## TALAT Lectures 2504

# Examples and Applications

20 pages, 16 Figures

Basic Level

**prepared by Steinar Lundberg, Hydro Aluminium Structures, Karmoy**

**Objectives:**

- to calculate the required fire resistance of uninsulated and insulated load bearing structural members such as columns and beams on the basis of a simple calculation method and according to ENV 1999-1-2
- to point out more refined methods of analysis with the aid of computer programmes
- to present some approved and existing fire resistance rated applications, e.g. in the off-shore industry

**Prerequisites:**

- background in structural engineering
- TALAT lectures no. 2501-2503

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# 2504 Examples and Applications

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## 2504.01 Calculation Examples

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  - Uninsulated column
  - Uninsulated beam
  - Insulated column inside a wall
  - Insulated freestanding column
  - Insulated beam
- Computer analysis for temperature development

### 2504.01.01 Simplified Method

*a) Uninsulated Column*

The column is standing outside the building, but can be exposed to the fire through window openings. The column is RHS 250 x10 and the required fire resistance is 10 minutes. The span of the column is 8000 mm and it is simply supported in both ends (see **Figure 2504.01.01**). It is no welds in the column. The alloy and temper are EN AW 6082 T6 ($f_0$ = 260 MPa).

The column is loaded with the following loads:

- permanent loads: 150 kN
- imposed loads: 330 kN

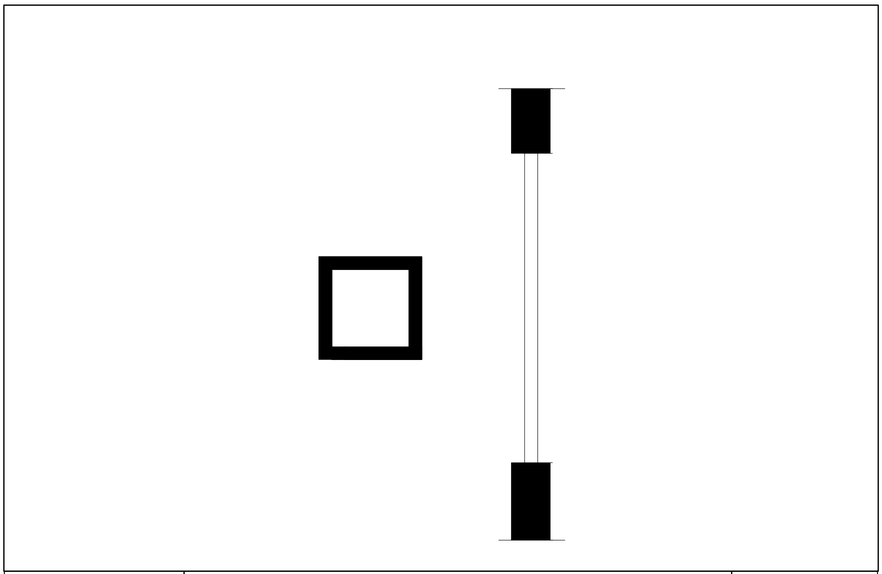
Partiell coefficient for permanent loads is, $\gamma_G$ = 1,10 and for variable loads, $\gamma_Q$ = 1,50.

The bearing capacity according to ENV 1999-1-1 is calculated to:

$$N_{b,Rd} = 767 \text{ kN}$$

The design value of the axial force:

$$N_{Ed} = 1{,}10 \cdot 150 \text{ kN} + 1{,}50 \cdot 330 \text{ kN} = 660 \text{ kN}$$



Schema of the uninsulated column 2504.01.01

F/V calculated according to **Figure 2503.03.01**:

$$\frac{F}{V} = \frac{3 \cdot 0,25}{0,25 \cdot 0,01 \cdot 4 - 0,01^2 \cdot 4} = 78$$

Using **Figure 2504.01.02** with the following input

- 10 mins. fire resistance
- resulting emissivity = 0,2
- F/V = 78

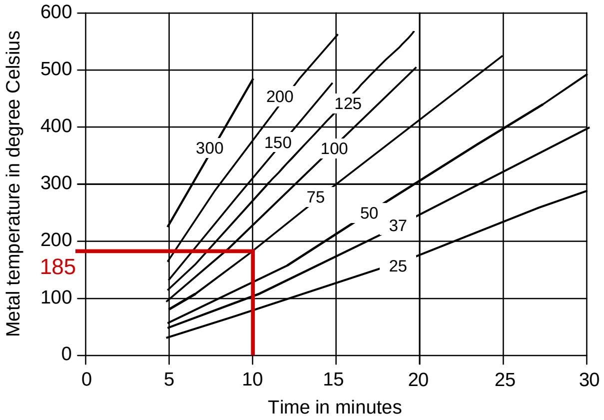
the metal temperature of the column is 185 °C.

