Commission of the European Communities

technical steel research

Properties and service performance

Practical design tools for composite steel-concrete construction elements submitted to ISO-fire considering the interaction between axial load N and bending moment M

Refao-II

Parts I - II - III

Report

EUR 13309 EN

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ARBED Recherches
66, rue de Luxembourg
L-4221 Esch/Alzette

Contract No 7210-SA/504
(1.10.1985 - 30.9.1988)

Final report

Directorate-General
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Refao-II

1 October 1985 to 30 September 1988

Final report

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We want to acknowledge first of all the important financial support from the COMMISSION OF THE EUROPEAN COMMUNITY, as well as the moral support given this research by all the members of the C.E.C. EXECUTIVE COMMITTEE F8 "LIGHT WEIGHT STRUCTURES".

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We wish to record our appreciation of the cooperation of the specialists of Professor Dr. Ing. R. BAUS, Director of the Department for Bridges and Structural Engineering of Liège University (Belgium), and especially of Dr. Ing. J-M. FRANSSEN, for the improvement of the computer code CEFICOSS. We appreciated alike the help of Prof. Dr.-Ing. W. KLINGSCH, "Lehrstuhl für Baustofftechnologie und Brandschutz, Bergische Universität Wuppertal" (Germany).

Thanks are finally due to all, who by any means may have contributed to the establishment of the very practical and unique set of **STRUCTURAL FIRE DESIGN TOOLS** given in this **FINAL REPORT.**

"Practical design tools for composite steel-concrete construction elements submitted to ISO-fire considering the interaction between axial load N and bending moment M."

Agreement N° 7210 - SA/504 C.E.C. - ARBED

SUMMARY

The thermo-mechanical laws describing the behaviour of steel and concrete at various temperatures are presented first and discussed. These stress-strain relationships have been slightly improved in order to better simulate all boundary conditions. The choice concerning heat exchange, particularly the convection factor and the relative resultant emissivity used in CEFICOSS calculations, is described.

The selection of material qualities has been limited to four basis possible combinations, because it could be shown that any other combination with intermediate qualities of structural steel and concrete is covered by a most simple interaction method.

The first part of this research programme concerns **FOUR DIFFERENT CROSS SECTION TYPES OF COMPOSITE COLUMNS** for which all geometrical parameters have been defined. These columns have been analysed under ISO-fire conditions starting with a constant first order eccentricity. Results, i.e. the **AXIAL BUCKLING LOAD** N_θ together with the corresponding **FIRST ORDER ECCENTRICITY**, are given in tables for the fire classes F30, F60, F90 and F120, and for buckling lengths of 2.00, 4.00, 6.00 and 8.00 m, whereas a simple interpolation method allows to consider intermediate buckling lengths. These tables include informations for various eccentricities selected in such a way as to permit a linear interpolation for all possible (N, M) combinations. Moreover a method is proposed allowing to take profit of the advantage of a non uniform first order bending moment distribution.

The second part of this research programme concerns **THREE TYPES OF COMPOSITE BEAMS**, statically determinate and uniformly loaded. Tables are presented for the different fire resistance classes, and give the **ULTIMATE BENDING MOMENTS** and the **ULTIMATE SHEAR FORCES**. These tables include different concrete slab thicknesses and effective widths, and an interpolation method is given for intermediate values. The ultimate bending moments correspond to the plastic hinge equilibrium failure; if a deflection criterion is requested, the beam deflection evaluation method presented on the basis of moment-curvature diagrams could be used.

"Outils pratiques de dimensionnement pour des éléments de construction mixtes acier-béton soumis au feu ISO compte tenu de l'interaction entre l'effort axial N et le moment de flexion M".

Contrat N° 7210 - SA/504 C.C.E. - ARBED

RESUME

Dans une première phase les lois de comportement thermo-mécanique de l'acier et du béton introduites dans le programme CEFICOSS sont présentées et discutées. Les lois σ-ε de l'acier et du béton à haute température ont été légèrement améliorées de manière à mieux simuler certaines conditions limites. Ensuite sont décrits certains choix relatifs aux échanges thermiques, notamment les coefficients de convection et de radiation utilisés dans les calculs.

Le choix des qualités d'acier et de béton a été limité à quatre combinaisons extrêmes possibles, car il a été établi que des combinaisons acier-béton réalisées avec d'autres qualités intermédiaires pouvaient être couvertes par des méthodes d'interpolation très simples définies dans ce rapport.

La première partie de la recherche concerne **QUATRE TYPES DIFFERENTS DE SECTIONS DROITES DE COLONNES**, pour lesquelles ont été définis les paramètres géométriques à prendre en compte, tels que l'armaturage du béton ou les longueurs de flambement. Ces colonnes ont été calculées au feu avec une excentricité initiale du premier ordre constante, et les résultats sont proposés en tables donnant les **CHARGES AXIALES ADMISSIBLES EN FONCTION DES EXCENTRICITES** pour les classes au feu F30 à F120, et pour les longueurs de flambement de 2.00, 4.00, 6.00 et 8.00 mètres, tandis qu'une méthode simple d'interpolation est donnée pour d'autres longueurs. Ces tables comportent les valeurs correspondant à différentes excentricités choisies de manière telle que l'interpolation linéaire entre ces valeurs donne de bons résultats. Enfin, une méthode est proposée pour prendre en compte l'effet bénéfique d'une distribution de moments non uniforme qui est le cas habituel en pratique.

La seconde partie concerne **TROIS TYPES DE POUTRES MIXTES** isostatiques soumises à une charge uniformément répartie. Pour ces poutres, les tableaux fournissent les **MOMENTS ULTIMES** correspondant à l'apparition d'une rotule plastique et les **EFFORTS TRANCHANTS ULTIMES** pour les différentes classes de résistance au feu. Ces tableaux sont établis pour différentes épaisseurs de dalle et différentes largeurs collaborantes entre lesquelles une interpolation est possible. D'autre part, comme un critère de déformation peut être demandé dans le cas de poutres, une méthode d'évaluation des déformations à partir de diagrammes moments-courbures est proposée.

Praktische Bemessungshilfen für die Interaktion von Normalkräften (N) und Biegemomenten (M) für Stahl-Beton Verbundelemente unter Feuerbeanspruchung (ISO - Kurve)

Vertrag N° 7210-SA/504 K.E.G. - ARBED

Z U S A M M E N F A S S U N G

In der ersten Phase wird das Verhalten der thermomechanischen Gesetzen von Stahl und Beton, die im Program CEFICOSS enthalten sind, behandelt. Die Gesetze $\sigma - \varepsilon$ von Stahl und Beton wurden bei hohen Temperaturen leicht geändert, um einige Randbereiche besser simulieren zu können. Weiterhin werden die thermische Konvektionszahl, die Wärmeleitfähigkeit, die spezifische Wärmekapazität und die mittlere Emissionszahl besprochen.

Die Wahl der Beton- und Stahlgütekombination wurde auf vier mögliche äussere Kombinationen begrenzt. Um nun auf andere innere Beton- bzw. Stahlgüten zu schliessen, geben wir einfache Interpolationsmöglichkeiten an.

Der erste Teil des Berichtes behandelt **VIER VERSCHIEDENE STUETZEN QUERSCHNITTE**, bei denen die geometrichen Abmessungen, die Lage der Bewehrungseisen im Beton, sowie die Knicklängen als feste Angaben definiert sind. Die Stützen wurden mit einer konstanten Imperfektion ersten Grades berechnet. Die Werte der Tabellen geben die aufnehmbare **ZENTRISCHE DRUCKLAST**, bezogen auf die jeweilige **EXZENTRIZITÄT**, für die Feuerwiderstandsklassen F30 bis F120 und die Knicklängen L = 2.0, 4.0, 6.0, 8.0 Meter an. Andere Knicklängen können linear interpoliert werden. Die Wahl der verschiedenen Exzentrizitäten wurden so festgelegt, dass durch lineare Interpolation, Zwischenexzentrizitäten noch gute Resultate geben. Weiter schlagen wir eine Methode vor, mit der man von einer rechteckförmigen Momentenverteilung auf eine andere beliebige Momentenverteilung schliessen kann. (z.b. dreieckförmige Momentenverteilung).

Der zweite Teil des Berichtes behandelt **DREI VERBUNDTRAEGERQUERSCHNITTE**. Die Träger sind gelenkig - gelenkig verschieblich gelagert (statich bestimmt) und haben als Belastung eine unveränderliche Gleichlast. In den Tabellen haben wir die Werte der **PLASTISCHEN MOMENTE** (Bildung eines plastischen Gelenks), sowie die **PLASTISCHEN QUERKRÄFTE** bei verschiedenen Feuerwiderstandsklassen aufgeführt. Die Werte der Tabellen enthalten verschiedene Deckenstärken und verschiedene mitwirkende Plattenbreiten. Andere Deckenstärken oder Plattenbreiten können interpoliert werden. Wenn Verformungskriterien gefragt sind, schlagen wir eine Methode, mit Hilfe von Momenten - Krümmungsdiagrammen vor, die Durchbiegung ermitteln kann.

SUMMARY	Page

PART I: REPORT

Advisory Committee REFAO II

In order to obtain the largest possible agreement all over Europe for the results of the REFAO II research, it was decided to constitute a special committee, the so called "ADVISORY COMMITTEE REFAO II", whose duty was to closely supervise the progressing of the research work.

This committee was composed of the following gentlemen :

from	Belgium	Dr. P. VANDEVELDE
	France	Dr. J. KRUPPA
	Germany	Prof. Dr. H. BODE and
		Dr. R. BERGMANN
	Great Britain	Dr. G. COOKE
	Netherlands	M. L. TWILT
	Portugal	Prof. A. TOVAR DE LEMOS
	Sweden	M. J. THOR
	Switzerland	M. J. -P. FAVRE

and of course our direct research assistants :

from	Belgium	Dr. J.-M. FRANSSEN and
from	Germany	Prof. Dr. W. KLINGSCH

PART I

REPORT

1. *INTRODUCTION*

1.1. *Thermo-mechanical computer model CEFICOSS*

During the C.E.C. research, agreement N° 7210-SA/502 [1], a computer programme for the analysis of steel and composite structures under fire conditions has been developed. It is based on the finite element method using beam elements with subdivision of the cross section in a rectangular mesh. The structure submitted to increasing loads or temperatures is analysed step-by- step using the Newton-Raphson procedure. The thermal problem is solved by a finite difference method based on the heat balance between adjacent elements.

The numerical simulation of several full scale fire tests performed during various research projects ([1], [2], [3], [4], [5]) has demonstrated that this numerical software **CEFICOSS** is able to simulate in a correct way the structural behaviour of elements submitted to fire and provides a pretty good estimation of the fire resistance times. CEFICOSS is a tool, which allows most credible prediction of the fire resistance of columns or beams, and especially of steel-concrete composite elements ([6],[7],[8],[9])

1.2. *Aim of research*

The programme CEFICOSS can be used by engineers having a sufficiently good knowledge of Numerical Calculations and of the Problems arising under Fire conditions.

However this powerful software permits also a simulation of the behaviour of whole structures submitted to fire which leads of course to quite substantial C.P.U. (calculation) time. Therefore this computer code is not necessarily a practical software for those designers who have only to quickly check a given cross section.

In order to make the quite interesting results of this computer code available to everybody, it has been decided to establish tables or diagrams for different types of composite cross sections and for the most commonly used structural elements, e.g. beams and columns.

Finally the aim of this research was to give practical tools to designers allowing simultaneously an easy and realistic STRUCTURAL FIRE DESIGN of eccentrically loaded composite columns (N-M interaction, buckling included) and of statically determinate composite beams subjected to a uniformly distributed load (see figure 1.1).

The ISO-fire resistance classes F30, F60, F90 and F120 have been considered in this research.

1.3. ***Advisory Committee composed of European Experts***

A critical problem regarding the choice of a lot of parameters occured right at the beginning of this research. As a matter of fact the calculation by means of numerical simulation of elements submitted to fire was a totally new concept, and furthermore all the parameters governing the heat exchanges as well as the failure criteria had to be chosen.

Moreover some parameters regarding the calculation of composite elements in normal service conditions were not identical in the different European Countries, whereas the Eurocodes even now are not definitively established and adopted.

Therefore in order to obtain the largest possible agreement all over Europe for these research results, it was decided to constitute a special committee, the so called **"ADVISORY COMMITTEE REFAO II"**, whose duty was to fix the parameters needed for computer calculations and to closely supervise the progressing of this research work.

This committee is composed of the following gentlemen:

from Belgium	Dr. P. VANDEVELDE
France	Dr. J. KRUPPA
Germany	Prof. Dr.H.BODE and
	Dr. R. BERGMANN
Great Britain	Dr. G. COOKE
Netherlands	M. L. TWILT
Portugal	Prof. A. TOVAR DE LEMOS
Sweden	M. J. THOR
Switzerland	M. J.-P. FAVRE

and of course of the direct research assistants:

from Belgium	Dr. J.-M. FRANSSEN and
from Germany	Prof. Dr. W. KLINGSCH

All calculation conditions are presented in this final report and correspond to the previous Technical Reports N° 1 to 7 (**[10]**, **[11]**, **[12]**, **[13]**, **[14]**, **[15]**, **[16]**). This matter has been discussed in detail during five two days meetings and conclusions have been unanimously accepted by all the members of this ADVISORY COMMITTEE REFAO II.

2. THERMO-MECHANICAL MATERIAL PROPERTIES

2.1. Thermal properties of concrete and steel

In order to compute the time dependent temperature field in composite structural elements, the thermal conductivity λ (W/m.k) and the specific heat C (J/kg.K) of concrete and steel must be known as functions of temperature. These functions are presented in figure 2.1. for the thermal conductivity and in figure 2.2. for the specific heat, while the thermal expansion for concrete and steel is given in figure 2.3. These laws are the original laws introduced in the program CEFICOSS **[1]**.

The density of concrete and steel is taken as constant: 7850 kg/m³ for steel and 2350 kg/m³ for concrete.

2.2. Stress-strain relationships of steel

The relations between stresses σ and stress-related strains ε_σ are non linear and, moreover, vary with temperature.

Figure 2.4. shows the general σ - ε_σ diagram for steel. This diagram is characterized by 3 temperature dependent parameters: the yield point σ_y, the elastic modulus E_o and the elastic modulus E^*.

The reduction of the yield point in function of temperature is given in figure 2.5, while variations of elastic moduli are given in figures 2.6 and 2.7. The figures 2.8 and 2.9 show the resultant diagram for the steel quality Fe360.

It has to be pointed out that these laws include the strain hardening effect of steel, which is significant in zones of important bending moments. This is due to the fact that strain hardening can have only an influence when strains are important. The influence of strain-hardening grows with temperature because on one hand strains grow too with temperature and on the other hand the σ - ε_{σ} laws for steel show that the strain-hardening effect is more important at 300 - 400°C than at ambient temperatures (see figure 2.7).

