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# **FIRE ASSESSMENT REPORT**

## **FAR 4856**

**ASSESSMENT OF MONOKOTE MK-6/HY, MK-6S AND Z-106 FOR  
PERFORMANCE IN ACCORDANCE WITH AS 4100-1998 FOR CLOSED  
STRUCTURAL STEEL SECTIONS**

**CLIENT**

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## **ASSESSMENT OBJECTIVE**

To assess the fire resistance performance of Monokote MK-6/HY, MK-6s and Z-106 when used to protect closed section structural steel beams and columns, in accordance with AS 4100-1998 (AMD 1-2013).

## **CONCLUSION**

It is considered that Monokote MK-6/HY, MK-6s and Z-106 would provide a fire resistance for RHS and SHS section columns for various thicknesses and critical temperatures as shown in Tables 1 to 6 in accordance with AS 4100-1998 (AMD 1-2013), Steel Structures, Section 12.

## **LIMITATION**

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# 1. INTRODUCTION

This report gives BRANZ's assessment of closed section structural steel members using Monokote MK-6/HY, MK-6s and Z-106 as a four sided, Cementitious fire protection coating with a fire resistance of 30, 60, 90, 120, 180 and 240 minutes for closed section RHS and SHS columns depending on the size of the steel section and thickness of the protection in accordance with AS 4100-1998 (AMD 1-2013), Steel Structures, Section 12, Fire. It considers a range of critical steel temperatures between 350°C and 750°C.

The methodology used in the analysis is the numerical regression approach defined in Annex E.5 of EN 13381-4: 2013.

## 2. BACKGROUND

### 2.1 Full Scale Testing of Monokote MK6

In Underwriters Laboratories LLC assessment report No. 4787661076 consideration was given to the contribution to the fire resistance of closed steel section structural members protected by a cementitious fire protection coating identified as Monokote MK-6 in a contoured profile. The basis for the assessment was test data from three fire resistance tests, in accordance with BS 476: Part 21: 1987, of steel members protected with Monokote MK-6.

The Monokote MK-6 was spray applied until the desired thickness was achieved as per UL assessment report No. 4787661076. During the application of the test specimens, a number of density plate specimens were prepared in order to monitor the drying of the Monokote MK-6 and subsequently calculate the density of the material. The mean density of the Monokote MK-6 was calculated to be 252 kg/m<sup>3</sup>.

The specimens included in the tests comprised two, 4.1 m long loaded beams and two, 1 m long unloaded reference beams with nominal thicknesses of 10 mm and 75 mm which was three-sided contoured protection. In addition, a further five, 1 m long unloaded beams and nine, 1 m tall unloaded columns with three-and four sided contoured protection respectively ranging from 10 mm to 76 mm. The specimens included in the tests covered section factors, "exposed surface area to volume" (A/V), from 94 m<sup>-1</sup> to 332 m<sup>-1</sup>. A further data point derived from an unloaded column section with an A/V of 17 m<sup>-1</sup> tested in accordance with UL263 was used to allow the reduction of the minimum A/V to 30 m<sup>-1</sup>.



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Numerical regression analysis was performed as per Annex E.5 of EN 13381-4: 2013:

$$t = a_0 + a_1 d_p + a_2 \frac{d_p}{A_m/V} + a_3 \theta_a + a_4 d_p \theta_a + a_5 d_p \frac{\theta_a}{A_m/V} + a_6 \frac{\theta_a}{A_m/V} + a_7 \frac{1}{A_m/V}$$

Where

t is the fire resistance time (minutes)

a<sub>0</sub> to a<sub>7</sub> are the regression coefficients

d<sub>p</sub> is protection thickness (mm)

A<sub>m</sub>/V is the section factor (m<sup>-1</sup>)

θ<sub>a</sub> is the steel temperature (°C)

The outputs from the numerical regression were modified by the method described in section 2.3.4.6.d of the ASFP 'Yellow Book' 5<sup>th</sup> Edition which permits the assessment of closed sections using open section data:

For A/V values up to 250 m<sup>-1</sup>, the thickness is increased by:

$$\text{Modified thickness} = d_p \left( 1 + \frac{A_p/V}{1000} \right)$$

For A/V values higher than 250 m<sup>-1</sup>, the thickness is increased by:

$$\text{Modified thickness} = 1.25 d_p$$

The numerical regression analysis concluded that within the permitted range of section factor, thicknesses of fire protection and design temperature, the minimum thickness of Monokote MK-6 required for each fire resistance duration is as shown in Tables 1 to 6.

## 2.2 Monokote MK-6/HY and Monokote MK-6s

The assessment applies to both Monokote MK-6/HY and Monokote MK-6s cementitious coatings due to the similarity of the two formulations, Monokote MK-6/HY differs only with the addition of a Monokote Accelerator which is not expected to be detrimental to the fire resistance of the coating. As a result, both coatings are referred to simply as Monokote MK-6.

## 2.3 Thermal Equivalency Testing Monokote MK6 & Z106

In Underwriters Laboratories LLC letter report No. 4787390697, an evaluation was conducted to determine the effect of higher density cementitious fire protection coatings on thermal transmission when applied to various substrates when tested using the standard time/temperature curve detailed in UL 263.



The MK6 and Z-106 coatings were spray applied to three types of common substrate already covered by existing UL certification, 3/8 in. expanded metal lath, 26 MSG steel fluted decking and 1/4 in. thick steel plate, the dimensions of each substrate were nominally 900 mm sq.

Following completion of the testing, the times taken for an average 250°F or individual 325°F rise to occur was analysed and a relationship of Density vs Time was generated.