If the window breaks, and the flames engulf the column, the resulting emissivity must be: $\varepsilon_r$ = 0,7. The metal temperature of the column can be found from **Figure 2503.03.04** With the following input:

- 10 mins. Fire resistance
- resulting emissivity = 0,7
- F/V = 78

the metal temperature of the column is 410 °C.

Metal Temperature - Time Curves for $\varepsilon_r$ = 0,2




| TALAT Training in Aluminium Application Technologies | Metal Temperature - Time Curves for $\varepsilon_r$ = 0,2 | 2504.01.02 |
|---|---|---|

The 0,2% proof stress ratio, $k_{0.2,\theta}$ , is found from ENV 1999-1-2 Table 3.1:

$$\text{for 185 °C: } k_{0.2,\theta} = 0{,}79 - \frac{0{,}79 - 0{,}65}{50} \cdot 35 = 0{,}69$$

$$\text{for 410 °C: } k_{0.2,\theta} = 0{,}11 - \frac{0{,}11 - 0}{200} \cdot 60 = 0{,}08$$

The design buckling resistance of the column at 10 mins fire exposure, according to ENV 1999-1-2, 4.2.2.4:

$$\text{for 185 °C: } N_{b,fi,10,Rd} = k_{0.2,\theta} \cdot N_{b,Rd} \cdot \frac{\gamma_{M1}}{1{,}2 \cdot \gamma_{M,fi}} = 0{,}69 \cdot 767kN \cdot \frac{1{,}10}{1{,}2 \cdot 1{,}0} = 485kN$$

$$\text{for 410 °C: } N_{b,fi,10,Rd} = k_{0.2,\theta} \cdot N_{b,Rd} \cdot \frac{\gamma_{M1}}{1{,}2 \cdot \gamma_{M,fi}} = 0{,}08 \cdot 767kN \cdot \frac{1{,}10}{1{,}2 \cdot 1{,}0} = 56kN$$

The design value of the axial force in a fire situation (accidental situation):

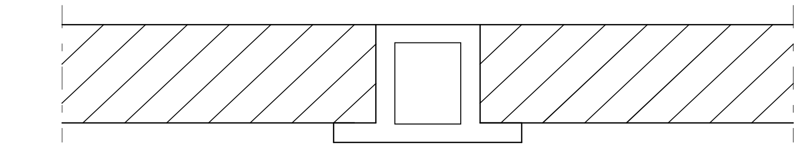
$$N_{Ed} = 1{,}00 \cdot 150 \text{ kN} + 1{,}00 \cdot 330 \text{ kN} = 480 \text{ kN}$$

If the column is not engulfed in flames ($\varepsilon_r$ = 0,2) the column will stand in 10 mins in an internal fire in the building, if the column may be engulfed in flames ($\varepsilon_r$ = 0,7) it has to be fire protected.

The temperature of the column may also be calculated on the basis of a simplified calculation method for thermal actions for external members. This method is described in ENV 1991-2-2 Annex C (Thermal actions for external members - simplified calculation method) and in ENV 1999-1-2 Annex B (Heat transfer to external aluminium structures). This method will probably give lower temperature in the aluminium column.

*b) Uninsulated Floor Beam*

The beam is bearing insulated floor elements and will be exposed directly to the fire (see **Figure 2504.01.03**). The bottom flange of the beam is 20 mm thick. The required fire resistance is 15 min. The span of the beam is 5000 mm. The alloy and temper are EN AW 6082 T6 ($f_0$ = 260 MPa).



| TALAT | Schema of the uninsulated Floor Beam | 2504.01.03 |
|---|---|---|

The beam is loaded with the following loads:

- permanent loads: 3,0 kN/m
- imposed loads: 12,0 kN/m

Partiell coefficient for permanent loads is, $\gamma_G$ = 1,10 and for variable loads, $\gamma_Q$ = 1,50.

The bearing capacity according to ENV 1999-1-1 is calculated to:

$$M_{c,Rd} = 123 \text{ kNm}$$

The design value of the bending moment at normal temperature:

$$M_{Ed} = 1/8(1{,}10 \cdot 3{,}0 \text{ kN/m} + 1{,}50 \cdot 12{,}0 \text{ kN/m})(5{,}0\text{m})^2 = 66{,}6 \text{ kNm}$$

The design value of the bending moment in a fire situation:

$$M_{Ed} = 1/8(1{,}0 \cdot 3{,}0 \text{ kN/m} + 1{,}0 \cdot 12{,}0 \text{ kN/m})(5{,}0\text{m})^2 = 46{,}9 \text{ kNm}$$