After several comparative calculations shown in the previous technical reports, the **Advisory Committee Refao II** decided to take the strain hardening effect of steel into account, as well for beams as for columns, because this corresponds to physical reality.

However these laws have been slightly improved in comparison with those laws included in [**1**]:

- σ_{max} has been limited to 1.5 σ_y (see figure 2.4)
- Between 600°C and 1200°C, the strain-hardening modulus E^* linearly decreases to 0. (see figure 2.7)

Indeed, the previous constant strain-hardening modulus of 84 KN/cm^2 for temperatures higher than 600°C could lead to significant stresses for very high strains. This could give exagerated fire resistance times in some limit cases (pure bending or pure tension for instance).

- As indicated in figure 2.7 the strain hardening modulus E^* follows practically the law proposed by Anderberg ([**17**], [**18**]).

2.3. *Stress-strain relationships of concrete*

The concrete laws used earlier in CEFICOSS [**1**] have been improved in order to correspond to the behaviour of concrete at high temperatures given in existing litterature.

In the new formulation, the descending branches remain linear, but the corresponding modulus E^- is now a function of temperature, and the descending branches cross one another as indicated in many publications (see [**19**] for instance). These improved concrete laws are shown in figure 2.10, and the corresponding parameters are defined in figures 2.11, 2.12, and 2.13.

It has to be pointed out that the ascending branches of these improved new laws remain unchanged, exactly as given in [**1**]. Moreover in all calculations of this final report the tension strength of concrete has been neglected and therefore the range III defined on figure 2.13 has never been used.

2.4. *Validity of improvements*

The program CEFICOSS has been calibrated in a previous research [**1**] by means of numerous full scale fire tests on various types of structural elements. The improvements of material laws proposed above have been definitively accepted by the "Advisory Committee REFAO-II" only after a new simulation of these tests had been done on the basis of the improved material laws. The detailed simulations, given in the technical report n° 5 [**14**], show totally insignificant differences between calculation results, less than 2% regarding fire resistance times, and also quite small regarding structural deformations.

In that respect it should be mentionned that for composite steel-concrete construction elements a slight material law modification of either steel or concrete is obviously less critical than for pure steel or pure concrete elements.

3. *FACTORS GOVERNING THE HEAT TRANSFER*

3.1. *Heating curve*

All the calculations performed in this research have been made with the ISO-834 [20] standard heating curve, giving a gas temperature varying as follows around the heated element:

$$Tg = 20 + 345 \log_{10} (8t + 1)$$

With t = fire time in minutes.

3.2. *Coefficient of convection*

Following the recommendations of Technical Committee 3 of the ECCS [21] it was decided to make all the calculations in this research programme with a value **α=25 W/m^2.K** for the convection heat transfer.

3.3. *Resultant emissivity*

The resultant relative emissivity ε^* to be introduced in CEFICOSS could vary between 0.45 and 0.7; that value depends on fire test conditions, and also normally varies during a test with temperature.

As suggested in the recommendations of the ECCS [21], only one constant value **ε^*=0.5** has been used as well for concrete surfaces as for steel surfaces.

3.4. *Water content of concrete*

The residual water content of concrete can vary from 40 up to 120 l/m^3 according to measurements made on tested elements described in [1]. That value has to be defined in CEFICOSS to perform as well as possible a test simulation.

A fire generally occurs, however, on a structure existing since a quite long time, and situated inside of building in quite dry surroundings. Therefore the lowest value of **40 l/m^3** has been adopted.

3.5. *Validity of chosen parameters*

To check the validity of choices, a few columns and beams have been calculated to see what is the influence of the resultant relative emissivity on results given by CEFICOSS. Furthermore one simulation has been performed by varying the coefficient of convection α to estimate also his influence.

The comparison of results for three examples calculated with different values of ε^* and α is given in figure 3.1. The first table of this figure shows that an increase of ε^* from 0.5 to 0.7 decreases a few minutes the calculated fire resistance time. The highest difference reaches 8 minutes (=8%) for the failure time of the beam.

The second table shows that the proposed value α = 25 W/m².K is in safe side.

As conclusion and in accordance with the European Recommendations of ECCS [**21**], the values proposed in § 3.2 and § 3.3 have been adopted and used in all the calculations.

4. MATERIAL QUALITIES

4.1. *Structural steel qualities*

In order to limit the number of calculations to be performed, the steels **Fe360 and Fe510** only have been considered. The Fe430 steel commonly used in United Kingdom, however, can be covered through a simple interpolation method.

4.2. *Quality of reinforcement*

Eurocode n°4 [**22**] has foreseen S220, S400 and S500 where the numbers indicate the minimum yield strength σ_y in N/mm².
Only the quality **S500** has been considered in this research because it is now the most commonly used reinforcing steel. Moreover a high strength reinforcement is the most interesting for composite sections submitted to fire.

4.3. *Concrete qualities*

The concrete classes C12-16-20-25-30-35-40-45-50, are defined in the Eurocodes where the numbers indicate the characteristic resistance in compression measured on cylinders. However for composite structures, the minimum quality to be used is C20.

Both classes **C20 and C50** have been considered to cover the whole field and to permit therefore an interpolation for any other concrete. A very simple interpolation method is proposed further.

4.4. Design strength of materials

The calculation of construction elements submitted to fire is not covered by Eurocode 4 [22] in its current version. Therefore, material design strengths had to be selected on basis of full scale tests simulations, as made in [1]. The following choices have been made for the calculations with CEFICOSS **as leading to the best concordance with tests:**

- for steel: the yield strength σ_y (f_y in Eurocode 4)
- for concrete: fck = βcylinder (characteristic value measured on cylinders ø 150 x 300 at 28 days)
- for the reinforcing bars: the yield strength $\sigma_{y,s}$ = 500 N/mm² (fsk in Eurocode 4).

Definitions of fy, fck and fsk comply with Eurocode n°4 [22], and no reduction factor will be applied on them.

4.5. Interpolation method for steel Fe430 (σ_y = 275 N/mm²)

The easiest possible interpolation method is a linear method with a simple basis, as for instance the yield strength σ_y in cold situation. Such a method assumes that any material contributes for a part to the fire resistance of the composite element, and that this part increases proportionally when the material strengths grows.

This method has been tested on many examples and gives very good results. It is based on the yield strengths of the concerned steels:

Fe360 : σ_y = 235 N/mm²
Fe430 : σ_y = 275 N/mm²
Fe510 : σ_y = 355 N/mm²

For columns in steel Fe430 the interpolation formula <u>for a given fire resistance class and a given eccentricity</u> is the following one:

$$\boxed{N_{430,F} = N_{360,F} + 1/3\ (N_{510,F} - N_{360,F})} \qquad (1)$$

where the coefficient 1/3, calculated from the ratio of the differences of yield strengths (275-235)/(355-235), defines a linear interpolation between the two steels Fe360 and Fe510. $N_{360,F}$ and $N_{510,F}$ are the axial loads given for an identical column, and read in tables corresponding to steels Fe360 and Fe510 <u>for a same eccentricity e, the same fire resistance class F and of course a same concrete quality</u>.

For beams, interpolation is made in the same way:

$$q_{430,F} = q_{360,F} + 1/3 \ (q_{510,F} - q_{360,F})$$

where q are the uniformly distributed loads corresponding to the different steels for a same span and a same fire resistance class F of a given section.

This formula can also be written in terms of ultimate bending moments for the given section:

$$\boxed{M_{430,F} = M_{360,F} + 1/3 \ (M_{510,F} - M_{360,F})} \qquad (2)$$

<u>Appendix A</u> of PART III includes a few examples showing the validity of this linear interpolation method for steel Fe430.

4.6. *Interpolation method for intermediate concrete qualities*

A same simple method has been tested on many examples, using the characteristic compression strength of concrete as basis to make linear interpolations. It has been observed (see Technical Report n°5 [**11**]) that this method gives also very good results when applied on concrete quality.

For a column made with concrete of quality Cx, for any x such as $20 \leq x \leq 50$, it may be written for a given fire resistance class F and a given eccentricity e:

$$\boxed{N_{Cx,F} = N_{C20,F} + \frac{x - 20}{50 - 20} \cdot (N_{C50,F} - N_{C20,F})} \qquad (3)$$

Similarly for beams:

$$\boxed{M_{Cx,F} = M_{C20,F} + \frac{x - 20}{50 - 20} \ (M_{C50,F} - M_{C20,F})} \qquad (4)$$

A few examples given in Appendix A OF PART III show the accuracy of this linear interpolation method.

5. DESIGN OF CONSTRUCTION ELEMENTS IN NORMAL SERVICE CONDITIONS

5.1. *Calculation with CEFICOSS*

There is of course a very good opportunity to calculate with CEFICOSS any structural element in normal service conditions. The static modulus included in the programm can indeed check the bearing capacity of any composite element, and it is then possible to find after a few iterations the highest admissible load at ambient temperature.

By calculating in that way many composite columns and beams, the validity of the program CEFICOSS has been demonstrated also in normal service conditions (see [11] and [12]).

5.2. *Conformity with Eurocodes or National Codes*

Calculations carried out with CEFICOSS in normal service conditions may have some deviation from the results calculated in accordance with Eurocode N°4[22] or any National Standard, if parameters accepted for fire situation are used. The following points have to be considered as leading to complication for a direct use of results given by CEFICOSS in normal service conditions:

a) Standards generally use a simplified steel law having an horizontal plastic plateau, without any strain hardening effect. To receive comparable results, calculations in cold service with CEFICOSS had to be performed with modified steel laws. This possibility has been, however, introduced in the programme.

b) Standards define material strengths which have to be used in computations and which can differ in some countries in their definition (characteristic strength of concrete measured on cylinder or on cube for instance) or in the safety factors to be used.

c) Very important controls have to be done in normal service for phenomena like creep and shrinkage of concrete, which are not directly considered in the programme CEFICOSS.

d) For beams a control of deflections has usually to be done, more often than not also under a part of the total load (the live load) which is not a constant part.

e) In some cases (see [23] for instance) the cross section considered for calculations in normal "cold" service may differ from the resisting cross section in fire. For example, according to figure 5.1 it is more convenient to calculate composite AF beams with the resisting cross section A, in order to avoid a complicated design of shear connectors and stirrups inside of the steel profile in normal service conditions. On the other hand, the cross section B is used to check the bearing capacity in fire, with very simple rules to determine shear connectors and stirrups, based on experimentation.

All the remarks above show that a calculation with CEFICOSS in normal service conditions had to be performed completely apart from the simulation in fire, with other assumptions regarding the cross section and the material laws. Moreover there are many additional controls to do, and only one calculation would not be sufficient.

5.3. ***Reduction of loads in fire conditions***

The loads to be considered for a calculation in fire are not yet defined in Eurocode 4 [22], but some National Fire Codes accept clearly a load reduction for fire conditions, and this concept will probably appear too in Eurocode 4.
As a matter of fact it is not logical to consider for instance the full wind load on building together with a fire situation.

Therefore an ultimate interaction curve N-M in normal service is not directly comparable with an interaction curve in fire, even under consideration for the safety factor (1.5 for instance) used in normal service conditions, because load N and ratio e=M/N will not be identical in both situations.

5.4. Conclusion

As the aim of this research is to provide design tools for fire situation, and as there are too many parameters in normal service conditions, the decision has been taken to omit completely to make calculations for normal service conditions.

This decision will also lead the designers to make first a correct and complete verification for normal service conditions.

6. PARAMETERS FOR COLUMNS

6.1. Section types

The 4 different types of cross section to be studied in this research programme are presented in figure 6.1. by sketches A to D.

They are:

A: Traditional AF-section with reinforced concrete inside of chambers of the steel profile.

B: Tee-shapes are welded on the web of main profile.

C: Octagonal section.

D: Completely encased steel profiles.

6.2. Selection of steel shapes

For section type A (called AF section), it is interesting to use a steel profile having quite thin flanges, and series HEAA, HEA as well as some W and HP are particularly convenient. Priority will be given to series HEA in size 300 to 650, because it is the most commonly used series.

The section type B, called AFC-section, will be calculated with a priority for the same HEA series with tee-shapes from HEM.

For octagonal section type C, so called AF8 section, IPE and HEA series of which two identical steel profiles are combined together will be considered in a first step, as for instance IPE 500 + 2 x 1/2 IPE 500.

The section type D, called HEC section, can be interesting with any thick flanged steel shape, as for instance HEB, HEM or HD. Priority will be given to the HD series.

6.3. Reinforcement: area and layout

It is of course interesting to put as many reinforcing bars as possible inside of concrete, because of the good situation of re-bars protected from fire. However Eurocode 4 [22] limits reinforcement area at 3 % of concrete area for calculation in normal service conditions. Such an area of reinforcement has been placed in section types AF to reach approximatively these 3%.

As concerns the AFC section, just a surface wire mesh is needed to avoid spalling of concrete in fire. This wire mesh will be neglected in calculations.

For section type HEC (full encased steel shape) a reinforcement of 4 ø 12 with stirrups will be taken into account for any cross section.

Bars will be placed at 60 mm far away of exposed concrete surfaces in AF and AF8 types. It is very important, however, to pay attention to the layout of re-bars given in this report with tables of results. That is particularly important for the first section type (AF) for which it is reasonable to locate re-bars differently according to the plane of bending. As a matter of fact all the bars have ideally to be placed near the surface of concrete for minor-axis bending, but rather near steel shape flanges for major-axis bending (see figure 6.2).

The octagonal section type AF8 has been found to be not very interesting without reinforcement in concrete, because the load bearing capacity in fire very quickly decreases as shown on figure 6.3. It is economically very good to incorporate reinforcing bars for the bearing capacity in fire goes up of about 75% for an addition of 17 % of steel.

6.4. Bending moment distribution

Except when transverse loads are applied between columns ends - which is not usual in normal buildings - the distribution of bending moments along the column may have any form presented in figure 6.4 and summarized by the schema of figure 6.5.

As shown in figure 6.6 by means of diagram N-e, distribution type 1 (ψ = - 1, bi-triangular distribution) is the most favourable one, allowing highest eccentricity for a given axial load, or the highest axial load for a given eccentricity. The distribution type 5 (ψ = 1, uniform distribution) is the most unfavourable one, whereas the unsymetrical distribution 2 is most usually encountered.

To go in the same way as Standards for design in normal service conditions, the columns have been calculated with the most unfavourable distribution of moments which is uniform, having a constant eccentricity and therefore a constant first order bending moment. A transformation method is proposed next for other distributions, allowing to reduce the unfavourable effect of the uniform one.