## **3. DISCUSSION**

### **3.1 The Standards**

Australian Standard AS 4100-1998 requires fire resistance tests, in accordance with AS 1530.4 Section 5 for columns and Section 6 for beams, on at least two loaded beams/columns with the minimum and maximum thickness of protection and a further seven tests on short unloaded specimens to obtain the temperature of the steel sections for a range of protection thicknesses and a range of exposed surface area to mass ratio (S/M) of the steel members. The required thicknesses of protection for alternative steel sections can be determined by regression analysis or by methods in accordance with ENV 13381-4 or EN 13381-8.

Underwriters Laboratories assessment report No. 4787661077 for open steel sections (I and H sections) established the fire protection of the sections protected with Monokote MK-6 by assessing the results of three fire resistance tests on eighteen specimens, including two loaded beams. The tests were in accordance with BS 476: Part 21: 1987 for loaded beams, additional guidance with respect to furnace control and performance criteria comes from BS 476: Part 20: 1987. The method of analysis used followed Annex E5 in EN 13381-4: 2013, numerical regression.

Fire resistance tests for loaded beam tests in accordance with BS 476: Part 21: 1987 or AS 1530.4-2014 are essentially the same with respect to furnace conditions and failure criteria. The only significant difference is that the BS 476: Part 21 test uses a 1.5 mm diameter mineral insulated metal sheathed thermocouples (MIMS) in the furnace compared with a 3 mm diameter mineral insulated metal sheathed thermocouples (MIMS) for AS 1530.4 tests. Although it is accepted that the smaller diameter thermocouple will heat up more rapidly, the difference between the two diameters thermocouples after 5 minutes would be minimal and therefore it is expected that the test results would be no less if the specimens had been tested in accordance with AS 1530.4.

The placement of the specimen thermocouples between that tested and AS 1530.4-2014 are slightly different. For loadbearing beams, AS 1530.4-2014 specifies that the thermocouples on the flanges on the I and H sections are at the web and the toe whereas in the BS test the thermocouples are specified to be midway between the web and the toe. Although the thermocouple locations were not positioned as defined in AS 1530.4 they were positioned in representative positions



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and complied with the minimum number of thermocouples required. Based on this it is considered that the measured temperatures would be sufficiently similar had they been positioned in accordance with AS1530.4 to be used in this analysis.

In the loaded beam tests, there was no significant material detachment observed for either the minimum or maximum thickness loaded beam, which established the ability for the thickest and thinnest protection to remain.

It is therefore considered that the resulting tables established in the Underwriters Laboratories assessment report No. 4787661077, and repeated in Tables 1 to 6 would be valid if the structural steel specimens protected by Monokote MK-6 had been tested in accordance with AS 1530.4-2014 and would comply with the requirement of AS 4100-1998.

Tables 1 to 6 show the minimum thickness of Monokote MK-6 required to satisfy FRLs ranging from 30 minutes to 240 minutes for closed section structural columns with design temperatures ranging from 350°C to 750°C.

### **3.2 Interpretation of Thermal Equivalency Testing**

The analysis of the test data generated from the small scale thermal equivalency testing showed that the thickness of coating required to achieve a given fire resistance period decreased as the density of the coating increased.

Monokote MK-6/HY and MK-6s both have a stated density of 240 kg/m<sup>3</sup>, the mean density recorded from the six density plates prepared during the application of Monokote MK-6 to the loaded beams and short sections tested under UL Test No. 4787661075 was calculated to be 252 kg/m<sup>3</sup>, the stated density of the Z-106 coating is 350 kg/m<sup>3</sup>.

It is therefore deemed acceptable to use the thicknesses shown in Tables 1- 6 for the cementitious coatings Monokote MK-6/HY, Monokote MK-6s and Z-106.

## **4. CONCLUSION**

It is considered that Monokote MK-6/HY, MK-6s and Z-106 would provide a fire resistance for RHS and SHS section columns for various thicknesses and critical temperatures as shown in Tables 1 to 6 in accordance with AS 4100-1998 (AMD 1-2013), Steel Structures, Section 12.



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**Table 1: Hollow Section Columns: Fire Protection Period 30 minutes**