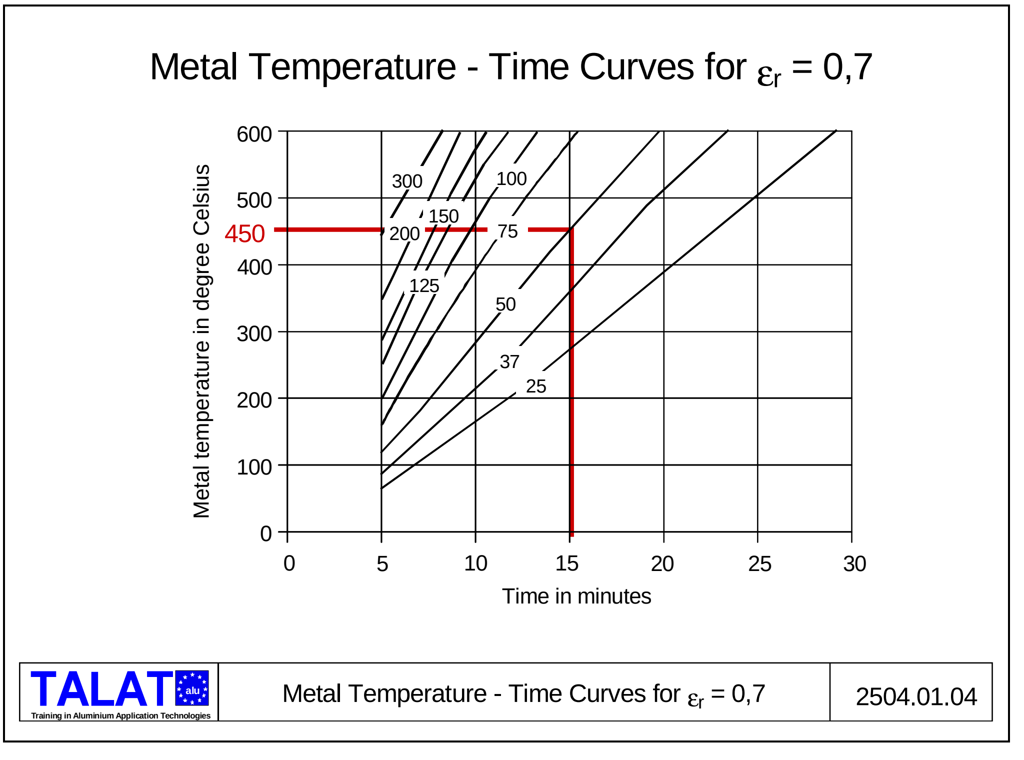
F/V calculated according to **Figure 2503.03.01**

$$\frac{F}{V} = \frac{1}{0{,}02} = 50$$

Using **Figure 2504.01.04** with the following input

- 15 min fire resistance
- resulting emissivity = 0,7
- F/V = 50

we find the metal temperature of the beam to be 450 °C.




The 0,2% proof stress ratio, $k_{0.2,\theta}$ , is found from ENV 1999-1-2 Table 3.1:

$$k_{0.2,\theta} = 0{,}11 - \frac{0{,}11 - 0}{200} \cdot 100 = 0{,}055$$

The design moment resistance of the beam at 15 min fire exposure and for a uniform distributed temperature, according to ENV 1999-1-2, 4.2.2.3:

$$M_{fi,15,Rd} = k_{0.2,\theta} \cdot M_{c,Rd} \cdot \frac{\gamma_{M1}}{\gamma_{M,fi}} = 0{,}055 \cdot 123kNm \cdot \frac{1{,}10}{1{,}0} = 7{,}4kNm$$

$$M_{fi,15,Rd} = 7{,}4kNm \leq M_{Ed} = 66{,}6kN$$

The beam has to be fire protected. If a computer software is used for the temperature analysis, the rules for a non-uniform temperature distribution can be used. These rules will give a higher design moment resistance than the above calculated one, but not so high as required.

*c) Insulated Column Inside a Wall*

The column is standing inside a fire rated wall, and the lining of the wall is passing the column (see **Figure 2504.01.05**). The lining consists of 18 mm gypsum boards and the required fire resistance is 30 min. The column is a channel U 150 x 75 x 6 x 9 and the alloy EN AW 6063 T6. ($f_0$ = 170 MPa)

The span of the wall is 3300 mm, the column is prevented against buckling about the weak axis and it is simply supported in both ends. It is no welds in the column.

The column is loaded with the following loads:

- permanent loads: 15 kN
- imposed loads: 60 kN

Partiell coefficient for permanent loads is, $\gamma_G$ = 1,10 and for variable loads, $\gamma_Q$ = 1,50.