6.5. Eccentricity limits

Practically columns rarely have a bending moment about minor axis, and when it exists, it is mainly due to geometry of the connection. Anyway, eccentricity about minor axis remains small. Therefore investigations may be limited to a zone situated near the N-axis for N-M interaction about weak axis: Of course this conclusion cannot be valid for columns having an important transversal rigidity, as for instance octagonal sections.

After discussion of this topic with the members of the Advisory Committee, the field of eccentricities to be covered has been limited to e/B = 1.0 for bending about minor axis, where e is the eccentricity and B is the width of the section (fig. 6.7).

For bending about major axis, the whole field of eccentricities has been covered.

6.6. Buckling lengths

The column buckling lengths considered in this project have been chosen between 2.00 meters and 8.00 meters by steps of 2.00 meters. Therefore, pin-ended columns of 2.00, 4.00, 6.00 and 8.00 meters have been calculated, whereas a simple linear interpolation method is sufficient for any intermediate length.

6.7. *Initial imperfection introduced in CEFICOSS*

An initial column imperfection has to be defined for CEFICOSS analysis, and has an influence for low bending moments.

As there is of course no reference in Standards to define this initial imperfection in fire, a calibration of the programme has been done at ambient temperature by comparison of its results with those furnished by a theoretical method allowing to establish N-M interaction diagrams.

The German DIN 18806 [24] has been used to draw N-M interaction curves at ambient temperature for different sections. Results have been then compared with the N-M curves provided by CEFICOSS. Of course calculations have been done in both cases with a same concrete cylindrical compressive strength (see [12]).

The correspondance between CEFICOSS interaction curve and DIN curve has been found acceptable, and the best correspondance is obtained when CEFICOSS runs with an imperfection constant on the height of the column as shown in figure 7.1 and equal to:

	e_o = constant = L/500 for bending about minor axis
and	**e_o = constant = L/1000 for bending about major axis**

These constant initial imperfections have been systematically introduced in the simulations performed with CEFICOSS in addition on the first order indicated eccentricities.

6.8. *Failure criterion*

The fire resistance time of a structure can be based on different criteria, usually depending on the type of structure. For a column, failure corresponds practically to BUCKLING. In the programme CEFICOSS, the mathematical simulation of this physical behaviour is given by the Determinant of the Structure Stiffness Matrix, which being positive becomes negative (DSSM = 0); from a practical point of view, it is sufficient to analyse the Minimum Proper Value (MPV) of the matrix, which also goes to zero.

The behaviour of the column can also be observed through horizontal displacement and displacement speed of the mid-height node, which rapidly increase when buckling occurs.

For columns many examples proved that a deflection criterion (D = L/10 for instance) has only a significant influence for very high bending moments, what means for very low axial loads N. In a practical point of view that zone of the interaction diagram is not really interesting as corresponding to a situation which never occurs in a building.

Therefore it was decided, with the agreement of the members of the ADVISORY COMMITTEE, to consider the equilibrium failure as single criterion for columns.

7. *DESIGN OF COLUMNS*

Until it is not otherless specified, notations used for columns correspond to figure 7.1.

7.1. *Calculation process*

For any column cross section the calculation of temperatures in different patches of the discretized section is subordinated neither to steel or concrete mechanical qualities, nor to the column length or to the loading. Therefore the thermal analysis can be done first and the resulting time dependent temperatures can be used as data for every static calculation of any column having a same cross section.

The statical calculation process is described in figure 7.2; the first step is to find by iterations the ultimate axial load at ambient temperature (point A on vertical axis corresponding to a time t=0'). Then CEFICOSS is run by reducing progressively the load for a series of eccentricities. For instance a load corresponding to the point B applied with an eccentricity of 1 cm gives a fire resistance time $t_{B,15}$, and defines the point C in figure 7.2.

All the curves established with various eccentricities permit to read by interpolation the axial loads N for any required fire resistance time (90 minutes for instance as shown on figure 7.2), and to create a file including pairs of values N-e for the four usual fire resistance classes.

In reality whole curves are not necessary; it is sufficient to find points near the classified fire resistance times to allow a quite accurate interpolation. An average of not less than 3 simulations are needed, however, for each requested point.

7.2. *Pure bending moment*

The pure bending moment corresponds to a limit situation when there is no more axial load (N=0) but just a constant bending moment acting on the whole column. Such a situation is obviously fictitious and never occurs in practice, and it has been decided to avoid to calculate it systematically.

However, the pure bending moment for any fire resistance classes has to be independent on column buckling lengths. This postulate has been used to check with some calculations the validity of the results given by CEFICOSS.

7.3. *Presentation of results*

There are many possible presentations of the results in a form N-M, where M = N.e (first order bending moment), or simply with both independent variables N-e. This second form has been selected as being easier to be covered by simple mathematical functions, what facilitates any simplification or interpolation.

7.4. *Building of load-eccentricity interaction curves*

Following calculations had finally to be performed for any composite column section:

- 4 basis material combinations: steels Fe360 and Fe510 combined with concretes C20 and C50.
- 4 buckling lengths: 2.00, 4.00, 6.00 and 8.00 meters.
- 4 fire resistance classes: F30, F60, F90 and F120.
- 2 buckling planes.
- an average of about 5 eccentricities in order to build interaction curves with quite good interpolation conditions.

The total amount of points needed for any section reaches then 640, and considering that an average of three iterations are needed for each point, the computer time had been enormous.

The detail above shows clearly the necessity to find some simplifications. Of course the value of Nc (for e = 0) corresponding to the column centrically loaded is very important, and a first step was to compare mathematically the drop of the bearing capacity when eccentricity increases, in fire and at ambient temperature.

Figure 7.3 shows the curves N/Nc of three columns calculated by CEFICOSS at ambient temperature (F0) and for the four fire resistance classes F30, F60, F90 and F120. That figure 7.3 demonstrates clearly that the curves F30 to F120 don't respect systematically a hierarchy, and moreover they are located in either side of curve F0, without any visible relation to the slenderness.

This observation indicates that it will not be possible to limit calculations to the pure axial load Nc (for e = 0), and to cover interaction by a simplified method based on the mathematical form of interaction at ambient temperature. It will be necessary to calculate at least a second point of the curve, as shown in figure 7.4.

Even if interaction in normal service conditions may not be used as it is, it can be observed in figure 7.3 that the general form of curves in fire remains similar to that at ambient temperature. That means that a quite similar mathematical formula could be used for any fire resistance class as for normal cold service conditions.

The mathematical forms usually accepted to define interaction are summarized in figure 7.5. They lead to the very simple formula (5):

$$\boxed{\frac{N}{Nc} = \frac{1}{1 + K \cdot e}} \qquad (5)$$

in which there is only one parameter K that could be easy determined from the second calculated point of figure 7.4:

$$K = \left(\frac{Nc}{Nr} - 1\right) \cdot \frac{1}{e_r}$$

This approach has been tested on various columns for which curves N-e have been built up by calculating for every fire resistance classes the axial loads N corresponding to several eccentricities: 0, 1, 5, 15, 30, 60 and 180 cm. Two examples are given in part III, Appendix B pages B.1 to B.6, showing application of that formula for a short and for a quite slender AF composite column. Differences up to 20% can be expected by using a reference eccentricity reaching about the height of the steel profile, and moreover, unfortunately, these differences may be as well positive as negative. Therefore it is necessary to calculate one additional point of the curve, or to apply corrections on (5), what is more convenient regarding the computation time.

Finally, after many investigations based on a lot of calculated columns in the domain concerned with this research programme, the best approximation has been obtained by modifying (5) to lead to formula (6) hereafter:

$$\left(\frac{N'}{Nc}\right)_F = \frac{1}{\left[1 + K_F\left(\frac{U/A}{H}\right)\left(e + e_o\right)\right]^{1/g}} \qquad (6)$$

where $\left(\frac{N'}{Nc}\right)_F$ = approached ratio for the fire class F

N, Nc, e, e_o, H (or B) are defined in figure 7.1.

U/A is a "massivity factor", simply calculated as follows on the whole composite section, as shown for instance in figure 7.6 for AF-type:

$$U/A = \frac{\text{total external perimeter}}{\text{full cross section area (steel+concrete)}} \quad [m^{-1}]$$

The height of the cross section H in [m] has to be replaced in (6) by the width B for bending about minor axis.

The correction factor g depends on the buckling length L and on the buckling direction; it is calculated as follows if L is introduced in meters:

- bending about major axis : g = 0.063(L-2.00)+1.01
- bending about minor axis : g = 0.67+0.433 ln L

The calculation process is the following one for any fire resistance class and any column:

- the pure axial load Nc is determined exactly with CEFICOSS together with one other point of the curve, corresponding to an eccentricity conventionally selected:

  e_r = 60 cm for bending about major axis

  or e_r = 15 cm for bending about minor axis

- this second point allows to calculate K_F by introduction of Nc,N=Nr and $e=e_r$ in (6), and finally the whole approached curve N - e can be built up.

However the approached values of N are a little overestimated for eccentricities higher than reference e_r, and results have to be adjusted by multiplying them with a reduction factor. As indicated in figure 7.7, a correction (1 - n/100) is applied on the highest proposed eccentricity e_m, and that correction is linearly adapted between e_r and e_m. Of course those values of n proposed in table of figure 7.7 have been calibrated on several curves completely carried out with CEFICOSS.

The highest proposed eccentricity e_m has been fixed to 180 cm for bending about major axis, and will be equal to the section width B according to § 6.5 for bending about minor axis.

Validity of this simplified method has been checked on a lot of columns, for which whole interaction curves have been established with CEFICOSS by computation of many points, and then compared with the approached ones. Appendix B of Part III includes on pages B.7 up to B.12 some examples of these controls, showing that the approached method is generally a little in the safe side. Approached load ratios N/Nc higher than calculated exactly by CEFICOSS have been rarely found and, anyway, in this case, the observed differences were very small.

The method proposed above has been used systematically to build up the tables enclosed hereafter. It has to be clearly pointed out, however, that the interaction formula (6) was just used to save computer time. It has been established by a mathematical observation on calculated examples, but it has statically no theoretical background, and it is not proposed here as a general interaction formula in fire.

7.5. ***Tables of results***

A presentation of results in form of tables rather than diagrams has been finally adopted in a practical purpose. As a matter of fact many interpolations will be necessary, and tables can easily be stored on floppy disks for an application on personal computer, allowing to perform quickly the various interpolations.

In **chapter A Part II** tables are given for several composite column sections of the four different types considered in this research. All the informations regarding one cross section in one bending axis are concentrated in two pages. The given eccentricities have been selected in order to allow linear interpolation between two points with a sufficient accuracy (see also figure 7.8)

7.6. *Interpolation on buckling lengths*

The simple linear interpolation method is proposed here to evaluate the ultimate load for any fire resistance class, when the buckling length is not directly given in tables.

The validity of this simple method has been checked with many examples, but can also be accepted on grounds of the form of curves showing evolution of the ultimate load as a function of the buckling length, for any fire resistance class. That can be illustrated by figure 7.8 where four curves F120 corresponding to four buckling lengths of an AF-section have been plotted on the first diagram in a form N-e, whereas the second diagram shows the decrease of the ultimate load N as a function of the buckling length for two eccentricities e=0 and e=60 cm. The curves of the second graph are nearly linear, and an interpolation will be made here with a high accuracy.

Situation is, however, not always so favourable. Next figures 7.9 and 7.10 show similar diagrams in a form N-L for other columns. Figure 7.9 concerns bending about major axis, with and without eccentricity, while figure 7.10 has been established for bending about minor axis. Manytimes, especially for buckling in the weak direction, curves show such a concavity which leads to a slight unsafety of the linear interpolation. However, as the form of curves N-L will be given by four points in tables, it will be open for any user to estimate himself a correction. In reality such a correction is not necessary, because the transformation of any actual bending moment distribution into an equivalent uniform distribution, as it will be explained later, will generally be quite conservative.

7.7. *Transformation method for non uniform bending moment distribution*

As noted in § 6.4 calculations have been performed with an uniform bending moment (ψ = 1.00 according to figure 6.4.) and a method defining how to use these results for another distribution is proposed here.

Possibility to use methods proposed usually at ambient temperature have been investigated first but these methods are not very safe. For instance, the method proposed in Eurocode 2 [25] for reinforced concrete columns at ambient temperature has been applied in figure 7.11 on the calculated column already presented in figure 6.6. The eccentricity of A (60 cm) is transformed in an equivalent eccentricity of point B (24 cm) which allows, by reading in tables for uniform distribution, a load N_C higher than N_A, and consequently unsafe. Observe that that method of Eurocode 2 leads early to unsafety, from e = 8.5 cm in this example. That indicates that a simply linear relation is not satisfying to find a transformation method valid for any eccentricity.

Another method is proposed in Eurocode 3 [26] for pure steel columns at ambient temperature: an interaction formula similar to that of figure 7.5 is used, and a coefficient β is applied on the bending moment. β depends only on the form of the moment distribution. The example of figure 7.11 shows that this method leads also to unsafety, from an eccentricity of about 16 cm. That confirms one more time that a corrective factor as β depends not only on the form of the moment diagram, but also on the loading level.

Analysis of a few columns subjected to different bending moment distributions brought us to establish a new transformation method explained hereafter. The way used to come to this method is explained with some details in Part III, Appendix C.

The new proposed method assumes similarly as done in Eurocode 3 [26] that a correction factor β is applied on bending moments in the interaction formula, what leads to modify (5) in (7):

$$\boxed{\frac{N}{N_c} = \frac{1}{1 + \beta \, . \, K \, . \, e}} \qquad (7)$$

This correction factor β depends on the form of the bending moment diagram through ψ, but depends also on the slenderness ratio of the column $\bar{\lambda}$ and on the relative eccentricity e/H or e/B. The bi-triangular moment distribution being the most favourable one, a lowest value of β will be found in this case and is given by formula (8) corresponding to $\psi = -1.00$:

$$\boxed{\beta_{bitr} = \mathrm{EXP}^{-\left(0.35 + 0.3 \frac{e}{H}\right) \bar{\lambda} \frac{H}{e}}} \qquad (8)$$

(B in place of H for weak axis)

In this formula the name EXP = 2.7183 is used to avoid confusion with character "e" used for "eccentricity". The slenderness ratio $\bar{\lambda}$ has to be calculated at ambient temperature as defined in Eurocode 4 [22] and reproduced in Appendix C Part III in page C1.

The uniform moment distribution, the most unfavourable distribution type, is covered by tables, which correspond to $\beta = 1.00$ for $\psi = +1.00$. The situation is described in figure 7.12 showing that any other form of distribution can be interpolated according to his own value of ψ between the curve β_{bitr} and the horizontal line $\beta = 1.00$.