MONOKOTE MK6										
Section Factor up to m <sup>-1</sup>	Table 1: Hollow Section Columns: Fire Resistance Period: 30 Minutes									
	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
30	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
35	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
40	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
45	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
50	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
55	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
60	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
65	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
70	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
75	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
80	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
85	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
90	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
95	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
100	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
105	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
110	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
115	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
120	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
125	10.9	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
130	11.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
135	12.2	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
140	12.8	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
145	13.3	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
150	13.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
155	14.3	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
160	14.8	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
165	15.2	11.2	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
170	15.6	11.7	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
175	16.0	12.2	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
180	16.4	12.7	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
185	16.7	13.2	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
190	17.1	13.6	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
195	17.4	14.0	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
200	17.7	14.4	11.3	11.2	11.2	11.2	11.2	11.2	11.2	11.2
205	18.0	14.8	11.8	11.3	11.3	11.3	11.3	11.3	11.3	11.3
210	18.3	15.2	12.2	11.3	11.3	11.3	11.3	11.3	11.3	11.3
215	18.6	15.5	12.7	11.4	11.4	11.4	11.4	11.4	11.4	11.4
220	18.9	15.9	13.1	11.4	11.4	11.4	11.4	11.4	11.4	11.4
225	19.2	16.2	13.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
230	19.4	16.5	13.8	11.5	11.5	11.5	11.5	11.5	11.5	11.5
235	19.7	16.9	14.2	11.8	11.6	11.6	11.6	11.6	11.6	11.6
240	19.9	17.2	14.6	12.2	11.6	11.6	11.6	11.6	11.6	11.6
245	20.2	17.5	14.9	12.6	11.7	11.7	11.7	11.7	11.7	11.7
250	20.4	17.7	15.2	13.0	11.7	11.7	11.7	11.7	11.7	11.7
255	20.6	18.0	15.5	13.3	11.7	11.7	11.7	11.7	11.7	11.7
260	20.7	18.2	15.8	13.6	11.7	11.7	11.7	11.7	11.7	11.7
265	20.9	18.3	16.0	13.9	12.1	11.7	11.7	11.7	11.7	11.7
270	21.0	18.5	16.2	14.2	12.4	11.7	11.7	11.7	11.7	11.7
275	21.1	18.7	16.5	14.5	12.7	11.7	11.7	11.7	11.7	11.7
280	21.2	18.9	16.7	14.7	13.0	11.7	11.7	11.7	11.7	11.7
285	21.4	19.0	16.9	15.0	13.3	11.9	11.7	11.7	11.7	11.7
290	21.5	19.2	17.1	15.2	13.6	12.2	11.7	11.7	11.7	11.7
295	21.6	19.4	17.3	15.4	13.8	12.5	11.8	11.7	11.7	11.7
300	21.7	19.5	17.5	15.6	14.1	12.7	12.1	11.7	11.7	11.7
305	21.8	19.6	17.6	15.9	14.3	13.0	12.4	11.7	11.7	11.7
310	21.9	19.8	17.8	16.1	14.6	13.3	12.7	11.7	11.7	11.7
315	22.0	19.9	18.0	16.3	14.8	13.5	13.0	12.0	11.7	11.7
320	22.1	20.0	18.1	16.5	15.0	13.8	13.2	12.3	11.7	11.7
325	22.2	20.2	18.3	16.6	15.2	14.0	13.5	12.5	11.7	11.7
330	22.3	20.3	18.4	16.8	15.4	14.3	13.7	12.8	11.7	11.7
335	22.3	20.4	18.6	17.0	15.6	14.5	13.9	13.0	11.7	11.7
340	22.4	20.5	18.7	17.2	15.8	14.7	14.2	13.3	12.0	11.7
345	22.5	20.6	18.9	17.3	16.0	14.9	14.4	13.5	12.3	11.7
350	22.6	20.7	19.0	17.5	16.2	15.1	14.6	13.7	12.5	11.7
355	22.7	20.8	19.1	17.6	16.4	15.3	14.8	13.9	12.7	11.7
360	22.7	20.9	19.2	17.8	16.5	15.5	15.0	14.2	13.0	12.0
365	22.8	21.0	19.4	17.9	16.7	15.7	15.2	14.4	13.2	12.2