The bearing capacity according to ENV 1999-1-1 is calculated to:

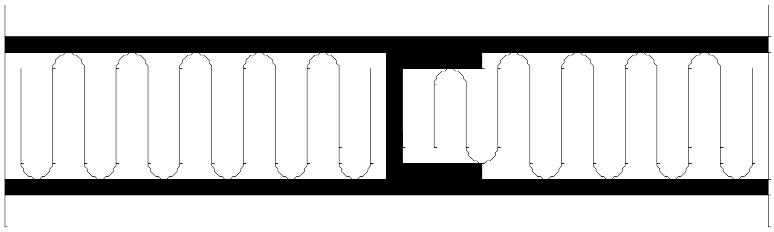
$N_{b,Rd}$ = 226 kN

The design value of the axial force at normal temperature:

$N_{Ed}$ = 1,10·15 kN + 1,50·60 kN = 106,5 kN

The design value of the axial force in fire situation:

$N_{Ed}$ = 1,0·15 kN + 1,0·60 kN = 75 kN



| TALAT | Schema of the insulated column inside a wall | 2504.01.05 |
|---|---|---|

$F_i/V$ is calculated according to **Figure 2503.03.06**:

$$\frac{F_i}{V} = \frac{1}{0{,}009} = 111$$

**Figure 2503.03.08** gives the insulation correction factor:

C = 1/160 * 111 + 0,5 = 1,19

The equivalent insulation thickness is

$t_{equ}$ = 1,19 * 18 mm = 21,4 mm

**Figure 2503.03.11** gives a metal temperature of the column of 250 °C.

The 0,2% proof stress ratio, $k_{0.2,\theta}$ , is found from ENV 1999-1-2 Table 3.1:

$$k_{0.2,\theta} = 0{,}38$$

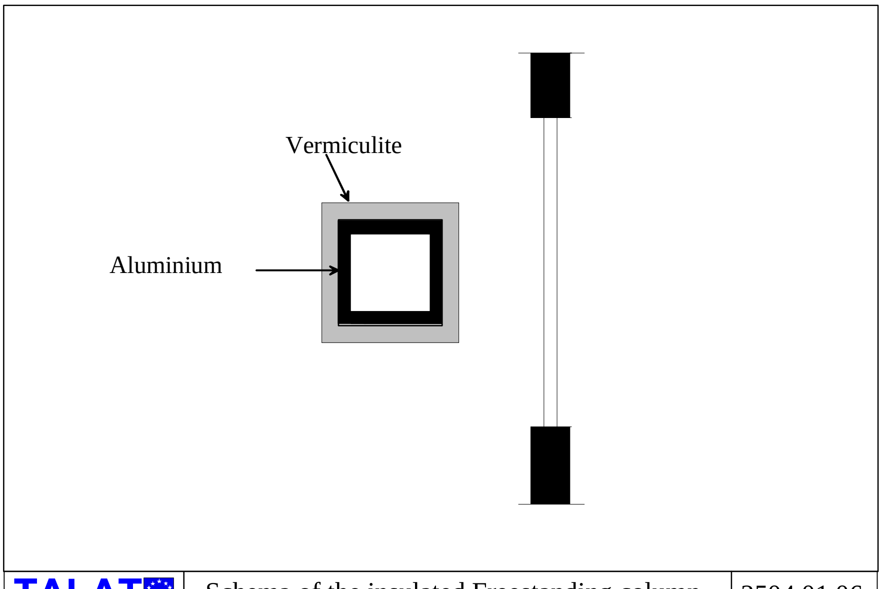
The design buckling resistance of the column at 30 mins fire exposure, according to ENV 1999-1-2, 4.2.2.4:

$$N_{b,fi,30,Rd} = k_{0.2,\theta} \cdot N_{b,Rd} \cdot \frac{\gamma_{M1}}{1{,}2 \cdot \gamma_{M,fi}} = 0{,}38 \cdot 226kN \cdot \frac{1{,}10}{1{,}2 \cdot 1{,}0} = 78{,}7kN$$

$$N_{b,fi,30,Rd} = 78{,}7kN \geq N_{Ed} = 75kN$$

*d)Insulated Freestanding Column*

The column is insulated by a 70 mm vermiculite board (see **Figure 2504.01.06**). The required fire resistance is 60 min. The column is a RHS 250 x 10, the alloy and temper are EN AW 6082 T6 ($f_0$ = 260 MPa). The span of the column is 8000 mm, and it is simply supported in both ends. It is no welds in the column. The column is similar to that in the first example about the external column.




TALAT | Schema of the insulated Freestanding column | 2504.01.06

The column is loaded with the following loads:

- permanent loads: 150 kN
- imposed loads: 330 kN

Partiell coefficient for permanent loads is, $\gamma_G$ = 1,10 and for variable loads, $\gamma_Q$ = 1,50.

