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Assessment report of the dimensioning of the fire protection of steel constructions inside a wall

Executive summary

DBI – Danish Institute of Fire and Security Technology has been requested by Rockwool A/S to assess the required thickness of fire protection which is to be applied on steel columns encapsulated in a wall.

It is the opinion of DBI that the required thickness of the fire protection on a steel column (R30 – R90) inside a wall can be based on a three-sided exposure of the steel, and that the thickness can be calculated based on the results from Efectis Nederland BV assessment report 2009-Efectis-R1008 [Rev. 3]. This means that the section factor of a steel profile should be calculated based on a three-sided exposure. The required thickness for a given section factor are shown on the enclosed tables 1.1 – 1.3 (R30 – R90).

This assessment is given with the following preconditions:

- The steel profiles are insulated on all four sides.
- The insulation is fixed to the steel profiles as described in test report 2009-Efectis-R1007 [Rev. 1].
- The wall is mounted with two layers of 12.5 mm gypsum boards on each side.
- The cavity of the wall is fully insulated with batts of stone wool.
- The maximum distance between mullions is 600 mm.

DBI refers to the subsequent text which gives insight into the underlying reasons for this assessment.

Full text assessment

DBI – Danish Institute of Fire and Security Technology has been requested by Rockwool A/S to assess the required thickness of fire protection of steel constructions inside a wall.

Basis for the assessment:

Efectis Nederland BV assessment report 2009-Efectis-R1008 [Rev. 3], dated February 2013: Assessment report based on numerical regression analysis. The data is taken from Efectis Nederland BV test report 2009-Efectis-R1007 [Rev. 1], dated March 2010.

Danish Institute of Fire and Security Technology

DBI assessment report PHA10137, dated 2010-10-15: Assessment report based on numerical regression analysis. The data is taken from DBI test reports PGA10093, dated 2011-12-13 and PGA10094, dated 2011-12-16.

Considerations:

The steel profiles tested in 2009-Efectis-R1007 [Rev. 1] were mounted with a layer of fibre gypsum boards (type F, producer unknown) on the outside of the insulation and the profiles were exposed on four sides.

The main questions in this assessment are if the dimensioning of the insulation of steel constructions in walls can be based upon assessment report 2009-Efectis-R1008 [Rev. 3], but without the layer of fibre gypsum boards, and if the dimensioning can be based upon a three-sided exposure.

A generic drawing of the steel construction inside a wall is shown on enclosed Figure 1.

It is clear that none of the submitted test reports covers the specific use dealt with in this assessment, without being very conservative. Basically the wall construction surrounding the column will "protect" the protection system applied to the steel column. The gypsum board facing on the wall will provide some protection and the insulation in the wall will limit the number of faces from which a fire can expose the column.

Quantification of, and how to deal with, the alleged improvement, is the essential content of this assessment.

DBI have chosen to approximate the problem with a fictional system based on the test data Rockwool have presented and a semi physical scenario which can be related to the expected behavior of the wall and column in a fire. The line of arguments used to justify the chosen solution is based on the following main assumptions:

1. The exposure during the full 90 minutes covered by this assessment is 3-sided. The two layers of gypsum will protect the underlying material. When the gypsum has disappeared the column will be exposed from one side only, as the insulation in the wall will protect the sides of the column. It is the opinion of DBI that 3-sided exposure through all 90 minutes is a conservative approach.
2. The data for determining the steel temperature is based on test report 2009-Efectis-R1007 [Rev. 1]. The test report deals with a fire protection system constructed from a layer of stone wool fixed to the steel and a layer of 12.5mm gypsum glued to the outside of the stone wool. The assessed construction is limited to walls with two layers of gypsum plaster board. DBI has chosen to equate the two systems through all 90 minutes. It is, in the opinion of DBI, also a conservative estimate.

Assessment:

It is the opinion of DBI that the dimensioning of the fire protection of steel constructions (R30 – R90) inside a wall can be based on a three-sided exposure of the steel, and that the insulation thickness can be calculated based on the results from Efectis Nederland BV assessment report 2009-Efectis-R1008 [Rev. 3]. This means that the section factor of a steel profile should be calculated based on a three-sided exposure. The required thickness for a given section factor are shown on the enclosed tables 1.1 – 1.3 (R30 – R90).