Table applies to fully exposed rectangular and circular hollow columns. Thickness is protection material only.



**Table 2: Hollow Section Columns: Fire Protection Period 60 minutes**

MONOKOTE MK6										
Section Factor up to m <sup>-1</sup>	Table 2: Hollow Section Columns: Fire Resistance Period: 60 Minutes									
	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
30	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
35	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
40	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
45	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
50	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
55	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
60	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
65	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
70	10.4	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
75	12.5	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
80	14.3	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
85	15.8	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
90	17.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
95	18.4	10.6	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
100	19.4	12.1	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
105	20.4	13.5	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
110	21.3	14.7	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
115	22.1	15.8	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
120	22.8	16.8	11.1	10.5	10.5	10.5	10.5	10.5	10.5	10.5
125	23.5	17.8	12.2	10.5	10.5	10.5	10.5	10.5	10.5	10.5
130	24.2	18.6	13.3	10.6	10.6	10.6	10.6	10.6	10.6	10.6
135	24.8	19.4	14.3	10.6	10.6	10.6	10.6	10.6	10.6	10.6
140	25.4	20.2	15.3	10.8	10.7	10.7	10.7	10.7	10.7	10.7
145	25.9	20.9	16.1	11.8	10.7	10.7	10.7	10.7	10.7	10.7
150	26.4	21.5	16.9	12.8	10.8	10.8	10.8	10.8	10.8	10.8
155	26.9	22.2	17.7	13.7	10.8	10.8	10.8	10.8	10.8	10.8
160	27.4	22.8	18.4	14.5	11.0	10.9	10.9	10.9	10.9	10.9
165	27.8	23.3	19.1	15.3	12.0	10.9	10.9	10.9	10.9	10.9
170	28.2	23.9	19.8	16.1	12.8	11.0	11.0	11.0	11.0	11.0
175	28.6	24.4	20.4	16.8	13.6	11.0	11.0	11.0	11.0	11.0
180	29.0	24.9	21.0	17.5	14.4	11.8	11.0	11.0	11.0	11.0
185	29.4	25.3	21.5	18.1	15.1	12.6	11.4	11.1	11.1	11.1
190	29.8	25.8	22.1	18.7	15.8	13.4	12.2	11.1	11.1	11.1
195	30.1	26.2	22.6	19.3	16.5	14.1	13.0	11.2	11.2	11.2
200	30.5	26.6	23.1	19.9	17.1	14.8	13.7	11.8	11.2	11.2
205	30.8	27.1	23.5	20.4	17.7	15.5	14.4	12.6	11.3	11.3
210	31.1	27.4	24.0	21.0	18.3	16.1	15.0	13.3	11.3	11.3
215	31.4	27.8	24.4	21.5	18.9	16.7	15.7	13.9	11.4	11.4
220	31.8	28.2	24.9	21.9	19.4	17.3	16.3	14.6	12.1	11.4
225	32.1	28.6	25.3	22.4	19.9	17.9	16.9	15.2	12.8	11.5
230	32.4	28.9	25.7	22.9	20.4	18.4	17.5	15.8	13.4	11.5
235	32.6	29.3	26.1	23.3	20.9	19.0	18.0	16.4	14.0	12.1
240	32.9	29.6	26.5	23.7	21.4	19.5	18.5	16.9	14.6	12.8
245	33.2	29.9	26.8	24.1	21.8	20.0	19.0	17.5	15.2	13.4
250	33.5	30.2	27.2	24.5	22.3	20.5	19.5	18.0	15.8	13.9
255	33.6	30.4	27.4	24.8	22.6	20.8	19.9	18.4	16.2	14.5
260	33.7	30.6	27.7	25.1	23.0	21.2	20.3	18.8	16.7	14.9
265	33.9	30.8	27.9	25.4	23.3	21.6	20.7	19.2	17.1	15.4
270	34.0	30.9	28.1	25.6	23.6	21.9	21.1	19.6	17.5	15.8
275	34.1	31.1	28.3	25.9	23.9	22.2	21.4	19.9	17.9	16.3
280	34.2	31.3	28.5	26.1	24.1	22.5	21.7	20.3	18.3	16.7
285	34.3	31.4	28.7	26.4	24.4	22.8	22.0	20.6	18.7	17.1
290	34.4	31.5	28.9	26.6	24.6	23.1	22.3	20.9	19.0	17.5
295	34.5	31.7	29.1	26.8	24.9	23.4	22.6	21.3	19.4	17.8
300	34.6	31.8	29.2	27.0	25.1	23.7	22.9	21.6	19.7	18.2
305	34.7	31.9	29.4	27.2	25.4	23.9	23.2	21.8	20.0	18.5
310	34.8	32.1	29.5	27.4	25.6	24.2	23.4	22.1	20.3	18.8
315	34.9	32.2	29.7	27.6	25.8	24.4	23.7	22.4	20.6	19.2
320	34.9	32.3	29.8	27.7	26.0	24.6	23.9	22.6	20.9	19.5
325	35.0	32.4	30.0	27.9	26.2	24.9	24.2	22.9	21.1	19.8
330	35.1	32.5	30.1	28.1	26.4	25.1	24.4	23.1	21.4	20.0
335	35.2	32.6	30.3	28.2	26.6	25.3	24.6	23.4	21.7	20.3
340	35.2	32.7	30.4	28.4	26.8	25.5	24.8	23.6	21.9	20.6
345	35.3	32.8	30.5	28.6	26.9	25.7	25.0	23.8	22.1	20.8
350	35.4	32.9	30.6	28.7	27.1	25.9	25.2	24.0	22.4	21.1
355	35.5	33.0	30.8	28.8	27.3	26.1	25.4	24.2	22.6	21.3
360	35.5	33.1	30.9	29.0	27.4	26.3	25.6	24.4	22.8	21.6
365	35.6	33.2	31.0	29.1	27.6	26.4	25.8	24.6	23.0	21.8