The bearing capacity according to ENV 1999-1-1 is calculated to:

$$N_{b,Rd} = 767 \text{ kN}$$

The design value of the axial force for normal temperature:

$$N_{Ed} = 1{,}10 \cdot 150 \text{ kN} + 1{,}50 \cdot 330 \text{ kN} = 660 \text{ kN}$$

The design value of the axial force in fire situation:

$$N_{Ed} = 1{,}0 \cdot 150 \text{ kN} + 1{,}0 \cdot 330 \text{ kN} = 480 \text{ kN}$$

$F_i/V$ is calculated according to **Figure 2503.03.06** (**TALAT Lecture 2503**):

$$\frac{F_i}{V} = \frac{0,25 \cdot 4}{0,25 \cdot 4 \cdot 0,01 - 0,01^2 \cdot 4} = 104$$

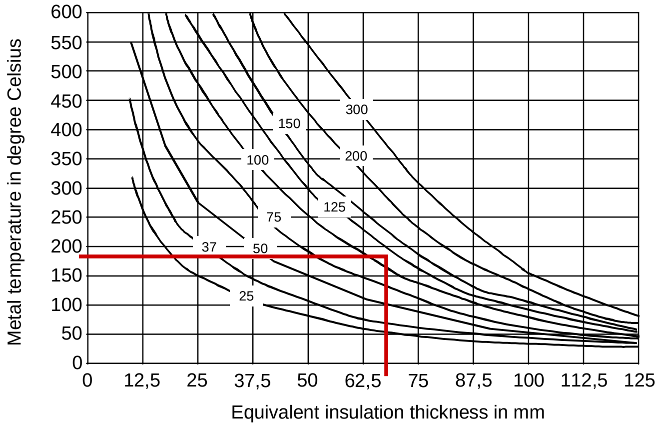
**Figure 2503.03.08** gives the insulation correction factor

C = 1/625 * 104 + 0,8 =  0,97

Equivalent insulation thickness

$t_{equ}$ = 0,97 * 70 mm = 68 mm

Equivalent Insulation Thickness Versus Metal Temperature for 60 Min Fire Resistance




| TALAT | Equivalent Insulation Thickness Versus Metal Temperature for 60 Min Fire Resistance | 2504.01.07 |
|---|---|---|

**Figure 2504.01.07** shows the metal temperature of the column to be 180 °C.

The 0,2% proof stress ratio, $k_{0.2,\theta}$ , is found from ENV 1999-1-2 Table 3.1:

$$k_{0.2,\theta} = 0,79 - \frac{0,79 - 0,65}{50} \cdot 30 = 0,71$$

The design buckling resistance of the column at 60 mins fire exposure, according to ENV 1999-1-2, 4.2.2.4:

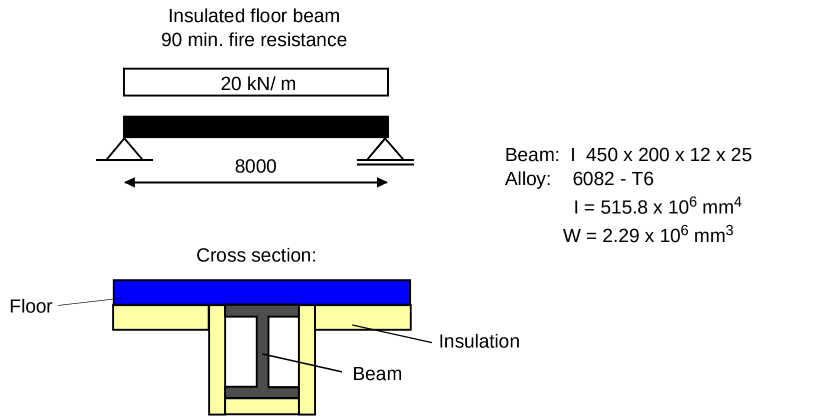
$$N_{b,fi,60,Rd} = k_{0.2,\theta} \cdot N_{b,Rd} \cdot \frac{\gamma_{M1}}{1,2 \cdot \gamma_{M,fi}} = 0,71 \cdot 767 kN \cdot \frac{1,10}{1,2 \cdot 1,0} = 499 kN$$

$$N_{b,fi,60,Rd} = 499kN \geq N_{Ed} = 480kN$$

*e) Insulated Beam*

The floor beam as shown in **Figure 2504.01.08** is insulated with 75 mm rockwool with density 120 kg/m³. The required fire resistance is 90 minutes. The beam is an I 450 x 200 x 12 x 25. The span of the beam is 8000 mm. The alloy and temper are EN AW 6082 T6 ($f_0$ = 260 MPa).

Calculation Example




| TALAT | Insulated Beam: Calculation Example | 2504.01.08 |
|---|---|---|

The beam is loaded with the following loads:

- permanent loads: 4,0 kN/m
- imposed loads: 16,0 kN/m

Partiell coefficient for permanent loads is, $\gamma_G$ = 1,10 and for variable loads, $\gamma_Q$ = 1,50.

The bearing capacity according to ENV 1999-1-1 is calculated to:

$M_{c,Rd}$ = 617 kNm

The design value of the bending moment at normal temperature:

$M_{Ed} = 1/8(1{,}10 \cdot 4{,}0 \text{ kN/m} + 1{,}50 \cdot 16{,}0 \text{ kN/m})(8{,}0\text{m})^2 = 227 \text{ kNm}$

This over-capacity is caused by the deflection criteria which states that the maximum allowable deflection is 1/250 of span. This beam has a deflection in the middle of the span of 1/270 of span.