Figure 7.12 shows also that the influence of the distribution decreases progressively when eccentricity increases, and in a practical purpose the transformation method can be limited to a relative eccentricity e/H = 4.00 for bending about major axis; as concerns bending about minor axis investigations are anyway limited to e/B = 1.00.

Finally the transformation will be performed as follows:

- if /Mmax/ and /Mmin/ are the highest and the lowest absolute values of the first order end moments, calculate using the signs + or -:

$$\psi = \frac{M_{min}}{M_{max}} \quad (- 1.00 \leq \psi \leq 1.00)$$

- calculate the slenderness ratio $\bar{\lambda}$ at ambient temperature according to Eurocode 4 [22] (see page C.1 of Appendix C, Part III)

- calculate β_{bitr} corresponding to the bi-triangular distribution (ψ = - 1.00) according to formula (8) for the highest eccentricity defined by $e_{max} = /M_{max}//N$

- β will be given by linear interpolation between β_{bitr} and 1.00 based on ψ as indicated in figure 7.12

  The equivalent constant eccentricity will be given by

$$e_e = \beta \cdot e_{max}$$

and will be used to read in tables of Part II the maximum allowed load N which has to be compared with actual load applied on the column.

It is interesting to point out that the method proposed above <u>could be used also in normal service conditions</u> for the adimensional form of an interaction curve is quite similar in fire and at ambient temperature.

The $\beta - \psi$ method proposed above is generally quite conservative, and does'nt allow to recuperate fully the advantage offered by a non uniform bending moment distribution; this is shown in Appendix C of Part III as well as by application examples given further. However it is easy to use and remains in the safe side.

7.8. *Example for use of tables*

The axial loads given in tables will practically never be used directly. As a matter of fact following approximations and interpolations have to be done to check a column:

a) the first step will be to calculate an equivalent eccentricity as indicated in chapter 7.7 which for sure will never be directly readable in tables, and will need interpolation.

b) the column length leads to an interpolation between the given values 2,4,6 or 8 meters.

c) an interpolation will generally be needed for any quality of concrete between C20 and C50.

d) moreover, for steel Fe430, an interpolation will be necessary between Fe360 and Fe510.

As already noticed the various interpolations are quite accurate, whereas the transformation of a non uniform bending moment distribution remains in the safe side.

Figure 7.13 gives a practical example of column submitted to bending about major axis. This example has been chosen to obtain as near as possible the fire resistance class F90 by doing a simulation with CEFICOSS according to the actual situation of the column. In fact the simulation gives a failure after 91.5 minutes of ISO-fire, and the load of 1200 kN corresponds nearly to the fire resistance class F90. Transformation in equivalent constant eccentricity and different interpolations leads to find in tables of PART III an ultimate allowable load of 937.8 kN. That result seems to be much conservative, but a direct interpolation without transformation on moment distribution would give only 848.81 kN for a constant first order eccentricity of 25 cm.

A second example of column is presented in figure 7.14, for a fire resistance class F60 and buckling about minor axis. The calculation with CEFICOSS gives a fire resistance time of about 60 minutes for the vertical load N = 880 kN applied with end moments as noted. By reading in tables, N = 679 kN is obtained after interpolations with transformation in an equivalent uniform eccentricity, whereas only N = 507 kN is found when assuming a constant eccentricity e = 15.00 cm.

It is interesting to point out that both methods of Eurocode 2 [25] (presented in figure 7.11) and of Eurocode 3 [26] lead in these examples to the same result, after interpolations:

Example 1: e_e = 10 cm	N_{90} = 1510 kN > 1200 kN
Example 2: e_e = 6 cm	N_{60} = 794 kN < 880 kN

Both methods are already unsafe in the first example for the quite small given eccentricities.

7.9. Advices

First of all **USERS HAVE TO MAKE A CORRECT DESIGN OF THE COLUMN FOR NORMAL COLD SERVICE CONDITIONS** in conformity with Eurocode 4 [22] or with a National Code. LOADS given hereafter in tables may be SOMETIMES HIGHER THAN THE ALLOWABLE SERVICE LOAD at ambient temperature, and MAY NOT BE USED TO MAKE DIRECTLY A FINAL DESIGN of the column. This fact occurs many times for low fire resistance classes and means only that a column correctly designed for normal service reaches automatically this fire resistance without any load reduction.

Composite columns have particularly to comply with usual construction details regarding re-bars, stirrups and shear stud connectors for normal service at ambient temperature. Number and spacing of stirrups shall correspond to requirements of Standards for reinforced concrete (Eurocode 2 [25]) or for composite construction elements (Eurocode 4 [22]). Special care is due for column ends where the loads have to be introduced and distributed on both materials concrete and steel.

Moreover fire resistance requests a minimum connection of concrete to the steel shape, even if not necessary in cold service, to avoid a separation of materials in fire. This is especially the case for AF-sections where it is recommended to have at least one connector (stud, welded stirrup or stirrup passing through the web) every 500 mm, located alternately on two rows if the opening between flanges is larger than 400 mm.

Designers can find more informations in Part 10 "Structural Fire Design" of the Eurocodes which are now in preparation ([27] for instance), or in a Technical Note of E.C.C.S. [20].

Shear effect is not directly taken into account by CEFICOSS, but it is generally not critical till a steel web remains quite cool inside of concrete. However, that is not the case when AF-sections are bent about minor axis; special attention is due in that situation to undertake shear forces which have to be supported only by reinforced concrete in fire, steel flanges being overheated.

Another remark concerns calculation of columns as elements of a quite complex complete structure submitted to a local fire. All the simulations in this situation show that bending moments and sometimes vertical loads don't remain constant during the fire development. Therefore results presented in this report have to be used with enough prudence in some complicated situations not directly covered by this research.

Finally users have to remember that calculations have been performed in one loading and buckling plane, and consequently both strong and weak buckling directions have to be checked.

Note:

For quite low loading levels (uneconomical and never used in practical situations) the influence of thermal stresses is predominant compared to quite low stresses produced by the external load.

Therefore apparent anomalies appear sometimes in results, mainly for slender columns bent about minor axis and for the highest fire resistance classes. For instance ultimate load F120 for an AF-HEA 300 may be a little higher than the load found in the same conditions for an AF-HEA 320, due to the predominant influence of thermal stresses.

8. PARAMETERS FOR BEAMS

Until not other specified in text, notations are used according to figure 8.1.

8.1. Types of sections

The section types defined in figure 8.2 have been considered in this research programme:

E: Traditional composite beam, where moreover chambers of steel shape have been filled with reinforced concrete. The full interaction between steel flange and concrete slab is assumed.

F: This section is geometrically identical to section E above, but there is no mechanical interaction between steel flange and concrete slab. The presence of a concrete slab is, however, very important insuring in cross section the same temperature distribution as for section E above.

G: Fully encased shapes used up to a slab thickness of about 35 cm. In this case steel is well protected and therefore the behaviour in fire is good. Architects have an interest for this section in office buildings because the freedom given in ceiling for technical equipments.

8.2. Selection of steel shapes

Shapes HEA (and HEAA) are well adapted for AF sections because the 300 mm width allowing enough space for reinforced concrete. IPE series is most commonly used for decks, but an application as AF-section needs a minimum width of about 200 mm for practical purpose regarding the reinforcement as well as for a sufficient concrete covering limiting the temperature increase in reinforcing bars.

Priority has been given to the wide flange HD-shapes for fully encased section type. Of course depth of section has to be restricted here to about 300 mm in order to keep at least 5 cm concrete over steel flange.

8.3. Reinforcement: area and layout

Neither reinforcement of concrete slab or top reinforcement in chambers of I-beam have been taken into account during the calculations in fire.

The bottom reinforcement inside of the steel section plays of course an important role on the ultimate bending moment. A higher reinforcement area leads to a higher fire resistance time, and consequently to a higher ultimate moment for a given fire resistance class. Figure 8.3 is a typical example showing the variation of fire resistance time related to reinforcement area in the steel shape, when the beam is subjected to the maximum allowable service load at ambient temperature usually calculated without consideration for reinforced concrete located inside of steel shape. Several calculated examples furnish a curve having a look identical to that of figure 8.3, and it has been decided to compute ultimate bending moments in fire for sections having a re-bar cross area equal to about 20% of the steel flange area. This choice allows in many cases to reach the fire resistance class F90 without any load reduction, and seems to be the most reasonable one. A simple method will be proposed to extent the results to other reinforcement areas. The reinforcing bars will be located 60 mm inside of surface of concrete in both directions.

8.4. Statical system and loading

This research deals with statically determinate simply supported composite beams submitted to a uniformly distributed load q which produces a bending moment $M = q \cdot L^2/8$ at mid span, as noted in figure 8.1.

8.5. *Range of spans to be considered*

Spans of composite beams usually vary between 15h and 30h, where h is the height of the steel shape as defined in Figure 8.1. This range has been investigated here.

8.6. *Thickness of the concrete slab (for AF - sections)*

Usual slab thicknesses are found between 12 and at the most 24 cm. Tables have been carried out for 12, 16, 20 and sometimes 24 cm (for quite high steel shapes only) whereas interpolation is possible for intermediate thicknesses.

8.7. *Effective width of the concrete slab*

The effective breadth of the concrete flange in fire conditions **may be at least equal to that used for the calculation at ambient temperature, up to one third of the span (L/3)** as commonly accepted in many countries. Tests made for the calibration of CEFICOSS [1] demonstrated that this computer model simulates very well the behaviour of beams with a concrete deck width corresponding to about L/3 when the whole breadth of the slab is assumed to collaborate.

Of course the concrete slab has to be sufficiently reinforced in transverse direction to resist to longitudinal shear and transverse forces; this condition is generally fulfilled if a correct design in normal service conditions has been made, for reinforcing bars remain quite cold in fire conditions.

For spans varying from 15h up to 30h as noted in § 8.5, usual effective widths of the concrete slab are going from five times up to ten times the height of the steel shape. Practically, for any AF-section, all possible usual slab widths can be covered by furnishing ultimate bending moments corresponding to 0h, 5h, 7.5h and 10h, and an interpolation method for intermediate breadths.

Considerations for realistic sizes, however, have to be taken into account, as for instance it is not necessary to combine a thin concrete slab with a very large effective width, and, moreover spans are generally limited to 7 or 8 meters for concrete slabs.

8.8. ***Failure criteria***

Many criteria are known to define performance requirements of beams submitted to fire. The main criterion is obviously the EQUILIBRIUM FAILURE due, in case of simply supported beams, to formation of a PLASTIC HINGE. In CEFICOSS the mathematical simulation of this behaviour is given by DSSM = 0 (or MPV = 0) as already explained in § 6.8 for buckling of columns.

For testing, deflection limits are normally specified to protect the testing devices, as for instance D=L/30 or D = L/20. Moreover there is criteria limiting the deflection speed to an arbitrary value depending on the span of the tested beam and on the statical height of the structural section, for instance the Ryan and Robertson criterion [29].

As the complete behaviour of a structure is known in a CEFICOSS simulation from the beginning up to the end (DSSM=0 or MPV=0=), the fire exposure time after which a deflection or a deflection speed criterion is reached can easily be noted.

Fire resistance times calculated according to various criteria have been analysed and compared for many composite beams.It has been finally decided to remain with the MATHEMATICAL EQUILIBRIUM FAILURE, equivalent to the formation of a PLASTIC HINGE at mid-span of the beam. This criterion leads to compute an ultimate bending moment corresponding to each fire resistance class.

As noted in [27], however, deformation limits need sometimes to be considered, where deformations give way to premature collapse due to an important modification in the thermal or statical system. For that reason, it should be interesting to furnish to designers a possibility to evaluate the deflections by means of a simplified method.

Following conclusions for beams have been drawn from the simulations performed with CEFICOSS:

- the conventional deflection criterion **D = L/30** proposed in [**21**] for protected steel beams and used in some countries **SHOULD NOT BE CONSIDERED** for composite beams, for it leads to small resistance times compared to the real behaviour.

- **a more realistic deflection criterion could be D = L/10, leading to resistance times which are not so far away from the equilibrium failure by plastic hinge for a still quite reasonable deflection.**

- the **RYAN-ROBERTSON CRITERION SHOULD ALSO BE ABANDONED** for composite beams, for it gives too arbitrary failure times.

Finally a simplified method allowing to evaluate the deflection after 30, 60, 90 or 120 minutes is proposed in this report, in addition to the tables giving ultimate bending moments. When required by local conditions, designers have the means to estimate quite correctly the deflection of a beam at the requested fire resistance time.

9. DESIGN OF BEAMS

9.1. Calculation of an ultimate bending moment

Calculation process runs by iterations similarly as presented in § 7.1 for columns. For one defined cross section and for one basis material combination, the fire resistance time has to be calculated by varying the load q for any span L till it is possible to interpolate with enough accuracy and to find the load corresponding to any fire resistance class, as shown in figure 9.1.

It should be expected, however, to find for each fire resistance class a quite constant ultimate bending moment:

$$M_F = \frac{q \cdot L^2}{8} = \text{constant}$$

As a matter of fact one can observe that ultimate bending moments calculated in that way increase a little when the fire resistance time increases as shown by figure 9.2. But observed differences are strongly reduced and practically dissapear if the thermal variations of length are taken into consideration in the formula above. Therefore it is sufficient to compute ultimate bending moments for only one (short) span.

Moreover it has been observed that simulations with CEFICOSS lead practically to a same ultimate bending moment if, from one hand, calculations are done as above (a beam submitted to an uniform load q) and, from the other hand, the beam is loaded with a bending moment applied at both ends, as shown in figure 9.3. Observed deviations between both methods are not higher than 1%, and moments calculated with the second method of loading are most conservative.

9.2. ***General calculation process***

A big advantage can be taken of the loading with a bending moment, for the span has no importance in this case, what eliminates one parameter. Therefore it is possible to calculate beams made of only one finite element, by using the advantage of symetry, as shown in figure 9.3. That reduces strongly calculation times.

The calculation of such a small beam loaded with a constant bending moment is repeated for different moments, what allows to build the diagram (M-t) of figure 9.4. The moments corresponding to requested fire resistance times can be read by interpolation on that curve.

From a practical point of view tables and diagrams can be limited to a realistic field of moments. The maximum service load on a beam may never produce a bending moment exceeding Mplastic / 1.5. As the value M_0 calculated with CEFICOSS is systematically higher than Mplastic calculated according to Eurocode 4 [22] (see § 5.2.; for instance there is no reduction factor on material strengths in CEFICOSS), more than the range of use of a beam will be covered by starting calculations of figure 9.4 at a level M_1 such as $M_1 = M_0/1.5$. In the example presented in this figure, M_{30} will not be found, but it is sufficient to know that a normal cold design allows to reach automatically this fire resistance class.

