Introduction

Promat FENDOLITE® MII does not chemically degrade when heated up to temperatures below the boiling point of water. Therefore the material is in principle suitable to be applied in situations where the service temperature is high. However, at increased service temperatures the fire resistance will be reduced due to two factors:

- Less moisture will be retained in the material in service conditions. The moisture contributes to the fire resistance because it has to evaporate and boil out of the pores, which delays the temperature rise of the steel substrate ("moisture plateau"). At high service temperatures the spray mortar contains less moisture so the steel will heat up faster.
- Due to the initial higher temperature than in fire tests (usually starting at approx. 20°C), the time to reach the critical steel temperature (i.e. the fire resistance) will be reduced.

To compensate for the reduction in fire resistance, the thickness of Promat FENDOLITE® MII can be increased.
NOTE: Apart from the influence on the fire resistance, other aspects may also need to be verified, such as adhesion, effect of temperature variations on the spray mortar, suitability of topcoats for the given temperature condition, etc.

Solution

Promat has evaluated the effect of higher service temperatures on the fire resistance of Promat FENDOLITE® MII by computer modelling. The model is based on conservative assumptions:

- the full cross-section of steel and spray mortar are at the service temperature when the fire starts. This will be conservative in most cases.
- the spray mortar does not contain any moisture at the start of the fire, so the delaying effect of moisture evaporation is fully discarded. This is very conservative because the material does in fact retain part of the moisture also at increased service temperatures.

The computer modelling was done by a combination of finite element modelling and linear regression analysis. With the model, design tables have been created for the required increase of Promat FENDOLITE® MII to compensate for the high service temperature.

Design tables

The design tables contain percentages of additional thickness, to compensate for increased service temperatures. Intermediate values may be determined by interpolation. Extrapolation is not permitted.
For thicknesses according to UL 1709 designs, the critical steel temperature is always 1000°F (538 °C) and the standard column (W10x49) has a section factor of 160 m^{-1}, which is therefore included in the design tables.

Example of how to read the table: if the required thickness based on a fire test report/certificate is 30 mm, and the design table states (for the relevant service temperature, fire resistance, critical steel temperature and section factor) a value of 10%, then the thickness to be applied is 30 mm + 10% = 33 mm.

Design table 1: Required additional Promat FENDOLITE® MII thickness for 60 minutes fire resistance

Section factor [m^{-1}]	**≤100**	**200**	**≤100**	**160**	**200**	**≤100**	**200**	**≤100**	**200**
Critical steel temperature [°C]	**500**	**500**	**538**	**538**	**538**	**600**	**600**	**700**	**700**
Service temperature 50 °C	8,6%	12,5%	7,4%	10,3%	11,3%	5,4%	9,3%	2,2%	6,1%
Service temperature 70 °C	9,9%	13,8%	8,6%	11,6%	12,5%	6,7%	10,6%	3,5%	7,4%
Service temperature 90 °C	11,1%	15,0%	9,9%	12,8%	13,8%	7,9%	11,8%	4,7%	8,6%

Design table 2: Required additional Promat FENDOLITE® MII thickness for 120 minutes fire resistance

Section factor [m^{-1}]	**≤100**	**200**	**≤100**	**160**	**200**	**≤100**	**200**	**≤100**	**200**
Critical steel temperature [°C]	**500**	**500**	**538**	**538**	**538**	**600**	**600**	**700**	**700**
Service temperature 50 °C	10,6%	14,5%	9,3%	12,3%	13,2%	7,4%	11,3%	4,2%	8,1%
Service temperature 70 °C	11,8%	15,7%	10,6%	13,5%	14,5%	8,6%	12,5%	5,4%	9,3%
Service temperature 90 °C	13,1%	17,0%	11,9%	14,8%	15,8%	9,9%	13,8%	6,7%	10,6%

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