The design value of the bending moment in a fire situation:

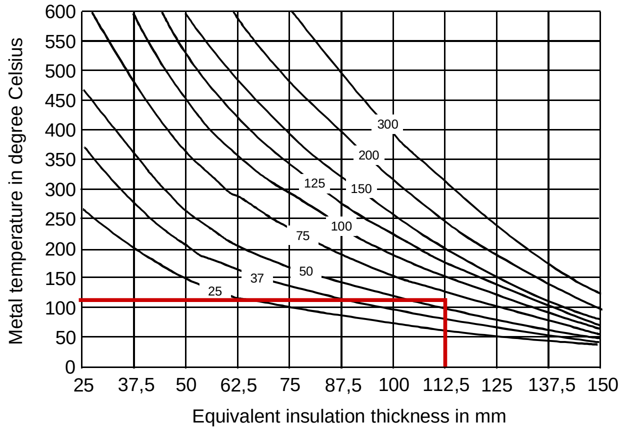
$$M_{Ed} = 1/8(1{,}0 \cdot 4{,}0 \text{ kN/m} + 1{,}0 \cdot 16{,}0 \text{ kN/m})(8{,}0\text{m})^2 = 160 \text{ kNm}$$

Fi/V is calculated according to **Figure 2503.03.06**

$$\frac{F_i}{V} = \frac{0{,}45 \cdot 2 + 0{,}2}{0{,}2 \cdot 0{,}025 \cdot 2 + 0{,}4 \cdot 0{,}012} = 74$$

From **Figure 2503.03.08** the insulation correction factor is determined as C = 1,0. The equivalent insulation thickness is $t_{equ}$ = 1,0 * 75 mm = 75 mm.

Equivalent Insulation Thickness Versus Metal Temperature for 90 Min Fire Resistance




| TALAT | Equivalent Insulation Thickness Versus Metal Temperature for 90 Min Fire Resistance | 2504.01.09 |
|---|---|---|

The metal temperature in the beam is 230 °C (**Figure 2504.01.09**).

The 0,2% proof stress ratio, $k_{0.2,\theta}$ , is found from ENV 1999-1-2 Table 3.1:

$$k_{0.2,\theta} = 0{,}65 - \frac{0{,}65 - 0{,}38}{50} \cdot 30 = 0{,}49$$

The design moment resistance of the beam at 90 mins fire exposure and for a uniform distributed temperature, according to ENV 1999-1-2, 4.2.2.3:

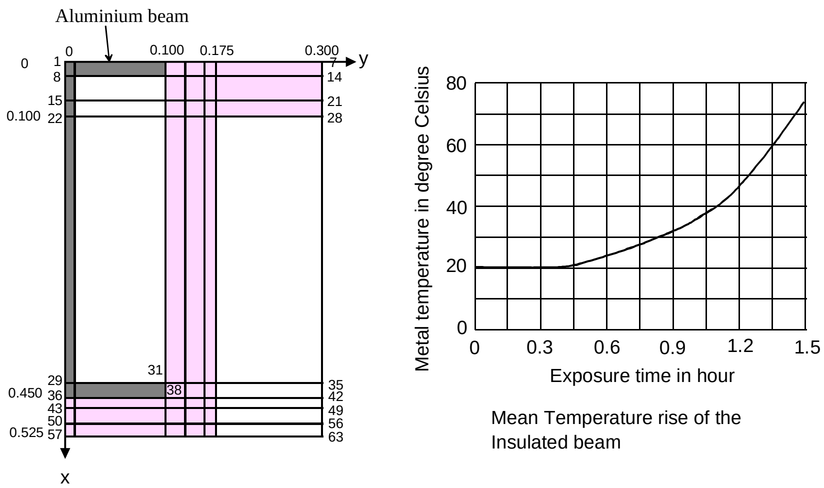
$$M_{fi,15,Rd} = k_{0.2,\theta} \cdot M_{c,Rd} \cdot \frac{\gamma_{M1}}{\gamma_{M,fi}} = 0{,}49 \cdot 617 kNm \cdot \frac{1{,}10}{1{,}0} = 333 kNm$$

$$M_{fi,15,Rd} = 333 kNm \geq M_{Ed} = 160 kNm$$

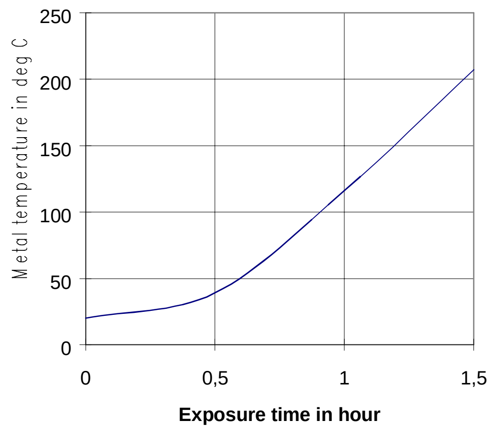
## 2504.01.02 Computer Analysis

In this example a computer analysis programme is used to find the metal temperature of the aluminium structure. The programme used is called TASEF (Temperature Analysis of Structures Exposed to Fire) and has been developed by Statens Provningsanstalt in Sweden. The programme is commercialized. [18]