9.3. ***Tables of ultimate bending moments***

Tables giving ultimate bending moments for the different fire resistance classes are enclosed in § **B of Part II.** As for columns, many interpolations will be necessary and the presentation in form of tables is most convenient.

It has to be pointed out that some compartments in tables may remain blank; that means that the corresponding fire resistance class (usually F30 or F60) is automatically obtained by a correct design in normal service conditions, as noticed before.

9.4. ***Shear failure table***

Shear effects are not directly considered in the program CEFICOSS, but could be important for short beams heavily loaded.

It is very difficult to provide a calculation method taking into account the presence of reinforced concrete between steel flanges. The method proposed here is defined in figure 9.5: as for a design at ambient temperature vertical shear shall be assumed to be resisted by the steel section alone. Instead of a constant σ_y on the whole steel web as in normal conditions, the yield strength of steel in fire has to be reduced in a mesh of the web according to the mean computed temperature of that mesh.

It has, however, to be pointed out that an excessive shear is not decisive in reality to select another section, because a local reinforcement is possible, for instance by welding steel plates on the web.

A shear failure table for the calculated sections is given at the end of Appendix B of Part II, after tables of ultimate bending moments.

9.5. *Deflections*

It is possible to save the rotations of the nodes calculated during the numerous simulations described previously in § 9.2. and to use them to calculate the deflection of a simply supported beam having the same cross section and same material qualities.

In the process used to compute ultimate bending moments, the curvature of a finite element is constant on the length of the beam, for the bending moment is constant, and is defined in figure 9.6.

During any simulation of figure 9.4 performed to find the ultimate bending moment, as M_2 for instance, rotations after 30 and 60 minutes can be read in the output file of CEFICOSS and saved. Another calculation as M_3 will furnish rotations for 30, 60 and 90 minutes, and finally moment-curvature diagrams for 30, 60, 90 and 120 minutes can be built up as shown in figure 9.7 between M_1 and M_{120}. A few additionnal simulations (held up at 120') for external moments smaller than M_{120} will allow to complete the moment-curvature diagram from 0 up to M_1.

For half a beam as presented in figure 9.8 , divided in n elements of length l_i submitted to a mean bending moment M_i, deflection at mid-span after a time of 30, 60, 90 or 120 minutes of ISO-fire is given by formula (9):

$$\boxed{\begin{aligned} D = {} & K_1 \cdot \frac{l_1^2}{2} - \left[\sum_1^n K_i \cdot l_i\right] \cdot l_1 \\ & + K_2 \cdot \frac{l_2^2}{2} - \left[\sum_2^n K_i \cdot l_i\right] \cdot l_2 \\ & + \cdots\cdots\cdots\cdots \\ & + K_n \cdot \frac{l_n^2}{2} - \left[K_n \cdot l_n \right] \cdot l_n \end{aligned}} \qquad [9]$$

where κ is negative (see figure 9.6) and has to be read on the corresponding curve of figure 9.7 in front of the moment M_i.

If all the elements have been chosen of a same length, then $l_1 = l_2 = l_i = ... = l_n = l$ and formula (9) is reduced to:

$$D = \frac{l^2}{2}\left(\sum_1^n K_i\right) - l^2\left[K_1 + 2K_2 + ... + n K_n\right]$$

Applications have shown that this method is as more accurate as many points have been calculated to built up the moment-curvature diagram, and as fine is the division of the beam. Of course, discrepancy with the normally calculated deflection will be found when the maximum bending moment at mid-span is not far away to produce an equilibrium failure. This case is, however, not usual and anyway results given by connecting two points with a straight line are in the safe side in comparison with the actual curve.

Many examples of such moment-curvature diagrams are given in Appendix C of Part II. To any ultimate bending moment given in Appendix B of Part II corresponds of course a whole curve of the moment-curvature diagram. It can be observed that the relation could be idealized as shown in figure 9.9, what would allow an easy storage on floppy disk as data for use in a personal computer.

9.6. Interpolation on the effective width

The tables given in Appendix B of Part II show that, similarly as it is in normal service conditions, ultimate bending moments increase slowly with the slab breadth, of 5% up to 20% when the effective width of the slab is multiplied by 2.

That observation makes sufficient a linear interpolation in the tables for any intermediate effective width of the concrete slab.

9.7. *Interpolation on the slab thickness*

Figure 9.10 represents the relation between ultimate bending moments and the slab thickness for several AF composite sections. Here too a linear interpolation is obviously sufficient.

9.8. *Variation of reinforcing bars area*

A possible extension of results to other reinforcement rates is given with the example of figure 9.11. An AF-beam made with a steel shape HEA 500 and a concrete slab of 367,5 cm x 12 cm has been calculated with CEFICOSS for three different reinforcing bar areas, to determine the ultimate bending moment for each fire resistance class F60, F90 and F120. On the same diagram have been also plotted (upper curve 1) plastic moments at ambient temperature, calculated with reduction factors of Eurocode 4 [22] and under consideration for the reinforcement. The lower curve 2 represents the plastic moments at ambient temperature calculated as 1 but without any consideration for the bottom flange of the steel shape in the calculations.

The five relations are not far away to be linear, and quite parallel in the explored reinforcement area. For any fire resistance classes, the ultimate bending moment for a reinforcement area of 6.27 or 22.69 cm^2 may be obtained with a quite good accuracy by multiplying the values given in tables for 12.54 cm^2 by a factor which is the ratio of plastic moments in normal service conditions, calculated as explained above. Moreover, if the bottom flange of the steel profile is not considered in the computation of plastic moments, the margin error is reduced to + or - 4%, whereas this error margin can reach + or - 10% when the whole steel shape is taken into account.

9.9. *Example for the use of tables*

A practical example showing how to use the tables is given in figure 9.12. As for columns some interpolations have to be done, on the following parameters:

- the quality of steel
- the quality of concrete
- the effective width of the concrete slab
- the thickness of the slab

The ultimate bending moment has to be compared with the actual maximum moment acting at mid-span of the beam.

It can be observed that the different interpolations lead for beam to a good accuracy.

9.10. Advices

First of all, exactly as for columns, **USERS HAVE TO MAKE A CORRECT DESIGN OF THE BEAM FOR NORMAL SERVICE CONDITIONS** in conformity with Eurocode 4 [**22**] or with a National Code. Moments given hereafter in tables may be sometimes higher than the allowable moment in service conditions for reasons already explained before.

Composite beams have to comply with usual construction details regarding the reinforcement of the slab and the connection between the concrete slab and the steel flange. Designers should be alert for that connection, for the program CEFICOSS calculates with assumption that there is NO SLIP between both materials. Tests show that a design of the shear connection and of the transverse reinforcement in the slab, correctly made for normal cold service, should be sufficient to reach the given ultimate bending moments in fire.

As for composite AF-columns, the same minimum connection is required for the reinforced concrete located inside of the steel shape. Designers can find informations in [**23**], [**27**] or [**28**].

Designers should also remember that this research has been performed on simply supported beams, and should use the results with care in case of continuous beams, or if horizontal displacements of supports are restrained by the structure.

10. CONCLUSIONS

For the first time practical design tools for composite steel concrete construction elements submitted to fire have been carried out in a very large scale, covering the N-M interaction for many section types.

In a next step, to improve the convenience of tables, it should perhaps be envisaged to put them on a floppy disk with a simple program allowing on a personal computer quick interpolations as well as performance of the transformation in equivalent eccentricity for columns and various extensions of results for beams.

Moreover the results of this research can be used as a basis to establish simplified method as well for columns loaded with eccentricity as for beams. We can for instance observe in figure 10.1 for a fire resistance class F120 that AF-sections bent about major axis seem to be quite well arranged in curves depending on the slenderness ratio on a fully adimensional diagram N/Nc - e/H.

This arrangement is no more observed when bending (and buckling) occurs about minor axis for the same class F120, but that is probably due to the great influence of thermal stresses in front of a low loading level.

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FINAL REPORT

FIGURES

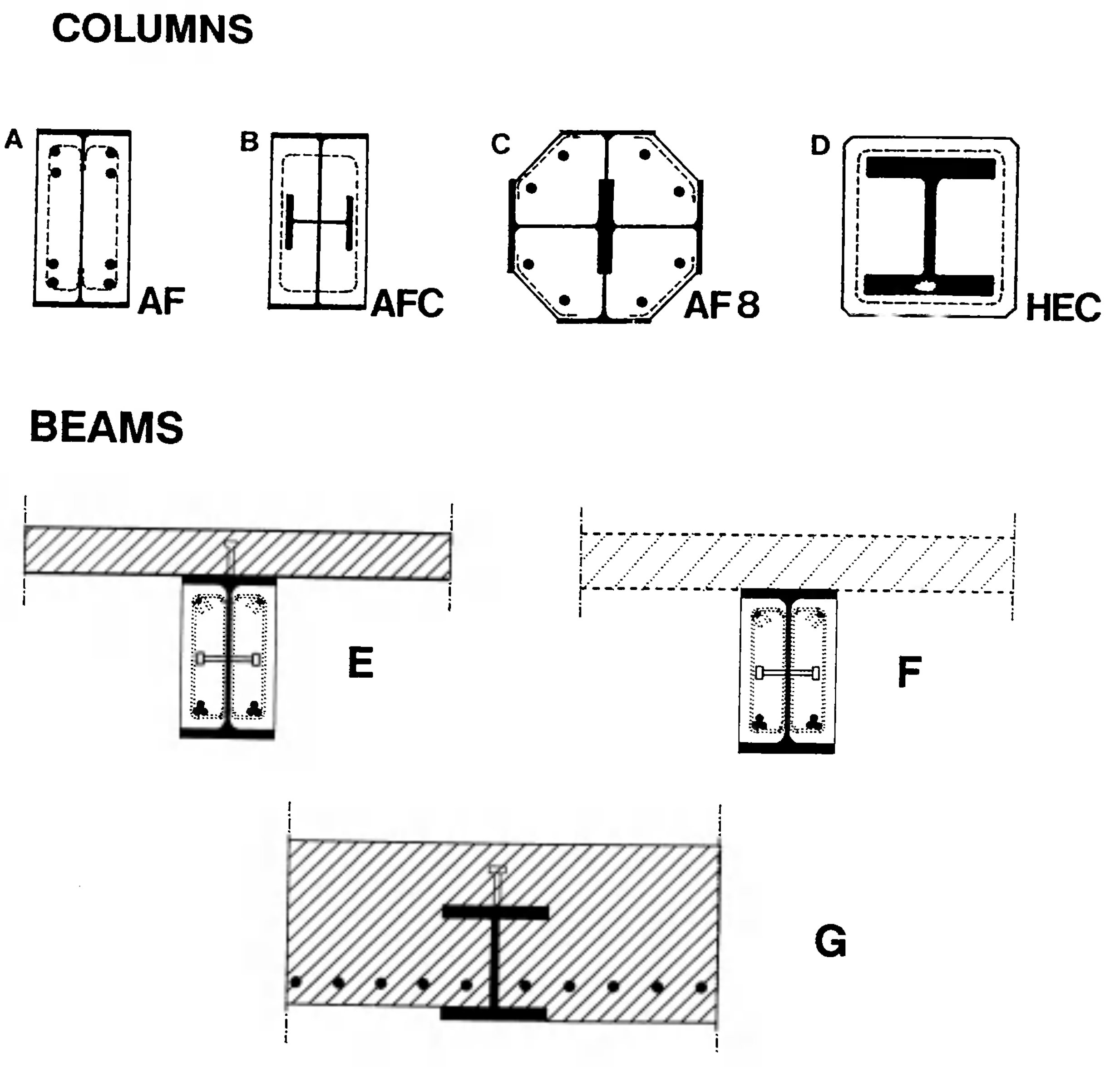
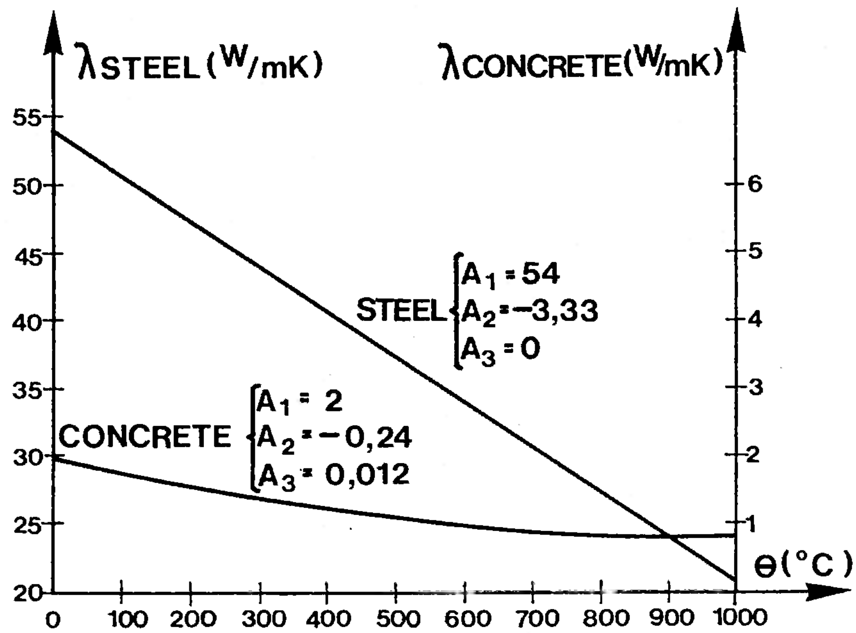


Figure 1.1

Composite cross section types considered in the establishment of PRACTICAL TOOLS FOR STRUCTURAL FIRE DESIGN

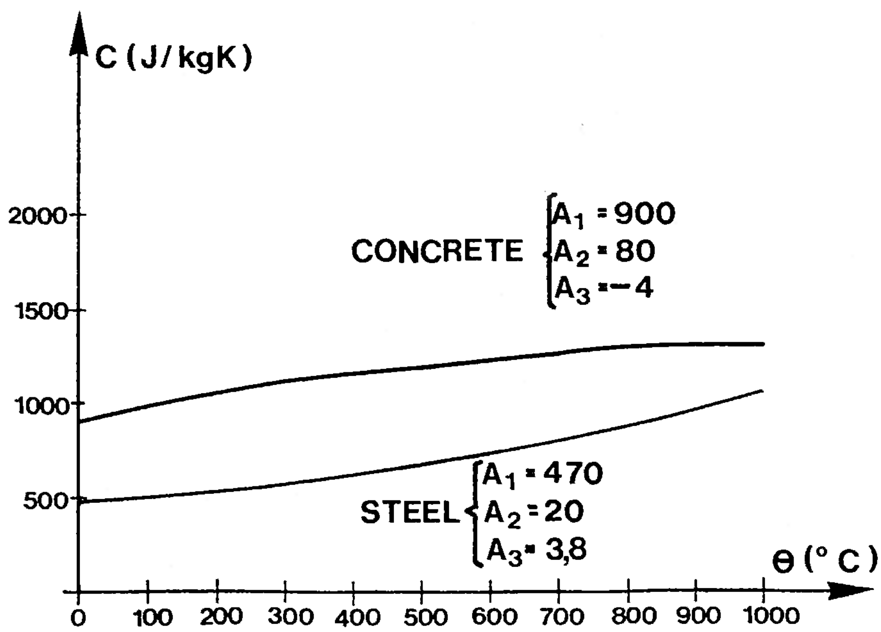
PARAMETRIC MATERIAL LAWS

$$\begin{Bmatrix}\lambda \\ C\end{Bmatrix} = A_1 + A_2\left(\frac{\theta}{100}\right) + A_3\left(\frac{\theta}{100}\right)^2$$