Table applies to fully exposed rectangular and circular hollow columns. Thickness is protection material only.



**Table 3: Hollow Section Columns: Fire Protection Period 90 minutes**

MONOKOTE MK6										
Section Factor up to m <sup>-1</sup>	Table 3: Hollow Section Columns: Fire Resistance Period: 90 Minutes									
	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
30	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
35	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
40	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
45	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
50	11.7	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
55	15.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
60	19.1	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
65	21.8	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
70	24.0	12.6	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
75	25.9	15.4	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
80	27.5	17.7	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
85	28.9	19.8	10.9	10.2	10.2	10.2	10.2	10.2	10.2	10.2
90	30.1	21.6	13.3	10.2	10.2	10.2	10.2	10.2	10.2	10.2
95	31.2	23.2	15.3	10.2	10.2	10.2	10.2	10.2	10.2	10.2
100	32.2	24.6	17.2	10.4	10.3	10.3	10.3	10.3	10.3	10.3
105	33.1	25.9	18.8	12.4	10.3	10.3	10.3	10.3	10.3	10.3
110	34.0	27.0	20.3	14.2	10.4	10.4	10.4	10.4	10.4	10.4
115	34.8	28.1	21.7	15.8	10.6	10.4	10.4	10.4	10.4	10.4
120	35.5	29.0	22.9	17.3	12.3	10.5	10.5	10.5	10.5	10.5
125	36.2	30.0	24.0	18.7	13.9	10.5	10.5	10.5	10.5	10.5
130	36.8	30.8	25.1	19.9	15.4	11.4	10.6	10.6	10.6	10.6
135	37.4	31.6	26.1	21.1	16.7	13.0	11.2	10.6	10.6	10.6
140	37.9	32.3	27.0	22.2	18.0	14.4	12.7	10.7	10.7	10.7
145	38.5	33.0	27.8	23.2	19.1	15.7	14.0	11.3	10.7	10.7
150	39.0	33.7	28.6	24.1	20.2	16.9	15.3	12.6	10.8	10.8
155	39.5	34.3	29.4	25.0	21.2	18.0	16.5	13.9	10.8	10.8
160	40.0	34.9	30.1	25.8	22.2	19.1	17.6	15.0	11.4	10.9
165	40.4	35.5	30.8	26.6	23.1	20.1	18.6	16.1	12.6	10.9
170	40.9	36.0	31.4	27.4	23.9	21.0	19.6	17.2	13.7	11.0
175	41.3	36.5	32.0	28.1	24.7	21.9	20.5	18.2	14.8	12.0
180	41.7	37.0	32.6	28.8	25.5	22.8	21.4	19.1	15.8	13.0
185	42.1	37.5	33.2	29.4	26.2	23.6	22.3	20.0	16.7	14.1
190	42.5	38.0	33.7	30.1	26.9	24.4	23.1	20.8	17.6	15.0
195	42.9	38.4	34.3	30.7	27.6	25.1	23.8	21.6	18.5	16.0
200	43.2	38.9	34.8	31.2	28.2	25.8	24.6	22.4	19.3	16.9
205	43.6	39.3	35.3	31.8	28.8	26.5	25.3	23.1	20.1	17.7
210	43.9	39.7	35.8	32.3	29.4	27.1	25.9	23.8	20.9	18.5
215	44.3	40.1	36.2	32.8	30.0	27.8	26.6	24.5	21.6	19.3
220	44.6	40.5	36.7	33.3	30.6	28.4	27.2	25.2	22.3	20.0
225	44.9	40.9	37.1	33.8	31.1	28.9	27.8	25.8	23.0	20.7
230	45.3	41.3	37.5	34.3	31.6	29.5	28.4	26.4	23.6	21.4
235	45.6	41.6	37.9	34.8	32.1	30.1	28.9	27.0	24.2	22.1
240	45.9	42.0	38.3	35.2	32.6	30.6	29.5	27.5	24.9	22.7
245	46.2	42.4	38.7	35.7	33.1	31.1	30.0	28.1	25.4	23.3
250	46.5	42.7	39.1	36.1	33.5	31.6	30.5	28.6	26.0	23.9
255	46.6	42.9	39.4	36.4	33.9	32.0	30.9	29.0	26.4	24.4
260	46.8	43.0	39.6	36.6	34.2	32.3	31.3	29.4	26.9	24.9
265	46.9	43.2	39.8	36.9	34.5	32.6	31.6	29.8	27.3	25.3
270	47.0	43.4	40.0	37.1	34.7	32.9	31.9	30.1	27.7	25.7
275	47.1	43.5	40.2	37.3	35.0	33.3	32.3	30.5	28.0	26.2
280	47.2	43.6	40.3	37.5	35.3	33.5	32.6	30.8	28.4	26.5
285	47.3	43.8	40.5	37.8	35.5	33.8	32.9	31.1	28.7	26.9
290	47.3	43.9	40.7	38.0	35.7	34.1	33.1	31.4	29.1	27.3
295	47.4	44.0	40.8	38.2	36.0	34.4	33.4	31.7	29.4	27.6
300	47.5	44.1	41.0	38.3	36.2	34.6	33.7	32.0	29.7	28.0
305	47.6	44.3	41.1	38.5	36.4	34.8	33.9	32.3	30.0	28.3
310	47.7	44.4	41.3	38.7	36.6	35.1	34.2	32.5	30.3	28.6
315	47.7	44.5	41.4	38.9	36.8	35.3	34.4	32.8	30.6	28.9
320	47.8	44.6	41.6	39.0	37.0	35.5	34.6	33.0	30.8	29.2
325	47.9	44.7	41.7	39.2	37.2	35.7	34.9	33.2	31.1	29.5
330	47.9	44.8	41.8	39.4	37.4	35.9	35.1	33.5	31.3	29.7
335	48.0	44.9	41.9	39.5	37.5	36.1	35.3	33.7	31.6	30.0
340	48.1	45.0	42.1	39.6	37.7	36.3	35.5	33.9	31.8	30.2
345	48.1	45.1	42.2	39.8	37.9	36.5	35.7	34.1	32.0	30.5
350	48.2	45.1	42.3	39.9	38.0	36.7	35.9	34.3	32.3	30.7
355	48.2	45.2	42.4	40.1	38.2	36.9	36.0	34.5	32.5	30.9
360	48.3	45.3	42.5	40.2	38.3	37.0	36.2	34.7	32.7	31.2
365	48.4	45.4	42.6	40.3	38.5	37.2	36.4	34.9	32.9	31.4

Table applies to fully exposed rectangular and circular hollow columns. Thickness is protection material only.



