



# Technical Approval

SINTEF Building and Infrastructure confirms that

## CCL Deck

has been found to be fit for use in Norway and to meet the provisions regarding product documentation given in the regulation relating to the marketing of products for construction works (DOK) and regulations on technical requirements for building works (TEK), with the properties, fields of application and conditions for use as stated in this document

### 1. Holder of the approval

Thilt Engineering AS  
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### 2. Product description

CCL Deck is a concept for in-situ cast concrete slabs supported by columns and/or walls. The main reinforcement is post-tensioned unbonded tendons. CCL Deck differentiates from ordinary concrete slabs because steel fibre reinforcement replaces most of the non-tensioned reinforcement required by NS-EN 1992-1-1.

The approval does not cover every component in the concrete slab. Each component should be specified for every building project and are presumed to meet the provisions regarding product documentation given in the regulation related to the marketing of products for construction works (DOK).

The products should be CE marked in accordance with valid regulations when demanded.

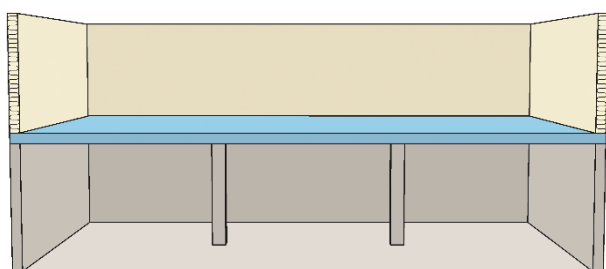


Fig. 1  
 Example of field of application for CCL Deck

### 3. Fields of application

CCL Deck can be used as elevated or as ground supported concrete slabs in buildings within Reliability class 1 and 2; see Fig 1.

### 4. Properties

#### *Load-carrying capacity*

The load-carrying capacity of CCL Deck will correspond to a post-tensioned concrete slab with traditional reinforcement.

#### *Safety in case of fire*

CCL Deck has a fire resistance corresponding to concrete slabs with traditional reinforcement. Required cover of the tendons should be calculated by the owner or his representatives in each case. The steel fibres within the cover zone on the exposed side should not be included in the load carrying capacity in case of fire exposure.

Calculated fire resistance for various slab thickness as listed in SINTEF Building Research Design Guide No. 520.321 on *Fire resistance of floors (Brannmotstand for etasjeskillere)* can be used as a guideline.

#### *Sound insulation*

CCL Deck has soundproofing properties corresponding to traditional massive concrete slabs.

#### *Thermal insulation*

The U-factor for CCL Deck is the same as for concrete slabs with traditional reinforcement.

#### *Durability*

CCL Deck is suitable for use in exposure classes X0, XC1-XC4 and XD1-XD3 according to NS-EN 206.

For exposure classes XD1-XD3 the steel fibres' contribution in the outer 10 mm of the exposed side should not be included in calculations of serviceability and ultimate limit states.

## 5. Environmental aspects

The environmental aspects of each component in the CCL Deck are not considered. It is assumed that substances hazardous to health and environment and their effect on the indoor environment are documented for each component and each material used for construction of the CCL Deck.

## 6. Special conditions for use and installation

### *Design considerations*

Reliability requirements according to NS-EN 1990:2002 shall be documented in each case according to NS-EN 1992-1-1 and guidelines stated in the Norwegian Concrete Association's publication No. 38 (NB38).

For use in buildings within Reliability class 2, sufficient moment capacity without fibre contribution should be documented when the load and material factors are set equal to 1.0.

### *Manufacturing of concrete*

Concrete with steel fibres shall be manufactured according to NS-EN 206 and additional control requirements in NB38. Concrete used in CCL Deck shall be self-compacting.

### *Reinforcement*

The main load carrying system consists of post-tensioned tendons. The cables should be placed relatively concentrated in one direction and evenly distributed in the other direction; see Fig. 2.

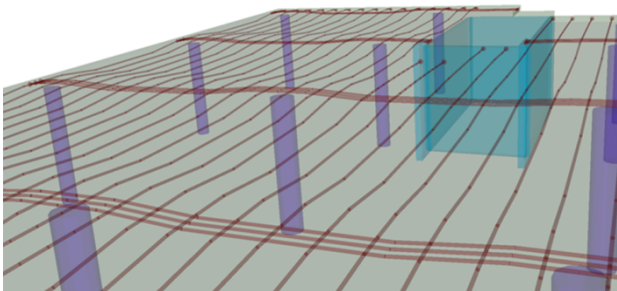


Fig. 2  
Typical layout for post-tensioned reinforcement

The spacing between the evenly distributed tendons should not exceed  $4 \cdot h \leq 750$  mm.

If sufficient capacity is documented, the non-tensioned reinforcement can be omitted except for:

- Reinforcement in the lower edge above columns according to NS-EN 1992-1-1 item 9.4.1(3)
- Splitting strength reinforcement in areas where multiple tendons are anchored.
- Reinforcement through casting joints

### *Casting*

The concrete can be cast by pumping. The diameter of the pipeline should be at the least 1.5 times the length of the fibres. A fibre distribution and orientation in accordance to the design calculations should be aimed for. Fibre-balling can be avoided by pumping through a grid.

Special considerations should be taken with respect to possible weak zones with uneven fibre distribution in structural elements due to changes in cross section areas, tendon groups, plastic tubes or other installations.

Self-compacting fibre reinforced concrete should not be vibrated.

Concrete delivery and casting should be planned to avoid unintended casting joints which may create weak zones.

## 7. Factory production control

The product is produced by Thilt Engineering AS, Ålesund, Norway.

The holder of the approval is responsible for the factory production control in order to ensure that the product is produced in accordance with the preconditions applying to this approval.

The manufacturing of the product is subjected to continuous surveillance of the factory production control in accordance with the contract regarding the SINTEF Technical Approval.

## 8. Basis for the approval

The approval is based on verification of properties and way of structural action as demonstrated in the following documents:

- Spenteknikk Construction AS: "Full scale test. Prestressed tendons and steel fibre in flat slab." Report November 2013
- Hallberg, M. A og Hanssen, H. E. : "Post-Tensioned Fiber Reinforced Flat slab", Master's thesis, NTNU 2013
- THiLT Engineering AS: "Dimensjonering og utførelse av CCL Deck", August 2015
- Norsk Betongforenings publikasjon 38: "Dimensjonering og utførelse av fiberarmert betong" (draft august 2015)
- Sivertsen, M. og Tøsti, A. B. : "Etteroppspent og fiberarmert flatdekke", Master's thesis, NTNU 2015

### 9. Marking

The approval mark for SINTEF Technical Approval No. 20462 may be used.



Approval mark

### 10. Liability

The holder/manufacturer has sole product responsibility according to existing law. Claims resulting from the use of the product cannot be brought against SINTEF beyond the provisions of Norwegian Standard NS 8402

for SINTEF Building and Infrastructure

A handwritten signature in blue ink that reads "Marius Kvalvik".

Marius Kvalvik  
Approval Manager