THERMAL CONDUCTIVITY

Figure 2.1



SPECIFIC HEAT

Figure 2.2

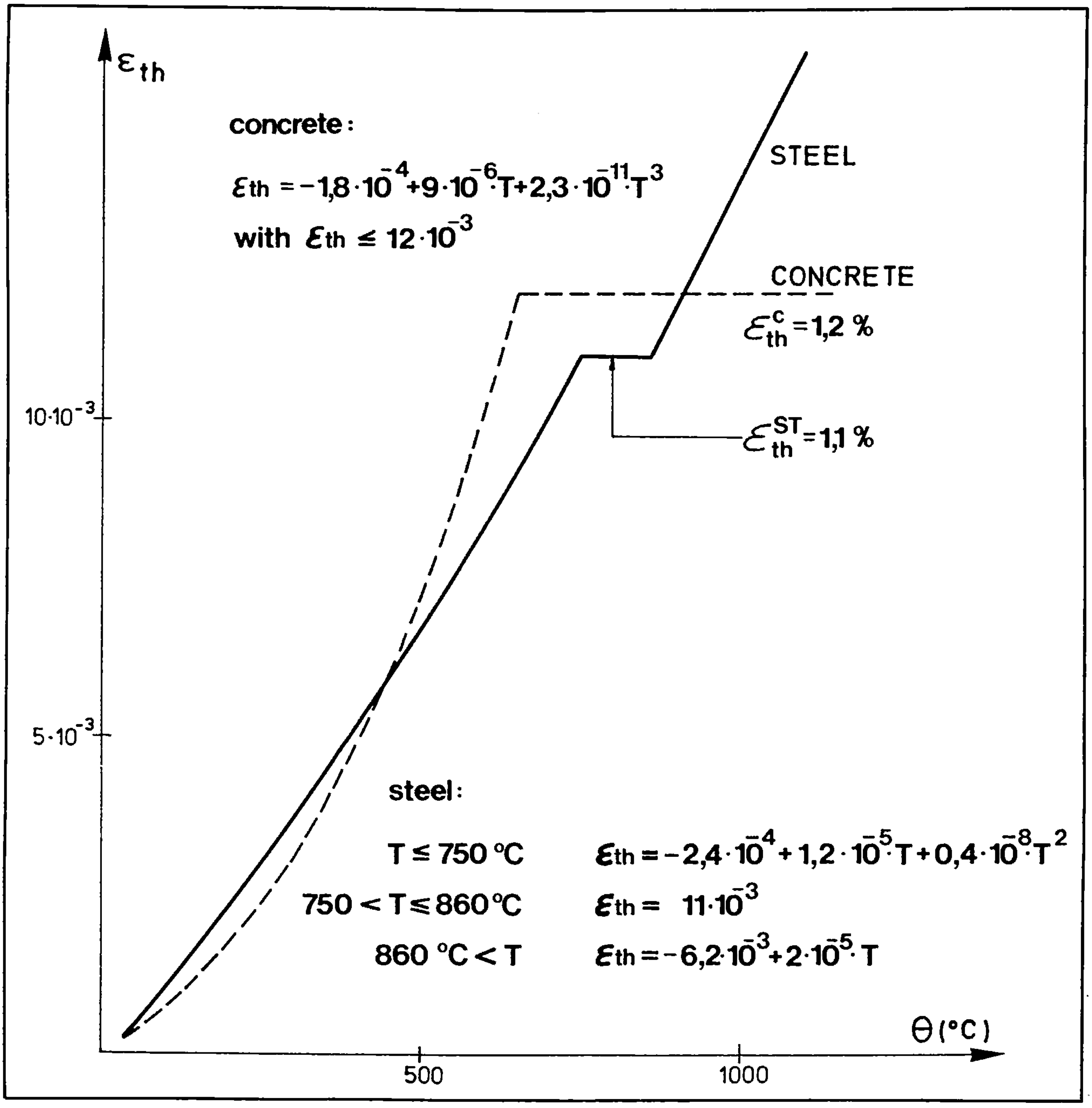


Fig. 2.3: Thermal expansion.

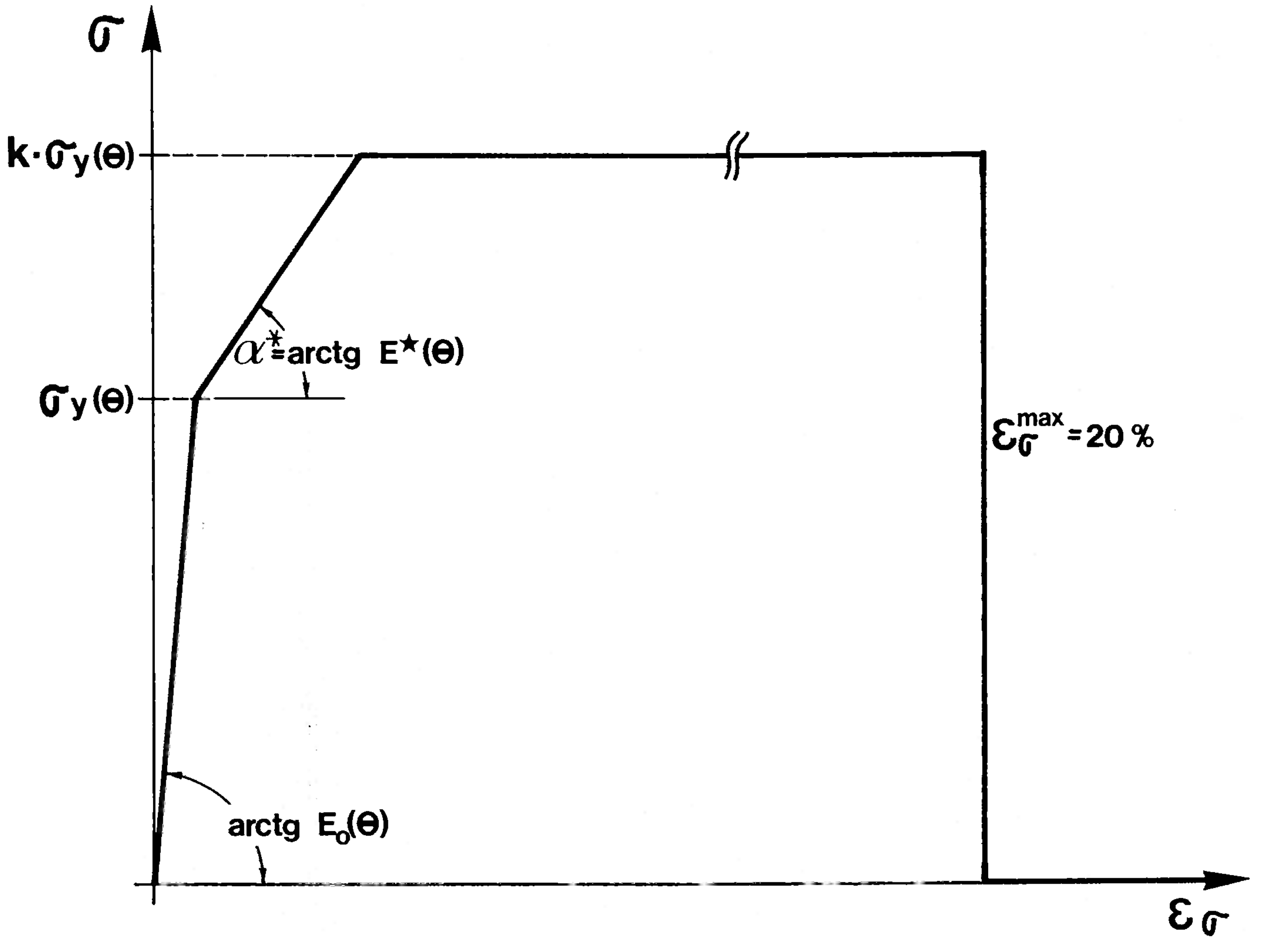


Fig.2.4 : General σ-ε_σ diagram for steel.
Factor k has been chosen equal to 1,5.

$$\Theta \leqslant 100° ; \quad \frac{\sigma_{y,\Theta}}{\sigma_{y,20°}} = 1$$

$$100° < \Theta \leqslant 500° ; \quad \frac{\sigma_{y,\Theta}}{\sigma_{y,20°}} = 2{,}95 \cdot 10^{-3} \left(\frac{\Theta}{100}\right)^3 - 4{,}88 \cdot 10^{-2} \left(\frac{\Theta}{100}\right)^2 + 8{,}87 \cdot 10^{-2} \frac{\Theta}{100} + 0{,}957$$

$$500° < \Theta \leqslant 1200° ; \quad \frac{\sigma_{y,\Theta}}{\sigma_{y,20°}} = -4{,}21 \cdot 10^{-4} \left(\frac{\Theta}{100}\right)^3 + 2{,}344 \cdot 10^{-2} \left(\frac{\Theta}{100}\right)^2 - 0{,}3806 \frac{\Theta}{100} + 1{,}919$$

$$\Theta > 1200\ °C ; \quad \frac{\sigma_{y,\Theta}}{\sigma_{y,20°}} = 0$$

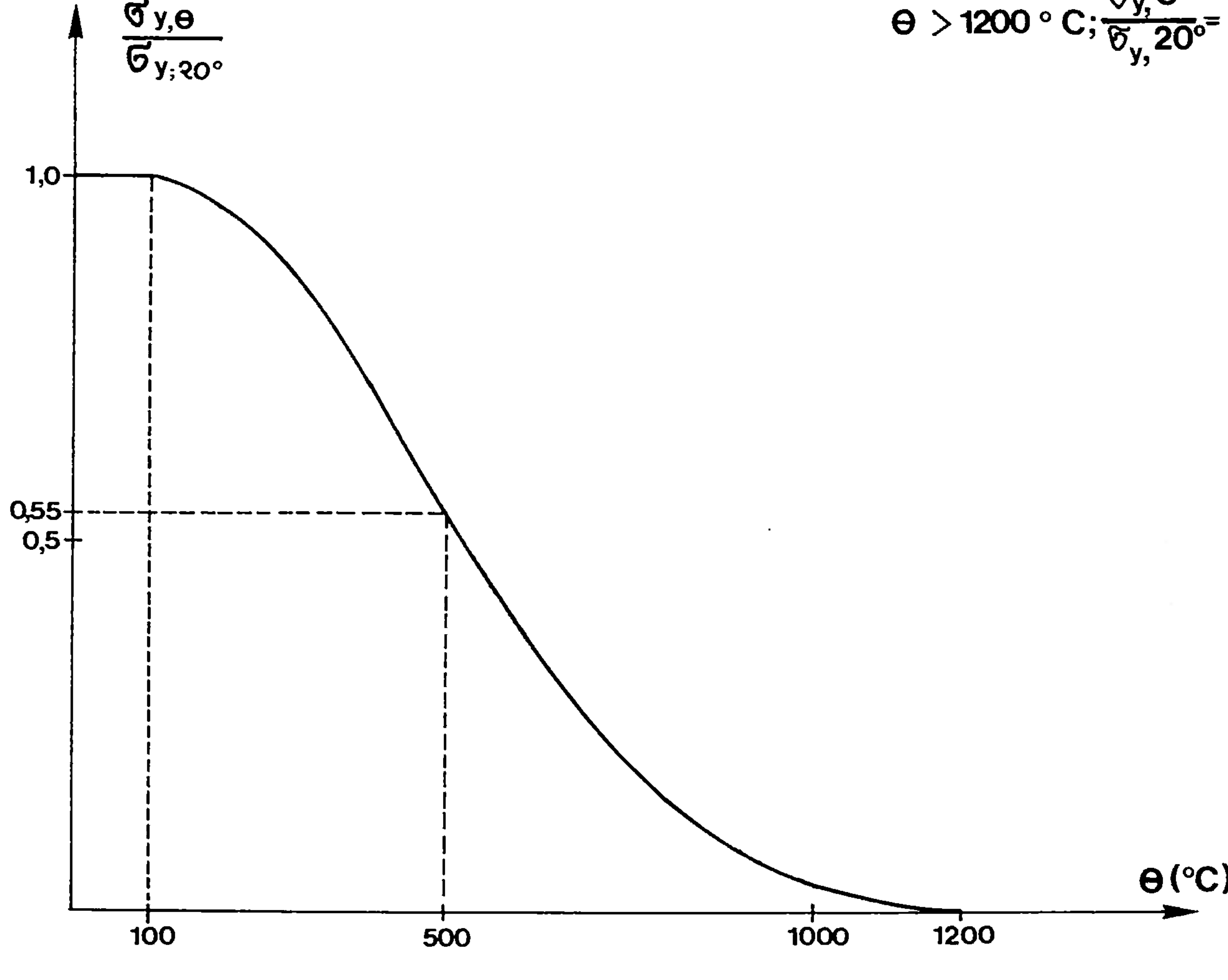


Fig. 2.5: Reduction of the yield point of steel σ_y in function of temperature Θ.