**Table 4: Hollow Section Columns: Fire Protection Period 120 minutes**

MONOKOTE MK6										
Section Factor up to m <sup>-1</sup>	Table 4:Hollow Section Columns: Fire Resistance Period: 120 Minutes									
	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
30	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
35	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
40	15.3	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
45	22.0	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
50	26.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
55	30.4	14.6	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
60	33.3	19.2	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
65	35.6	22.9	10.2	10.0	10.0	10.0	10.0	10.0	10.0	10.0
70	37.6	26.0	14.4	10.0	10.0	10.0	10.0	10.0	10.0	10.0
75	39.2	28.5	17.9	10.1	10.1	10.1	10.1	10.1	10.1	10.1
80	40.7	30.7	20.9	11.7	10.1	10.1	10.1	10.1	10.1	10.1
85	41.9	32.6	23.4	14.9	10.2	10.2	10.2	10.2	10.2	10.2
90	43.1	34.2	25.6	17.7	10.4	10.2	10.2	10.2	10.2	10.2
95	44.1	35.7	27.6	20.1	13.4	10.2	10.2	10.2	10.2	10.2
100	45.0	37.0	29.3	22.3	15.9	10.4	10.3	10.3	10.3	10.3
105	45.9	38.2	30.9	24.2	18.2	13.0	10.6	10.3	10.3	10.3
110	46.7	39.3	32.3	25.9	20.2	15.4	13.0	10.4	10.4	10.4
115	47.4	40.3	33.6	27.5	22.1	17.5	15.2	11.5	10.4	10.4
120	48.1	41.3	34.7	28.9	23.7	19.4	17.2	13.6	10.5	10.5
125	48.8	42.2	35.8	30.2	25.2	21.1	19.1	15.6	10.5	10.5
130	49.4	43.0	36.8	31.4	26.6	22.7	20.7	17.4	12.5	10.6
135	50.0	43.7	37.8	32.5	27.9	24.2	22.3	19.0	14.3	10.6
140	50.5	44.5	38.7	33.6	29.2	25.5	23.7	20.5	16.0	12.3
145	51.1	45.1	39.5	34.6	30.3	26.8	25.0	22.0	17.6	14.0
150	51.6	45.8	40.3	35.5	31.3	28.0	26.3	23.3	19.0	15.5
155	52.1	46.4	41.0	36.3	32.3	29.1	27.4	24.5	20.4	17.0
160	52.6	47.0	41.8	37.2	33.3	30.1	28.5	25.6	21.6	18.3
165	53.0	47.6	42.4	38.0	34.2	31.1	29.5	26.7	22.8	19.6
170	53.5	48.1	43.1	38.7	35.0	32.1	30.5	27.8	23.9	20.8
175	53.9	48.7	43.7	39.4	35.8	32.9	31.4	28.7	25.0	21.9
180	54.3	49.2	44.3	40.1	36.6	33.8	32.3	29.6	26.0	23.0
185	54.8	49.7	44.9	40.8	37.3	34.6	33.1	30.5	26.9	24.0
190	55.2	50.2	45.4	41.4	38.0	35.4	33.9	31.4	27.8	25.0
195	55.6	50.6	46.0	42.0	38.7	36.1	34.7	32.2	28.7	25.9
200	56.0	51.1	46.5	42.6	39.3	36.8	35.4	32.9	29.5	26.8
205	56.4	51.5	47.0	43.2	39.9	37.5	36.1	33.7	30.3	27.6
210	56.7	52.0	47.5	43.7	40.6	38.2	36.8	34.4	31.0	28.4
215	57.1	52.4	48.0	44.2	41.1	38.8	37.5	35.1	31.8	29.2
220	57.5	52.8	48.5	44.8	41.7	39.4	38.1	35.7	32.5	30.0
225	57.8	53.2	48.9	45.3	42.3	40.0	38.7	36.4	33.2	30.7
230	58.2	53.6	49.4	45.8	42.8	40.6	39.3	37.0	33.8	31.4
235	58.6	54.0	49.8	46.2	43.3	41.1	39.9	37.6	34.5	32.0
240	58.9	54.4	50.2	46.7	43.8	41.7	40.4	38.2	35.1	32.7
245	59.2	54.8	50.7	47.2	44.3	42.2	41.0	38.7	35.7	33.3
250	59.6	55.2	51.1	47.6	44.8	42.7	41.5	39.3	36.2	33.9
255	59.7	55.3	51.3	47.9	45.1	43.1	41.9	39.7	36.7	34.4
260	59.8	55.5	51.5	48.1	45.4	43.4	42.2	40.0	37.1	34.8
265	59.9	55.6	51.6	48.3	45.6	43.7	42.5	40.4	37.4	35.2
270	60.0	55.8	51.8	48.5	45.9	44.0	42.8	40.7	37.8	35.6
275	60.0	55.9	52.0	48.8	46.2	44.3	43.1	41.0	38.2	36.0
280	60.1	56.0	52.2	49.0	46.4	44.5	43.4	41.3	38.5	36.4
285	60.2	56.1	52.3	49.2	46.6	44.8	43.7	41.6	38.8	36.7
290	60.3	56.2	52.5	49.3	46.8	45.1	44.0	41.9	39.1	37.1
295	60.3	56.4	52.6	49.5	47.0	45.3	44.2	42.2	39.4	37.4
300	60.4	56.5	52.8	49.7	47.3	45.5	44.5	42.4	39.7	37.7
305	60.5	56.6	52.9	49.9	47.5	45.8	44.7	42.7	40.0	38.0
310	60.5	56.7	53.0	50.0	47.6	46.0	44.9	42.9	40.3	38.3
315	60.6	56.8	53.2	50.2	47.8	46.2	45.1	43.2	40.5	38.6
320	60.7	56.8	53.3	50.3	48.0	46.4	45.3	43.4	40.8	38.9
325	60.7	56.9	53.4	50.5	48.2	46.6	45.6	43.6	41.0	39.1
330	60.8	57.0	53.5	50.6	48.3	46.8	45.7	43.8	41.3	39.4
335	60.8	57.1	53.6	50.8	48.5	47.0	45.9	44.0	41.5	39.6
340	60.9	57.2	53.7	50.9	48.7	47.1	46.1	44.2	41.7	39.9
345	60.9	57.3	53.8	51.0	48.8	47.3	46.3	44.4	41.9	40.1
350	61.0	57.3	53.9	51.1	49.0	47.5	46.5	44.6	42.1	40.3
355	61.0	57.4	54.0	51.3	49.1	47.6	46.6	44.8	42.3	40.6
360	61.1	57.5	54.1	51.4	49.2	47.8	46.8	45.0	42.5	40.8
365	61.1	57.6	54.2	51.5	49.4	47.9	47.0	45.1	42.7	41.0

Table applies to fully exposed rectangular and circular hollow columns. Thickness is protection material only.