The structure which is analyzed is the same as shown in **Figure 2504.01.08.** The cross section of the insulated floor beam is divided into a grid of nodes, for which the temperature rise is calculated by the computer analysis programme (**Figure 2504.01.10**). The nodes No. 31 and 38 get the highest temperatures, they will also be the nodes with the highest stress. The temperature rise at node 31 and 38 is shown in **Figure 2504.01.11.** The temperature in nodes no 31 and 38 after 90 min exposure is 207 °C. Using the simplified method the temperature was calculated to 230 °C.




| TALAT | Relation Between Mean Rise of Temperature and Duration of Exposure | 2504.01.10 |
|---|---|---|




| TALAT | Temperature evolution at node 31 and 38 of the insulated beam | 2504.01.11 |
|---|---|---|

The temperature distribution in the whole model (all nodes) after 90 minutes standard fire exposure is shown in **Figure 2504.01.10**. Temperatures at the "aluminium nodes" are given in **Figure 2504.01.12**.

```
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
F
F   MAXIMAL TEMPERATURES
F   ISO834
F   XMAX=     .525           YMAX=     .300
F
F     1 135.     2 135.     3 133.     4  43.     5  91.     6 103.     7 118.
F     8 135.     9 135.    10 133.    11 340.    12 416.    13 464.    14 547.
F    15 145.    16 145.    17 279.    18 664.    19 780.    20 836.    21 908.
F    22 150.    23 150.    24 331.    25 781.    26 910.    27 998.    281002.
F    29 202.    30 202.    31 207.    32 803.    33 931.    341001.    35   0.
F    36 202.    37 202.    38 207.    39 841.    40 938.    411001.    42   0.
F    43 784.    44 784.    45 834.    46 910.    47 968.    481003.    49   0.
F    50 919.    51 919.    52 938.    53 967.    54 987.    551004.    56   0.
F    571000.    58 999.    591001.    601003.    611004.    621006.    63   0.
F
F
F  MAX-TIME   1.50         NUMBER OF TIME INCREMENTS 1903
F
F
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```

| TALAT | Temperature at the "aluminium nodes" after 90 min of exposure | 2504.01.12 |
|---|---|---|

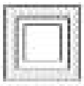
To analyze the temperature rise in an insulated construction with a computer programme gives more exact results than the simplified calculation method described in **TALAT Lecture 2503**. The simplified method, however, leads to results on the safe side and can successfully be used.

(The input data and the results of the analysis are appended as copies of the computer print-out.)

For the free standing column exposed to fire on all sides insulated with 70 mm vermiculite board the 60 min. fire resistance was calculated earlier. The metal temperature was found to be 180 °C. Using a computer analysis and a critical metal temperature of 200 °C the insulation thicknesses for various insulation materials are given in the table of **Figure 2504.01.13.**

Equally, for beams under a floor covered with a 100 mm insulation the necessary insulation thicknesses for a critical metal temperature of 200 °C and fire resistances of 30, 60 and 90 minutes are computer calculated for various insulation materials as given in the table of **Figure 2504.01.14.**

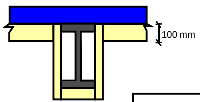
For gypsum boards and calcium silicate boards the simplified method gives inaccurate values. The values in the figured tables are based on computer analysis and are more correct than values calculated by use of the simplified method.



Necessary insulation thickness for a freestanding column exposed by fire on all sides.
Necessary insulation thickness are calculated using 200 °C as critical metal temperature.

| Section | Insulation material | Insulation thickness | | |
|---|---|---|---|---|
| | | 30 min fire resistance | 60 min fire resistance | 90 min fire resistance |
| RHS 200 x 18 | Rockwool, 120 kg/m³ | 15 mm | 40 mm | 70 mm |
| | Rockwool, 300 kg/m³ | 10 mm | 27 mm | 47 mm |
| | Ceramic fibre, 130 kg/m³ | 12 mm | 31 mm | 54 mm |
| | Gypsum boards | 14 mm | 33 mm | 50 mm |
| | Calcium silikat boards | 15 mm | 36 mm | 58 mm |
| RHS 200 x 10 | Rockwool, 120 kg/m³ | 24 mm | 61 mm | 95 mm |
| | Rockwool, 300 kg/m³ | 16 mm | 41 mm | 63 mm |
| | Ceramic fibre, 130 kg/m³ | 18 mm | 47 mm | 73 mm |
| | Gypsum boards | 18 mm | 36 mm | 50 mm |
| | Calcium silikat boards | 24 mm | 47 mm | 70 mm |
| RHS 200 x 5 | Rockwool, 120 kg/m³ | 41 mm | 84 mm | 120 mm |
| | Rockwool, 300 kg/m³ | 27 mm | 56 mm | 80 mm |