$$\theta \leqslant 100°; \quad \frac{E_{0,\theta}}{E_{0,20°}} = 1$$

$$100° < \theta < 600°; \quad \frac{E_{0,\theta}}{E_{0,20°}} = -0{,}018\left(\frac{\theta}{100}\right)^2 + 0{,}036\,\frac{\theta}{100} + 0{,}982$$

$$600° < \theta < 1200°; \quad \frac{E_{0,\theta}}{E_{0,20°}} = 9{,}25926 \cdot 10^{-5}\left(\frac{\theta}{100}\right)^3 + 0{,}0125\left(\frac{\theta}{100}\right)^2 - 0{,}34\,\frac{\theta}{100} + 2{,}12$$

$$1200° < \theta; \quad \frac{E_{0,\theta}}{E_{0,20°}} = 0$$

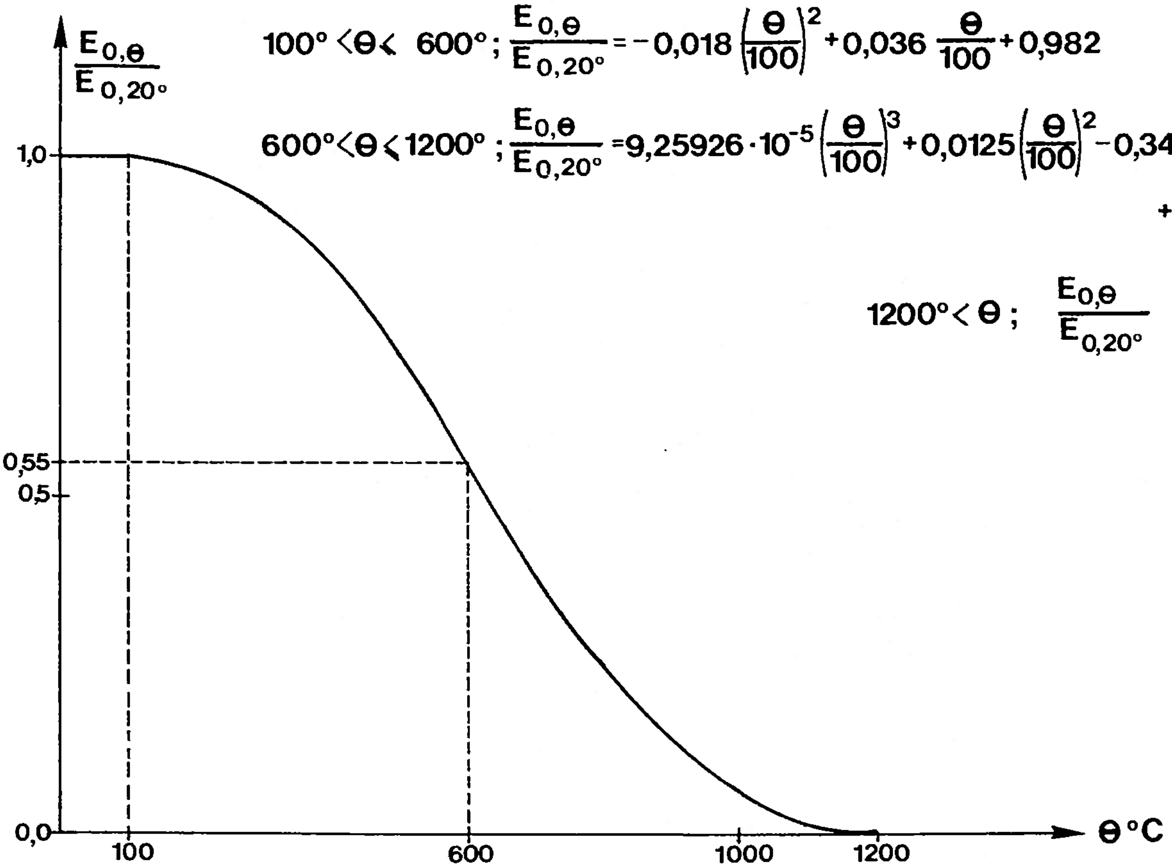


Fig. 2.6 : Reduction of the elastic modulus E_0 of steel in function of the temperature.

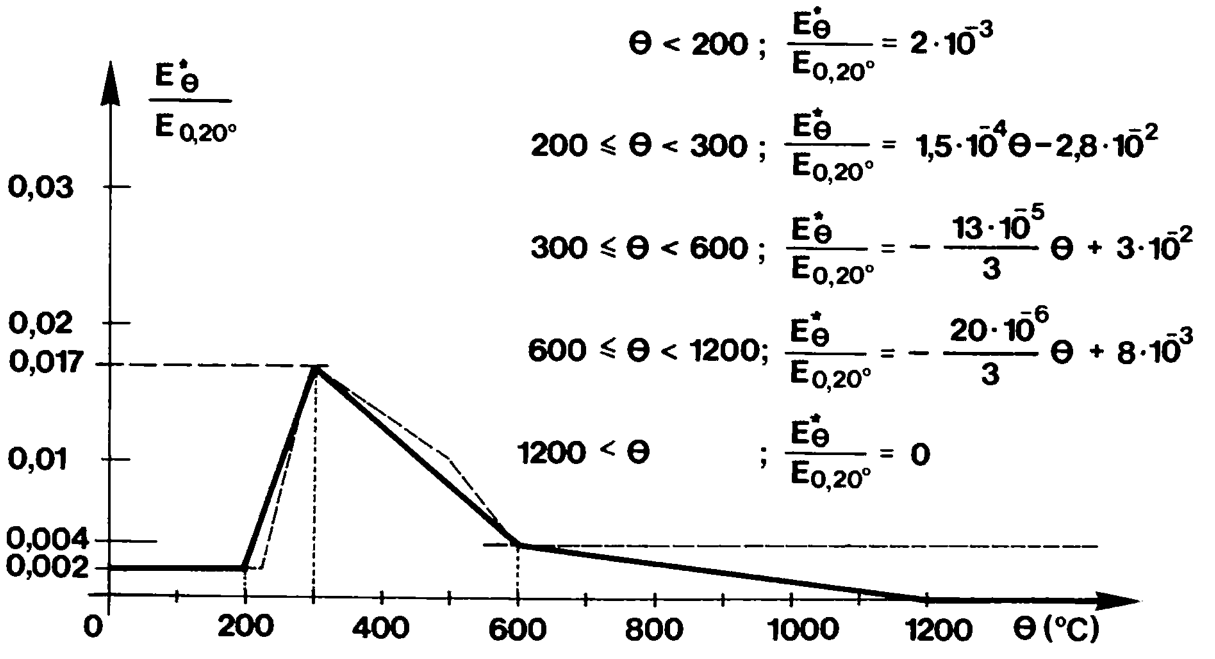


Fig. 2.7 : Variation of the elastic modulus E^* of steel in function of the temperature.

--------- "according to Anderberg"

———— included in CEFICOSS

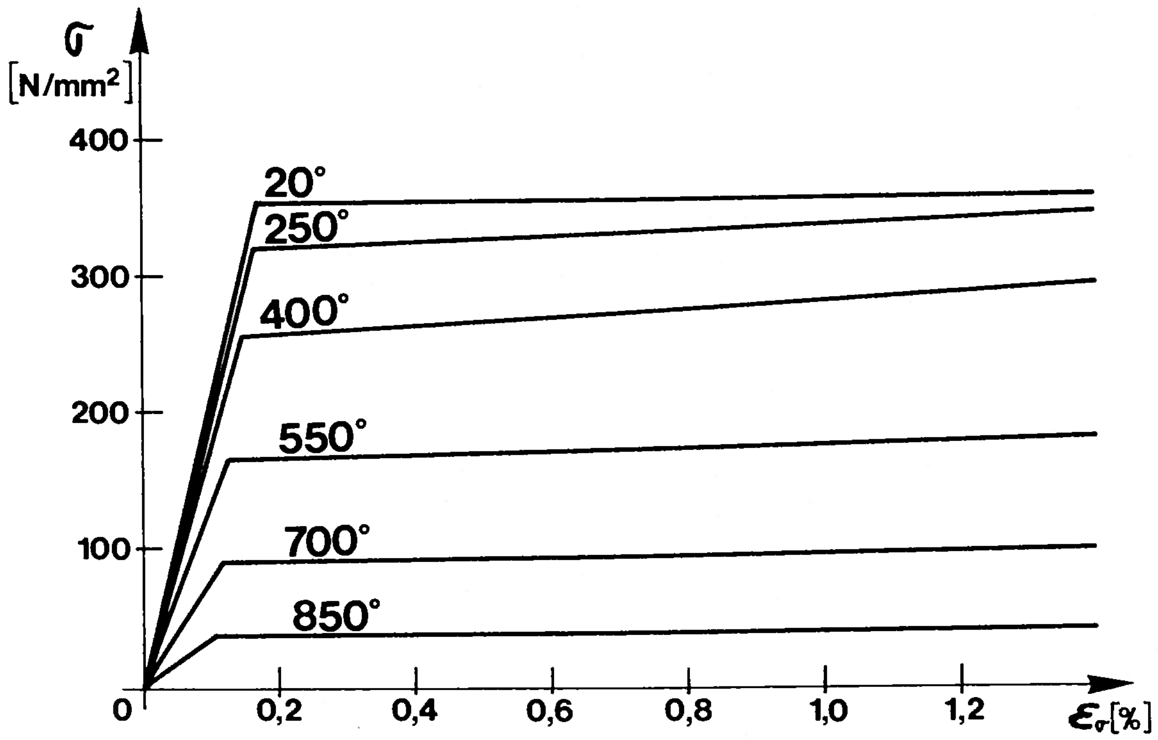


Fig. 2.8 : σ-ε_σ-diagram for Fe 510 at different temperatures.

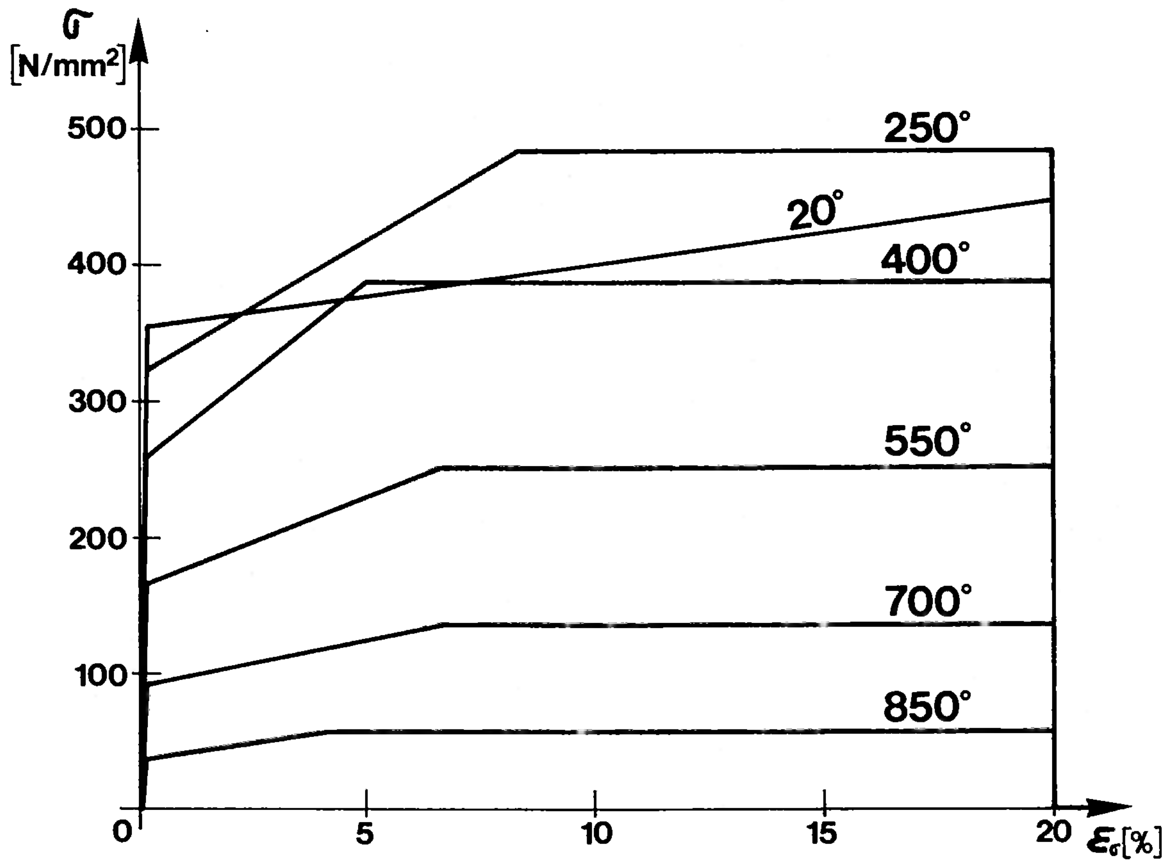


Fig. 2.9 : σ-ε_σ-diagram for Fe 510 at different temperatures with elongations ε_σ shown up to 20 % .

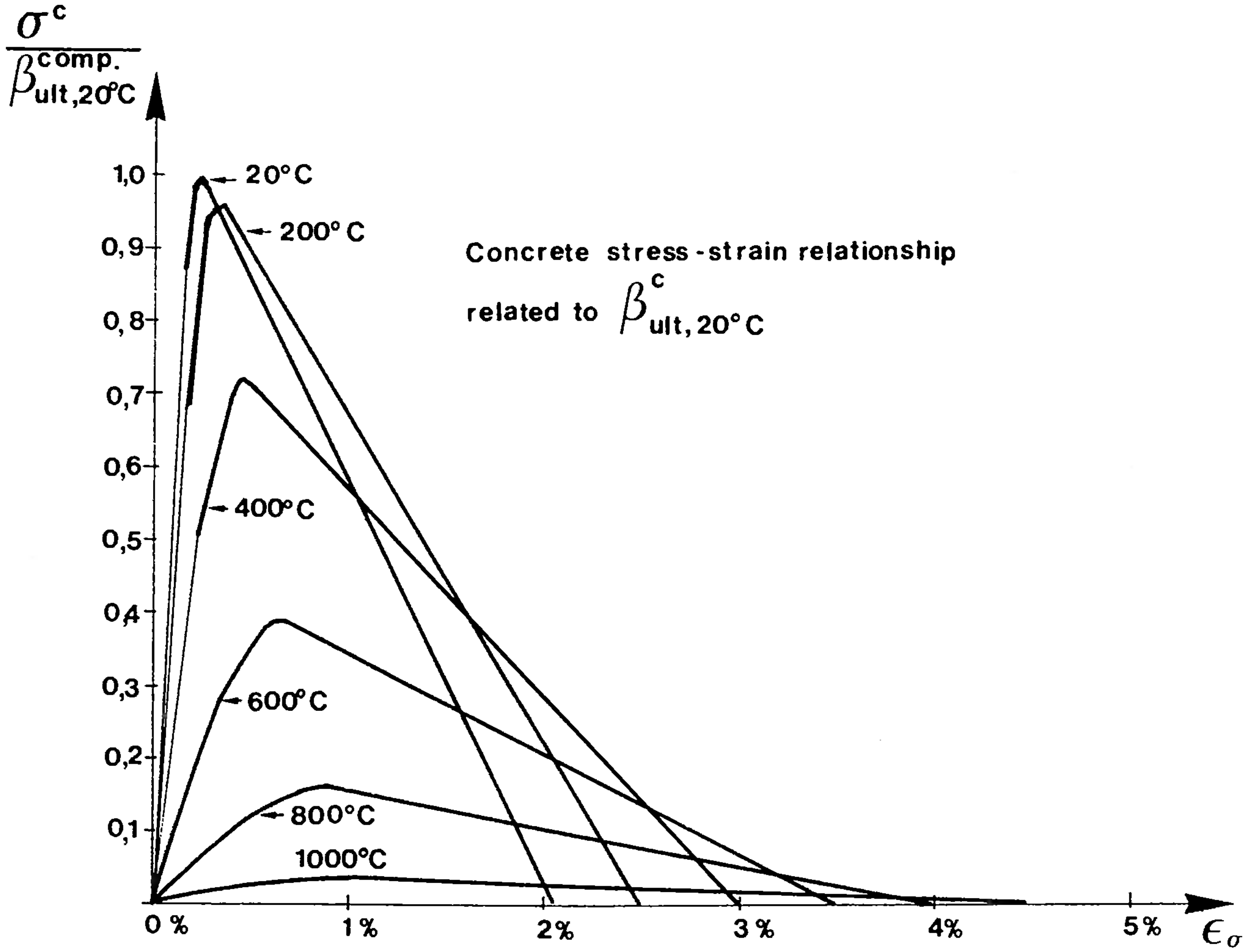

$\frac{\sigma^c}{\beta^{comp.}_{ult,20°C}}$
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
20°C
200° C
400°C
600°C
800°C
1000°C
Concrete stress-strain relationship
related to $\beta^c_{ult,20°C}$
0 %
1 %
2%
3 %
4%
5%
ϵ_σ