**Table 5: Hollow Section Columns: Fire Protection Period 180 minutes**

MONOKOTE MK6										
Section Factor up to m <sup>-1</sup>	Table 5: Hollow Section Columns: Fire Resistance Period: 180 Minutes									
	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
30	31.2	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
35	42.5	9.8	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
40	49.2	23.9	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
45	53.7	32.9	10.6	9.8	9.8	9.8	9.8	9.8	9.8	9.8
50	57.0	39.2	20.5	9.8	9.8	9.8	9.8	9.8	9.8	9.8
55	59.5	43.9	27.7	11.8	9.9	9.9	9.9	9.9	9.9	9.9
60	61.6	47.5	33.1	19.3	9.9	9.9	9.9	9.9	9.9	9.9
65	63.2	50.4	37.4	25.1	13.6	10.0	10.0	10.0	10.0	10.0
70	64.7	52.8	40.9	29.8	19.5	10.3	10.0	10.0	10.0	10.0
75	66.0	54.9	43.9	33.7	24.3	16.1	12.1	10.1	10.1	10.1
80	67.1	56.6	46.3	36.9	28.3	20.9	17.3	11.0	10.1	10.1
85	68.1	58.2	48.5	39.7	31.7	25.0	21.6	15.8	10.2	10.2
90	69.0	59.6	50.4	42.1	34.7	28.4	25.3	19.8	11.8	10.2
95	69.9	60.8	52.1	44.2	37.2	31.4	28.5	23.3	15.8	10.2
100	70.6	62.0	53.6	46.1	39.5	34.1	31.3	26.4	19.3	13.4
105	71.4	63.0	54.9	47.8	41.5	36.4	33.7	29.1	22.3	16.8
110	72.1	64.0	56.2	49.3	43.3	38.5	36.0	31.5	25.1	19.8
115	72.7	64.9	57.3	50.7	45.0	40.4	38.0	33.6	27.5	22.5
120	73.4	65.7	58.4	52.0	46.5	42.2	39.8	35.6	29.7	24.9
125	74.0	66.6	59.4	53.2	47.9	43.8	41.5	37.4	31.7	27.1
130	74.6	67.3	60.4	54.3	49.2	45.2	43.0	39.1	33.6	29.1
135	75.1	68.0	61.2	55.4	50.4	46.6	44.5	40.6	35.2	31.0
140	75.7	68.7	62.1	56.4	51.6	47.9	45.8	42.0	36.8	32.7
145	76.2	69.4	62.9	57.3	52.6	49.1	47.0	43.3	38.3	34.3
150	76.8	70.0	63.7	58.2	53.6	50.2	48.2	44.6	39.6	35.7
155	77.3	70.7	64.4	59.0	54.6	51.2	49.3	45.8	40.9	37.1
160	77.8	71.3	65.1	59.8	55.5	52.2	50.3	46.9	42.1	38.4
165	78.3	71.8	65.8	60.6	56.4	53.2	51.3	47.9	43.2	39.6
170	78.7	72.4	66.4	61.3	57.2	54.1	52.3	48.9	44.3	40.8
175	79.2	73.0	67.0	62.1	58.0	55.0	53.2	49.8	45.3	41.9
180	79.7	73.5	67.7	62.7	58.7	55.8	54.0	50.7	46.3	42.9
185	80.1	74.0	68.3	63.4	59.5	56.6	54.9	51.6	47.2	43.9
190	80.6	74.5	68.8	64.1	60.2	57.4	55.7	52.4	48.1	44.9
195	81.0	75.1	69.4	64.7	60.9	58.1	56.4	53.2	49.0	45.8
200	81.5	75.6	70.0	65.3	61.5	58.8	57.2	54.0	49.8	46.7
205	81.9	76.0	70.5	65.9	62.2	59.5	57.9	54.8	50.6	47.5
210	82.3	76.5	71.0	66.5	62.8	60.2	58.6	55.5	51.4	48.3
215	82.8	77.0	71.6	67.0	63.4	60.9	59.2	56.2	52.1	49.1
220	-	77.5	72.1	67.6	64.0	61.5	59.9	56.9	52.8	49.8
225	-	77.9	72.6	68.1	64.6	62.1	60.5	57.5	53.5	50.6
230	-	78.4	73.1	68.7	65.2	62.7	61.2	58.2	54.2	51.3
235	-	78.8	73.5	69.2	65.7	63.3	61.8	58.8	54.9	52.0
240	-	79.3	74.0	69.7	66.3	63.9	62.3	59.4	55.5	52.6
245	-	79.7	74.5	70.2	66.8	64.5	62.9	60.0	56.1	53.3
250	-	80.2	75.0	70.7	67.3	65.0	63.5	60.6	56.7	53.9
255	-	80.3	75.1	70.9	67.6	65.3	63.8	60.9	57.1	54.3
260	-	80.4	75.3	71.1	67.8	65.6	64.1	61.2	57.4	54.7
265	-	80.5	75.4	71.3	68.0	65.8	64.4	61.5	57.8	55.1
270	-	80.6	75.6	71.4	68.2	66.1	64.6	61.8	58.1	55.4
275	-	80.7	75.7	71.6	68.4	66.3	64.9	62.1	58.4	55.8
280	-	80.8	75.8	71.8	68.6	66.6	65.1	62.3	58.7	56.1
285	-	80.9	75.9	71.9	68.8	66.8	65.4	62.6	59.0	56.4
290	-	80.9	76.1	72.1	69.0	67.0	65.6	62.8	59.3	56.7
295	-	81.0	76.2	72.2	69.2	67.2	65.8	63.1	59.5	57.0
300	-	81.1	76.3	72.4	69.4	67.4	66.0	63.3	59.8	57.3
305	-	81.2	76.4	72.5	69.5	67.6	66.2	63.5	60.0	57.5
310	-	81.3	76.5	72.7	69.7	67.8	66.4	63.7	60.3	57.8
315	-	81.3	76.6	72.8	69.9	67.9	66.6	63.9	60.5	58.0
320	-	81.4	76.7	72.9	70.0	68.1	66.8	64.1	60.7	58.3
325	-	81.5	76.8	73.0	70.1	68.3	66.9	64.3	60.9	58.5
330	-	81.5	76.9	73.2	70.3	68.4	67.1	64.5	61.1	58.7
335	-	81.6	77.0	73.3	70.4	68.6	67.3	64.7	61.3	59.0
340	-	81.6	77.1	73.4	70.6	68.8	67.4	64.8	61.5	59.2
345	-	81.7	77.1	73.5	70.7	68.9	67.6	65.0	61.7	59.4
350	-	81.8	77.2	73.6	70.8	69.0	67.7	65.2	61.9	59.6
355	-	81.8	77.3	73.7	70.9	69.2	67.9	65.3	62.1	59.8
360	-	81.9	77.4	73.8	71.0	69.3	68.0	65.5	62.2	60.0
365	-	81.9	77.5	73.9	71.1	69.4	68.2	65.6	62.4	60.1

Table applies to fully exposed rectangular and circular hollow columns. Thickness is protection material only.



