commonly available in the UK are manufactured from quality-controlled softwood materials which have no natural defence against decay caused by sustained high levels of moisture, typically above the design threshold of 20% moisture content, unless treated with water repellents in their manufacture. CLT panels should comply with clause 6.2.11 of the NHBC Standards. Although wholly treated CLT are available in the EU, they are not common or readily available in the UK and hence the lamellae should be from naturally durable timber or the panels suitably treated for the applicable Use Class. External walls are typically Use Class 2 (UC2). See NHBC Standards chapter 3.3 for definition and requirements of different Use Classes.
- CLT structures should not be subjected to high moisture either during installation or in-service, as incorrect installation may create conditions for moisture to become trapped. Every effort should be made to ensure no moisture is trapped within CLT structure including detailed plan for protection against both short- and long-term exposure to excessive moisture or precipitation. A satisfactory **Moisture Control Plan** will be required for the management and control of moisture on all projects.
- Adequate breather membranes should be correctly provided to CLT panels to protect them from moisture during transportation, construction, and in-service conditions, and to allow water vapour from the home to pass into the cavity. Vapour control layers (VCL) should also be provided and installed correctly, where necessary, to restrict the passage of water from within the home to the CLT panels. Further guidance on what is acceptable VCL, and breather membrane are available in clauses 6.2.12 and 6.2.13 of our Standards.
- Insulation on CLT walls should be located on the outside face of the CLT panels and should preferably be of a breathable type. Foil faced rigid foam products may not be breathable and require special attention to check the vapour resistivity of the interface between CLT and insulation within the interstitial condensation check. In addition, a further breather membrane may be required between the CLT and insulation to avoid condensation issues at the board joints. Further guidance on this can be found on the STA Advice Note 14 titled 'Robustness of CLT Structures - Part 3: Key principles for good practice detailing for the external envelope of CLT'.
- In using CLT for external walls of homes, all the Performance Standards of Chapter 6.2 of the NHBC Standards should be met, and most of the guidance within the chapter will also be applicable including the use of treated soleplates at the base of walls in accordance with clause 6.2.4. A notable divergence of the guidance will be in clause 6.2.8 – Differential movement, where the gap sizes given in Table 1 of the clause will not be applicable. Gap sizes for use with CLT will need to be assessed on project specific basis. See TRADA Guidance Document GD 10 for guidance on differential settlement assessment of CLT walls.

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- The Structural Timber Association publication: STA Advice Note 14 titled '*Robustness of CLT Structures - Part 1: Key principles for moisture durability*' provides guidance for the design, concept detailing and installation of panelised CLT building structures.

Answer

Cross-laminated timber (CLT) as a mass timber building system is acceptable to NHBC to support residential development for warranty purposes provided, they

1. are manufactured and CE or UKCA marked to BS EN 16351
2. are made of naturally durable materials or are treated in accordance with guidance in clause 6.2.11 & Chapter 3.3 of our standards, depending on the applicable Use Class.
3. are to be used in external walls in service class 1 conditions to BS EN 1995-1-1 - i.e., timber system homes similar to studded Timber Frame (TF) panels generally outlined and described in Chapter 6.2 of our Standards, including encapsulation of the CLT panels in plaster or fire boards to current acceptable guidance. Use of exposed CLT internally is not covered and will not be acceptable under this guidance. Such use will require a satisfactory fire performance tests and assessment by a third-party approvals' authority acceptable to NHBC.
4. meet NHBC Technical Requirements and Chapter 6.2 Performance Standards,
5. are used as suspended upper floor construction, where appropriate and used in a similar way to timber upper floor construction outlined and described in Chapter 6.4 of our Standards, including appropriate measures to manage exposure to excessive moisture during construction; adequate strategy to manage potential in service water leakages in wet areas like bathrooms & kitchens; and provision of adequate fire protection to the underside of the floor when forming a ceiling,
6. meet NHBC Technical Requirements and Chapter 6.4 Performance Standards relevant to timber floors,
7. are restricted to use in residential developments or buildings of up to seven storeys or with a Storey Height less than 18m above the ground (whichever is the lesser), and
8. are used as summarised in the table below which highlights our risk analysis of what can or cannot be considered by NHBC

