

SINTEF 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

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2. Product description

CCL Deck is a concept for in-situ cast concrete slabs supported by columns and/or walls and beams. The main reinforcement is post-tensioned unbonded tendons. CCL Deck differentiates from ordinary concrete slabs because steel fibre reinforcement partly replaces the non-tensioned reinforcement required by NS-EN 1992-1-1. The punching shear resistance of fibre reinforced concrete in CCL Deck is calculated as additional contribution to the shear resistance from PT tendons, concrete and possible shear reinforcement. The fibre reinforced concrete is calculated as an integrated part of the total flexural strength of the slab.

This approval includes the design principle for CCL Deck with a detailed calculation basis for design in all limit states.

The approval does not cover the components 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), and shall be CE-marked where it is required according to the regulation.

3. Fields of application

CCL Deck can be used as elevated or as ground supported concrete slabs in buildings within Consequences Class CC1 or CC2 relating to Reliability Class RC1 or RC2 in accordance with NS-EN 1990.

4. Properties

4.1 Load-carrying capacity

The load-carrying capacity of CCL Deck will correspond to a post-tensioned concrete slab with traditional reinforcement without steel fibres.

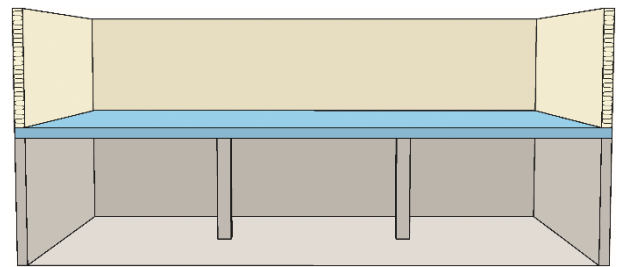


Fig. 1
Example of field of application for CCL Deck

4.2 Fire resistance

CCL Deck has a fire resistance capacity corresponding to concrete slabs with traditional reinforcement.

Required slab thickness and concrete cover of the PT tendons and reinforcement shall be calculated in accordance with NS-EN 1992-1-1 in each case, depending on required fire resistance class. 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.

Incidentally the capacity of CCL Deck in the fire limit state is documented in accordance with SINTEF report No. 2018:00165: "TG 20462 - Retningslinjer for prosjektering."

4.3 Sound insulation

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

Values for air sound insulation and step sound level can be found in Byggforskserien 522.513 *Sound insulation heavy floor separators*.

4.4 Thermal insulation

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

4.5 Durability

CCL Deck is suitable for use in exposure classes X0, XC1-XC4 and XD1-XD3 according to NS-EN 1992-1-1 and 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 the calculations in serviceability and ultimate limit states. CCL Deck shall not be used where chlorides from seawater may appear.

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

6.1 Design considerations

Thilt Engineering AS is responsible for the design of CCL Deck.

Reliability requirements according to NS-EN 1990:2002 shall be documented in each case according to NS-EN 1992-1-1 and SINTEF report No. 2018:00165: "*TG 20462 - Retningslinjer for prosjektering.*"

For use in buildings within Reliability class RC2, sufficient moment capacity without fibre contribution should be documented when the load and material factors are set equal to 1.0.

6.2 Manufacturing of concrete

Concrete with steel fibres shall be manufactured according to NS-EN 206 and additional control requirements given in SINTEF report No. 2018:00165: "*TG 20462 - Retningslinjer for prosjektering.*" Fibre reinforced concrete used in all CCL Deck is pre-documented by initial testing and determination of the characteristic residual tensile strength, $f_{tk, res, 2.5}$, in accordance with SINTEF report No. 2018: 00165, based on measured bending tensile strength in accordance with NS-EN 14651. The fibre reinforced concrete used in CCL Deck shall be self-compacting.

6.3 Reinforcement

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

The distance between the uniformly distributing tendons must be designed and executed in accordance with SINTEF report No. 2018:00165: "*TG 20462 - Retningslinjer for prosjektering.*"

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

- Robustness reinforcement in the lower part of the slab above internal columns
- Minimum reinforcement in the upper part of the slab above columns
- Splitting strength reinforcement in areas where multiple tendons are anchored
- Reinforcement through casting joints

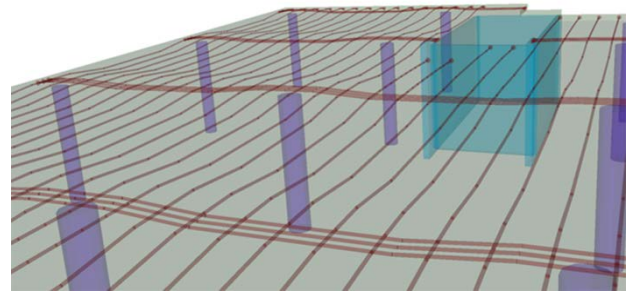


Fig. 2
Typical layout for post-tensioned reinforcement

6.4 Execution and casting

Independent of current Consequence- and Reliability Class, the inspection of execution for CCL Deck shall be according to Execution Class 3 in NS-EN 13670.

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 with 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

Thilt Engineering AS is responsible for the design and conditions for the control of fibre reinforced concrete production and construction to ensure that CCL Deck is manufactured in accordance with the conditions on which the approval is based.

SINTEF carries out random checks on design, fibre reinforced concrete production and execution of CCL Deck in accordance with the contract regarding 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:

- SINTEF, Report No. 2018:00165: "TG 20462 - Retningslinjer for prosjektering", 2019-11-05
- SINTEF, Evaluation report 2018-06-27
- Spenneteknikk Construction AS: "Full scale test. Prestressed tendons and steel fibre in flat slab." Report November 2013
- THiLT Engineering AS: "Dimensjonering og utførelse av CCL Deck", August 2015
- Norsk Betongforenings publikasjon no. 38 (NB38): "Dimensjonering og utførelse av fiberarmert betong" (draft august 2015)
- Hallberg, M. A. og Hanssen, H. E. : "Post-Tensioned Fiber Reinforced Flatslab", Master's thesis, NTNU 2013
- 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

Hans Boye Skogstad
Approval Manager