**Table 6: Hollow Section Columns: Fire Protection Period 240 minutes**

MONOKOTE MK6										
Section Factor up to m <sup>-1</sup>	Table 6: Hollow Section Columns: Fire Resistance Period: 240 Minutes									
	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
30	74.5	32.7	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
35	79.8	50.0	14.4	9.7	9.7	9.7	9.7	9.7	9.7	9.7
40	-	59.5	33.0	9.7	9.7	9.7	9.7	9.7	9.7	9.7
45	-	65.6	44.1	22.2	9.8	9.8	9.8	9.8	9.8	9.8
50	-	69.9	51.7	33.6	15.9	9.8	9.8	9.8	9.8	9.8
55	-	73.1	57.1	41.7	26.9	13.3	9.9	9.9	9.9	9.9
60	-	75.7	61.3	47.7	35.0	23.6	17.8	9.9	9.9	9.9
65	-	77.8	64.7	52.4	41.1	31.3	26.3	17.4	10.0	10.0
70	-	79.6	67.4	56.2	46.1	37.4	32.9	24.9	13.1	10.0
75	-	81.2	69.8	59.4	50.1	42.3	38.2	30.9	20.3	11.1
80	-	82.6	71.8	62.1	53.5	46.4	42.6	35.8	26.1	17.8
85	-	-	73.5	64.4	56.4	49.8	46.3	40.0	30.9	23.3
90	-	-	75.1	66.4	58.9	52.8	49.5	43.5	35.0	28.0
95	-	-	76.5	68.2	61.1	55.4	52.3	46.6	38.5	32.0
100	-	-	77.8	69.9	63.1	57.7	54.7	49.3	41.6	35.4
105	-	-	79.0	71.3	64.9	59.8	56.9	51.7	44.4	38.5
110	-	-	80.1	72.7	66.5	61.7	58.9	53.9	46.8	41.2
115	-	-	81.1	74.0	68.0	63.4	60.7	55.8	49.0	43.7
120	-	-	82.1	75.1	69.3	65.0	62.4	57.6	51.0	45.9
125	-	-	-	76.2	70.6	66.4	63.9	59.2	52.9	47.9
130	-	-	-	77.3	71.8	67.7	65.3	60.8	54.6	49.8
135	-	-	-	78.2	72.9	69.0	66.6	62.2	56.1	51.5
140	-	-	-	79.2	74.0	70.2	67.9	63.5	57.6	53.1
145	-	-	-	80.0	75.0	71.3	69.0	64.7	59.0	54.6
150	-	-	-	80.9	75.9	72.4	70.1	65.9	60.2	56.0
155	-	-	-	81.7	76.8	73.4	71.2	67.0	61.5	57.3
160	-	-	-	82.5	77.7	74.3	72.2	68.1	62.6	58.5
165	-	-	-	-	78.6	75.3	73.1	69.1	63.7	59.7
170	-	-	-	-	79.4	76.1	74.0	70.0	64.7	60.8
175	-	-	-	-	80.1	77.0	74.9	71.0	65.7	61.8
180	-	-	-	-	80.9	77.8	75.8	71.9	66.7	62.8
185	-	-	-	-	81.6	78.6	76.6	72.7	67.6	63.8
190	-	-	-	-	82.4	79.4	77.4	73.5	68.5	64.8
195	-	-	-	-	-	80.1	78.1	74.3	69.3	65.6
200	-	-	-	-	-	80.8	78.9	75.1	70.1	66.5
205	-	-	-	-	-	81.6	79.6	75.9	70.9	67.4
210	-	-	-	-	-	82.2	80.3	76.6	71.7	68.2
215	-	-	-	-	-	82.9	81.0	77.3	72.4	68.9
220	-	-	-	-	-	-	81.7	78.0	73.2	69.7
225	-	-	-	-	-	-	82.4	78.7	73.9	70.5
230	-	-	-	-	-	-	-	79.3	74.6	71.2
235	-	-	-	-	-	-	-	80.0	75.3	71.9
240	-	-	-	-	-	-	-	80.6	75.9	72.6
245	-	-	-	-	-	-	-	81.2	76.6	73.2
250	-	-	-	-	-	-	-	98.2	77.2	73.9
255	-	-	-	-	-	-	-	82.1	77.5	74.3
260	-	-	-	-	-	-	-	82.4	77.8	74.6
265	-	-	-	-	-	-	-	82.7	78.1	74.9
270	-	-	-	-	-	-	-	82.9	78.4	75.2
275	-	-	-	-	-	-	-	-	78.7	75.5
280	-	-	-	-	-	-	-	-	78.9	75.8
285	-	-	-	-	-	-	-	-	79.2	76.1
290	-	-	-	-	-	-	-	-	79.4	76.3
295	-	-	-	-	-	-	-	-	79.6	76.6
300	-	-	-	-	-	-	-	-	79.8	76.8
305	-	-	-	-	-	-	-	-	80.0	77.1
310	-	-	-	-	-	-	-	-	80.2	77.3
315	-	-	-	-	-	-	-	-	80.4	77.5
320	-	-	-	-	-	-	-	-	80.6	77.7
325	-	-	-	-	-	-	-	-	80.8	77.9
330	-	-	-	-	-	-	-	-	81.0	78.1
335	-	-	-	-	-	-	-	-	81.2	78.3
340	-	-	-	-	-	-	-	-	81.3	78.5
345	-	-	-	-	-	-	-	-	81.5	78.6
350	-	-	-	-	-	-	-	-	81.6	78.8
355	-	-	-	-	-	-	-	-	81.8	79.0
360	-	-	-	-	-	-	-	-	81.9	79.1
365	-	-	-	-	-	-	-	-	82.1	79.3

Table applies to fully exposed rectangular and circular hollow columns. Thickness is protection material only.