CLT application	Risk	Can be considered by NHBC?
External walls of a framed building with a Storey Height less than 18m above ground level	Medium: Risk of prolonged exposure to moisture and rainfall during construction. Need adequate strategy to mitigate risk. Where unavoidable, independent assessment of directly exposed structure or element of structure facing into a cavity to be undertaken, with recommendations on way forward.	Yes
Intermediate or upper floor (internal) construction in buildings with a Storey Height less than 18m above ground level	Medium: Risk of prolonged exposure to moisture and rainfall during construction, and in-service risk to water leakage from wet areas like kitchen and bathrooms. Need adequate strategy to mitigate both risk types. Also, where prolonged exposure is unavoidable, an independent assessment as noted above will be required.	Yes
Suspended ground floor construction	High: Apart from risks identified above for use as upper floor, there is increased risk to unlimited exposure to ground or subterranean moisture with additional risks at junction with external walls.	No

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CLT application	Risk	Can be considered by NHBC?
Flat roofs, balconies or parapets	High: Detailing of these elements to exclude moisture in the long term is difficult to achieve in practice and their adequate construction cannot be guaranteed.	No
Edges of floors exposed to the cavity, edges of openings (like windows & doors), penetrations through wall and floor panels and panel joints	Medium: Panel joints & ends, opening reveals and edges of penetrations are susceptible to moisture penetration during construction and in service, and they should be adequately treated with an appropriate end-grain sealer.	Yes

Further limitations on the use of CLT include:

- i. Where they are to be used as exposed wall or ceiling panels, such use will not be acceptable under this guidance. Such use will require a satisfactory fire performance tests and assessment by a third-party approvals' authority acceptable to NHBC.
- ii. CLT should not be used in the construction of flat cold roofs, parapets or balcony (cantilevered or otherwise). CLT will not be acceptable for inverted flat roofs, even with a seemingly acceptable condensation risk analysis
- iii. Warm CLT roofs, with slopes of over 10 degrees may be acceptable if properly detailed and has adequate moisture management plan to protect it from excessive exposure to significant precipitation during construction

Where CLT is to be used in modular construction, they must be independently assessed by a third-party approvals' authority acceptable to NHBC or equivalent (e.g., NHBC Accepts). Further information on what constitute an independent technical approvals authority acceptable to NHBC is available in our Technical Guidance Note 2.1/20

Any certification of the CLT systems should address the following as a minimum as part of an overall independent technical assessment:

- a. Manufacture – CLT products must be CE or UKCA/UKNI marked and produced in compliance with BS EN 16351, with audited surveillance of factory production control
- b. Building Regulations – the system will need to demonstrate compliance with all regulations in all relevant UK nations
- c. Structural performance – the system must be able to demonstrate a satisfactory structural performance through an acceptable design method in accordance with EN 1995-1. The system including connections, should be shown to have adequate strength and stiffness to sustain the loads to which it will be subjected from manufacture to installation to in-service use.
- d. Durability – the system should demonstrate they achieve a 60-year life
- e. Design consideration – the systems unique design considerations and typical detailing requirements will need to be highlighted
- f. Thermal performance – the systems performance as wall and roof elements will be required
- g. Air permeability and Condensation risk – the system should be assessed against these criteria
- h. Fire Performance – the systems behaviour in relation to fire will be required and its method of achieving any necessary fire resistance should be clearly stated
- i. Resistance to airborne sound and Weathertightness – the system should be assessed against these criteria
- j. Installation – systems characteristics particularly as it relates to the site installation of different structural elements should be adequately covered



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