| | Ceramic fibre, 130 kg/m³ | 32 mm | 65 mm | 92 mm |
| | Gypsum boards | 21 mm | 39 mm | 52 mm |
| | Calcium silikat boards | 33 mm | 58 mm | 80 mm |

TALAT | Necessary Insulation Thickness for a Column exposed to Fire | 2504.01.13




Necessary insulation thicknesses for a beam under an insulated floor.
Thicknesses are calculated using 200 °C as critical metal temperature.

| Section | Insulation material | Insulation thickness | | |
|---|---|---|---|---|
| | | 30 min fire resistance | 60 min fire resistance | 90 min fire resistance |
| I 300x200x12x40 | Rockwool, 120 kg/m | 8 mm | 24 mm | 45 mm |
| | Rockwool, 300 kg/m | 6 mm | 16 mm | 30 mm |
| | Ceramic fibre, 130 kg/m | 7 mm | 19 mm | 35 mm |
| | Gypsum boards | 12 mm | 30 mm | 45 mm |
| | Calcium silikat boards | 10 mm | 25 mm | 43 mm |
| I 300x200x8x20 | Rockwool, 120 kg/m | 16 mm | 42 mm | 72 mm |
| | Rockwool, 300 kg/m | 11 mm | 28 mm | 48 mm |
| | Ceramic fibre, 130 kg/m | 13 mm | 33 mm | 56 mm |
| | Gypsum boards | 15 mm | 34 mm | 47 mm |
| | Calcium silikat boards | 17 mm | 38 mm | 60 mm |
| I 300x200x4x10 | Rockwool, 120 kg/m | 29 mm | 67 mm | 105 mm |
| | Rockwool, 300 kg/m | 20 mm | 45 mm | 70 mm |
| | Ceramic fibre, 130 kg/m | 23 mm | 52 mm | 81 mm |
| | Gypsum boards | 21 mm | 37 mm | 54 mm |
| | Calcium silikat boards | 29 mm | 51 mm | 80 mm |

TALAT Training in Aluminium Application Technologies | Necessary Insulation Thicknesses for a Beam Under an Insulated Floor | 2504.01.14

## 2504.02 Products

### 2504.02.01 Prefabricated Fire Rated Walls

Prefabricated walls are available with fire resistance characteristics from 30 minutes standard fire to 120 minutes hydrocarbon fire. They are made of aluminium alloy extrusions and sheets and insulation materials. These walls have also been used on oil platforms in the North Sea during the last years. The advantages of these walls are their light weight, the little maintenance needed and the easy erection.

The insulation of these walls is fixed on the unexposed side or in the middle if the wall is to be exposed to the fire on both sides. The front plates protect the insulation against the environment and distribute the windload to the side members. During a fire the front plate will melt and the insulation will be directly exposed to the fire.

In all prefabricated walls for the oil industry (see **Figure 2504.02.01**) the insulation material is non-combustible. In some countries combustible insulation is allowed to be used with special approval from the authorities.

| TALAT Training in Aluminium Application Technologies | H 120 Rated Aluminium Prefabricated Wall Installed on Hydro´sOil Patform Oseberg A in the North Sea .Autumn 1990. | 2504.02.01 |
|---|---|---|

For that reason a sandwich structure with aluminium alloy sheets as skin and combustible rigid foam as core frequently must be tested by a fire technology laboratory before the authorities give their approval. Often some specific requirements have to be met. These conditions can consist of limitations to where the approved structure may be used, of requirements on specific properties of the material used in the structure and/or of frequent production controls by an impartial institution.

### 2504.02.02 Heat Radiation Shield

Due to aluminium alloys' excellent reflection of heat radiation, shields of aluminium are used as heat radiation shield (**Figure 2504.02.02**). There are, however, some limitations:

- the shield must not be covered by soot during the heat radiation exposure.
- the heat radiation on the shield must not exceed 15 kW/m² (exact calculation must be performed).

| TALAT alu Training in Aluminium Application Technologies | Aluminium Heat Radiation Shield to Protect the Lifeboats from Burning Blow Out on the Drilling Rig "West Delta". | 2504.02.02 |
|---|---|---|

### 2504.02.03 Fire Rated Doors

Several fire doors in aluminium with a fire rate up to A60 (60 mins. fire resistance) are available on the market. The doorleaf is fabricated of aluminium alloys and insulation, while the doorframe is made of steel or stainless steel.

Both, hinged doors and sliding doors are fire classified.

### 2504.02.04 Fire Rated Penetrations

During the fabrication of a living quarter for an oil platform in the North Sea, entirely built of aluminium alloys (Snorre), some manufacturers developed fire rated penetrations with aluminium alloy sleeves and penetration frames.

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## 2504.04 List of Figures