This assessment is given with the following preconditions:

- The steel profiles are insulated on all four sides.
- The insulation is fixed to the steel profiles as described in test report 2009-Efectis-R1007 [Rev. 1].
- The wall is mounted with two layers of 12.5 mm gypsum boards on each side.
- The cavity of the wall is fully insulated with batts of stone wool.
- The maximum distance between mullions is 600 mm.

Remarks:

This is an expressed opinion and is not a classification.

Validity:

This assessment is issued on the basis of test data and information available at the time of the issue. If contradictory evidence becomes available to DBI the assessment will be unconditionally withdrawn, and the manufacturer will be notified in writing. Similarly the assessment is invalidated if the assessed construction is subsequently tested because actual test data is deemed to take precedence over an expressed opinion.

DBI - Danish Institute of Fire and Security Technology



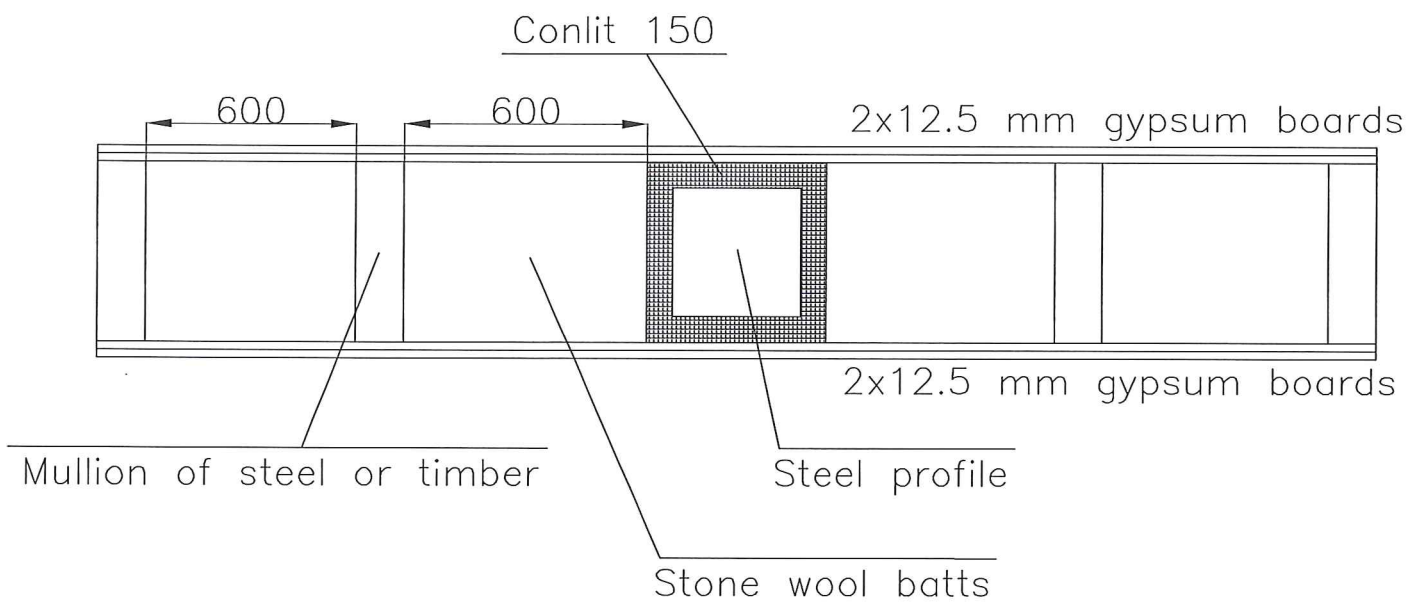
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Enclosed:

- Figure 1
- Table 1.1 – 1.3



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Axel Brabrand

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Tabel 1.2

Product: Conlit 150/150P insulation thickness

Fire resistance: R 60

U/A	Critical steel temperature								
	350	400	450	500	550	600	650	700	750
50	20	20	20	20	20	20	20	20	20
55	20	20	20	20	20	20	20	20	20
60	20	20	20	20	20	20	20	20	20
65	20	20	20	20	20	20	20	20	20
70	20	20	20	20	20	20	20	20	20
75	20	20	20	20	20	20	20	20	20
80	20	20	20	20	20	20	20	20	20
85	20	20	20	20	20	20	20	20	20
90	20	20	20	20	20	20	20	20	20
95	20	20	20	20	20	20	20	20	20
100	20	20	20	20	20	20	20	20	20
105	20	20	20	20	20	20	20	20	20
110	20	20	20	20	20	20	20	20	20
115	20	20	20	20	20	20	20	20	20
120	20	20	20	20	20	20	20	20	20
125	25	20	20	20	20	20	20	20	20
130	25	20	20	20	20	20	20	20	20
135	25	20	20	20	20	20	20	20	20
140	25	20	20	20	20	20	20	20	20
145	25	20	20	20	20	20	20	20	20
150	25	20	20	20	20	20	20	20	20
155	25	20	20	20	20	20	20	20	20
160	25	25	20	20	20	20	20	20	20
165	25	25	20	20	20	20	20	20	20
170	30	25	20	20	20	20	20	20	20
175	30	25	20	20	20	20	20	20	20
180	30	25	20	20	20	20	20	20	20
185	30	25	20	20	20	20	20	20	20
190	30	25	20	20	20	20	20	20	20
195	30	25	20	20	20	20	20	20	20
200	30	25	20	20	20	20	20	20	20
205	30	25	25	20	20	20	20	20	20
210	30	25	25	20	20	20	20	20	20
215	30	25	25	20	20	20	20	20	20
220	30	25	25	20	20	20	20	20	20
225	40	30	25	20	20	20	20	20	20
230	40	30	25	20	20	20	20	20	20
235	40	30	25	20	20	20	20	20	20
240	40	30	25	20	20	20	20	20	20
245	40	30	25	20	20	20	20	20	20
250	40	30	25	20	20	20	20	20	20
255	40	30	25	20	20	20	20	20	20
260	40	30	25	25	20	20	20	20	20

Arvid Bolund
25-10-2013

Tabel 1.3

Product: Conlit 150/150P insulation thickness
Fire resistance: R 90

U/A	Critical steel temperature								
	350	400	450	500	550	600	650	700	750
50	25	20	20	20	20	20	20	20	20
55	25	20	20	20	20	20	20	20	20
60	25	25	20	20	20	20	20	20	20
65	30	25	20	20	20	20	20	20	20
70	30	25	25	20	20	20	20	20	20
75	30	30	25	20	20	20	20	20	20
80	40	30	25	20	20	20	20	20	20
85	40	30	25	25	20	20	20	20	20
90	40	30	30	25	20	20	20	20	20
95	40	40	30	25	25	20	20	20	20
100	40	40	30	25	25	20	20	20	20
105	40	40	30	30	25	20	20	20	20
110	40	40	40	30	25	25	20	20	20
115	50	40	40	30	25	25	20	20	20
120	50	40	40	30	25	25	20	20	20
125	50	40	40	30	30	25	20	20	20
130	50	40	40	40	30	25	25	20	20
135	50	50	40	40	30	25	25	20	20
140	50	50	40	40	30	25	25	20	20
145	50	50	40	40	30	30	25	25	20
150	50	50	40	40	30	30	25	25	20
155	60	50	40	40	40	30	25	25	20
160	60	50	40	40	40	30	25	25	20
165	60	50	50	40	40	30	30	25	25
170	60	50	50	40	40	30	30	25	25
175	60	50	50	40	40	30	30	25	25
180	60	50	50	40	40	30	30	25	25
185	60	50	50	40	40	40	30	25	25
190	60	60	50	40	40	40	30	25	25
195	60	60	50	40	40	40	30	30	25
200	70	60	50	40	40	40	30	30	25
205	70	60	50	40	40	40	30	30	25
210	70	60	50	50	40	40	30	30	25
215	70	60	50	50	40	40	30	30	25
220	70	60	50	50	40	40	30	30	25
225	70	60	50	50	40	40	40	30	30
230	70	60	50	50	40	40	40	30	30
235	70	60	50	50	40	40	40	30	30
240	70	60	50	50	40	40	40	30	30
245	70	60	50	50	40	40	40	30	30
250	70	60	60	50	40	40	40	30	30
255	80	60	60	50	40	40	40	30	30
260	80	60	60	50	40	40	40	30	30