Figure 2.10

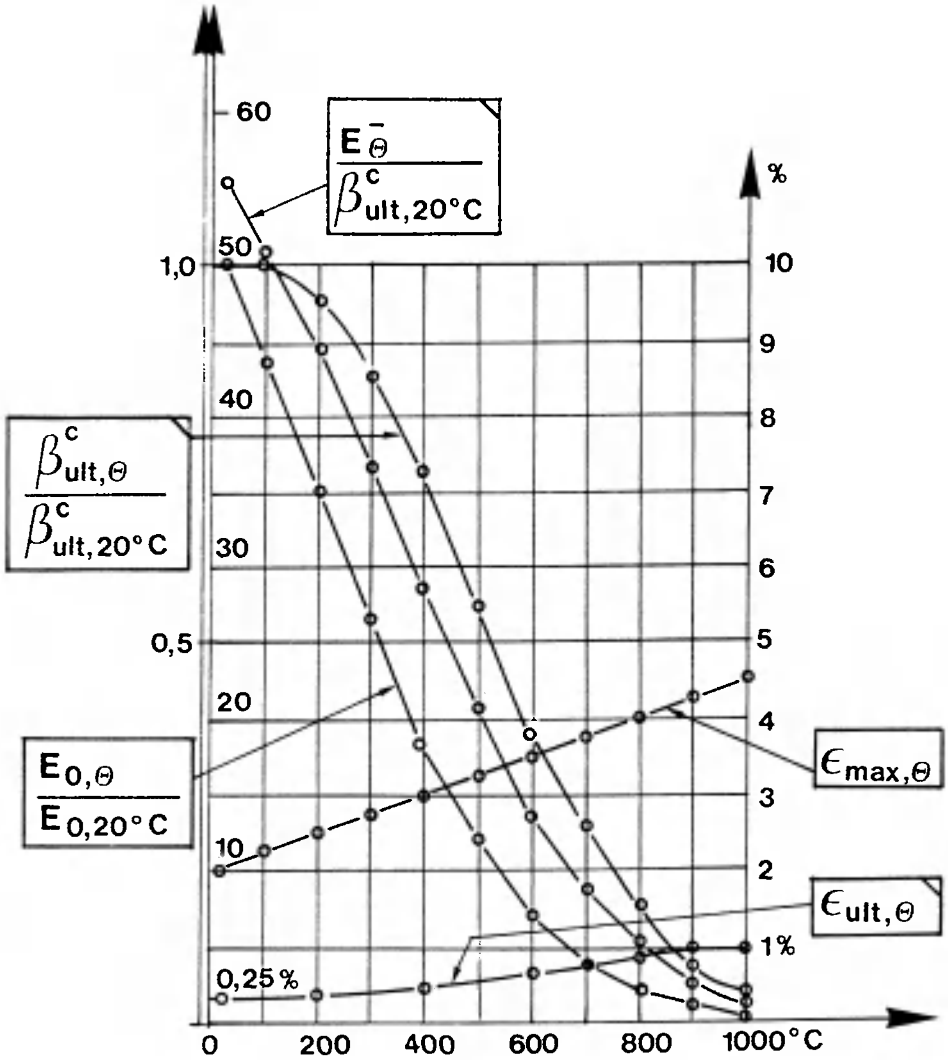
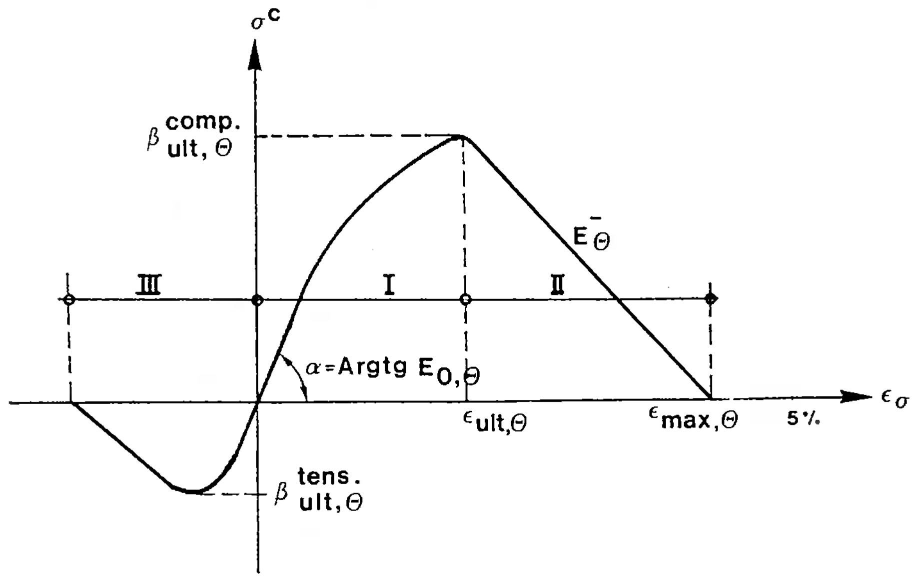

60
50
40
30
20
10
1,0
0,5
%
10
9
8
7
6
5
4
3
2
1%
0,25 %
0
200
400
600
800
1000°C
$\frac{E_{\bar{\Theta}}}{\beta^{c}_{ult,20°C}}$
$\frac{\beta^{c}_{ult,\Theta}}{\beta^{c}_{ult,20°C}}$
$\frac{E_{0,\Theta}}{E_{0,20°C}}$
$\epsilon_{max,\Theta}$
$\epsilon_{ult,\Theta}$

Figure 2.11

Temperature	$\left(\frac{\beta^c_{ult,\theta}}{\beta^c_{ult,20^\circ C}}\right)$	$\epsilon_{ult,\theta}$	$\left(\frac{\bar{E}_\theta}{\beta^c_{ult,20^\circ C}}\right)$	$\left(\frac{E_{0,\theta}}{E_{0,20^\circ C}}\right)$	$\epsilon_{max,\theta}$
20°C	1	$2,5 \cdot 10^{-3}$	55,55	1	$20,5 \cdot 10^{-3}$
100°C	1	$2,86 \cdot 10^{-3}$	50,92	0,873	$22,5 \cdot 10^{-3}$
200°C	0,963	$3,41 \cdot 10^{-3}$	44,61	0,705	$25,0 \cdot 10^{-3}$
300°C	0,864	$4,07 \cdot 10^{-3}$	36,88	0,531	$27,5 \cdot 10^{-3}$
400°C	0,720	$4,84 \cdot 10^{-3}$	28,63	0,372	$30,0 \cdot 10^{-3}$
500°C	0,550	$5,71 \cdot 10^{-3}$	20,53	0,241	$32,5 \cdot 10^{-3}$
600°C	0,389	$6,69 \cdot 10^{-3}$	13,74	0,145	$35,0 \cdot 10^{-3}$
700°C	0,259	$7,78 \cdot 10^{-3}$	8,73	0,083	$37,5 \cdot 10^{-3}$
800°C	0,159	$8,98 \cdot 10^{-3}$	5,14	0,044	$40,0 \cdot 10^{-3}$
900°C	0,086	$10 \cdot 10^{-3}$	2,64	0,021	$42,5 \cdot 10^{-3}$
1000°C	0,036	$10 \cdot 10^{-3}$	1,04	0,009	$45,0 \cdot 10^{-3}$
1100°C	0,009	$10 \cdot 10^{-3}$	0,23	0,002	$47,5 \cdot 10^{-3}$
1200°C	0,0	$10 \cdot 10^{-3}$	0,003	0,0	$50,0 \cdot 10^{-3}$

Figure 2.12



Range I

$$\sigma^c = (\beta^{comp.}_{ult,\Theta}) \left[\left(\frac{\epsilon_\sigma}{\epsilon_{ult,\Theta}}\right) \cdot \left(\frac{3}{2+\left(\frac{\epsilon_\sigma}{\epsilon_{ult,\Theta}}\right)^3}\right) \right]$$

$$\left.\begin{array}{r} \Theta \leq 100^\circ C \\ 100^\circ C < \Theta \leq 500^\circ C \\ 500^\circ C < \Theta \leq 1200^\circ C \\ \Theta > 1200^\circ C \end{array}\right\} \left(\frac{\beta^{comp.}_{ult,\Theta}}{\beta^{comp.}_{ult,20\ C}}\right) \left\{\begin{array}{l} = 1,0 \\ = 2,93\cdot 10^{-3}\left(\frac{\Theta}{100}\right)^3 - 4,87\cdot 10^{-2}\left(\frac{\Theta}{100}\right)^2 + 8,85\cdot 10^{-2}\ \frac{\Theta}{100} + 0,957 \\ = -4,21\cdot 10^{-4}\left(\frac{\Theta}{100}\right)^3 + 2,344\cdot 10^{-2}\left(\frac{\Theta}{100}\right)^2 - 0,3806\ \frac{\Theta}{100} + 1,919 \\ = 0,0 \end{array}\right.$$

$$\epsilon_{ult,\Theta} = 2,5\cdot 10^{-3} + 4,1\cdot 10^{-6}(\Theta-20) + 5,4\cdot 10^{-9}(\Theta-20)^2$$

$$\epsilon^{max}_{ult,\Theta} = 10\cdot 10^{-3}$$

Range II

$$\left|E^{-}_{\Theta}\right| = \frac{\beta^{comp.}_{ult,\Theta}}{(0,02+2,5\cdot 10^{-5}\cdot\Theta-\epsilon_{ult,\Theta})}$$

Range III

$$\left|\beta^{tens.}_{ult,\Theta}\right| = \beta^{comp.}_{ult,\Theta} / 10; \text{ If } \sigma^t > \beta^{tens.}_{ult,\Theta}\ ,\ \beta^{tens.}_{ult,\Theta} = 0$$

Figure 2.13

INFLUENCE OF ϵ^*

CALCULATED FIRE RESISTANCE TIMES IN MINUTES

		COMB.1	COMB.2	COMB.3	COMB.4	COMB.5
ϵ^*STEEL		0.50	0.55	0.60	0.70	0.50
ϵ^*CONCRETE		0.45	0.45	0.45	0.45	0.50
COLUMN CENTRICALLY LOADED		100	99	98	96	99.5
COLUMN LOADED WITH ECCENTRICITY		83	81	79.5	77.5	82.5
BEAM	D=L/30	50.5	48.5	47	44	50
	D=L/10	82	80.5	78.5	76	81.5
	FAILURE	100	98	96	92	94

INFLUENCE OF α

CALCULATED FIRE RESISTANCE TIMES IN MINUTES

α=[W/m$^2\cdot{}^o$K]		25	15
COLUMN CENTRICALLY LOADED		99.5	101
COLUMN LOADED WITH ECCENTRICITY		82.5	84
BEAM	D=L/30	50	53
	D=L/10	81.5	84
	FAILURE	94	99

Figure 3.1

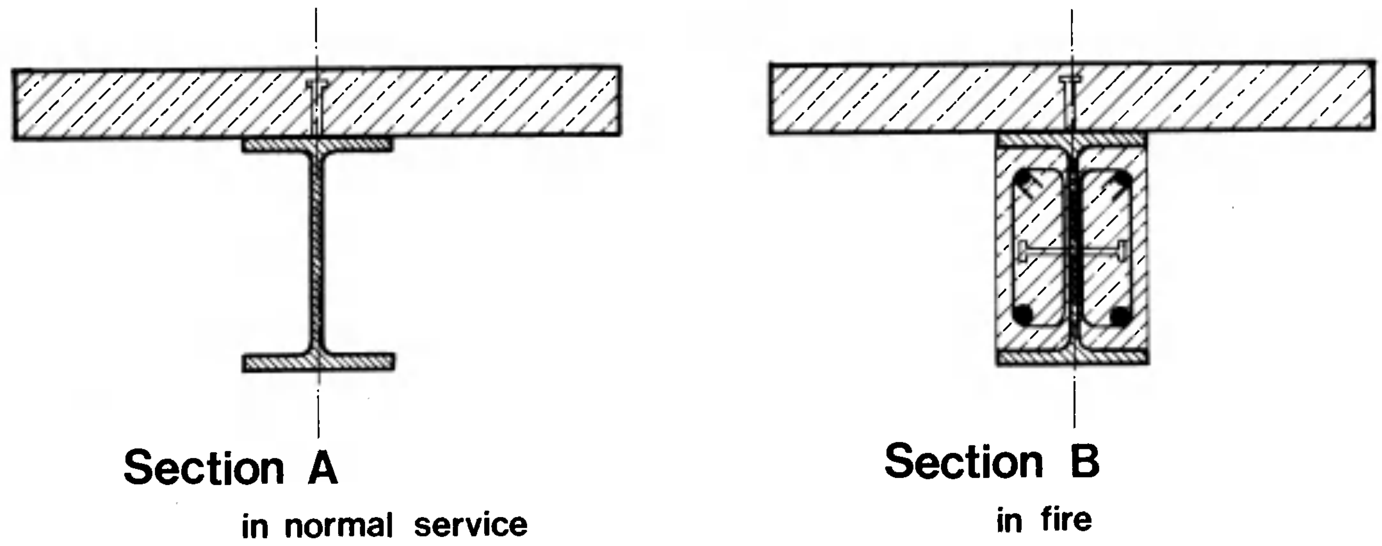


Figure 5.1

COLUMNS

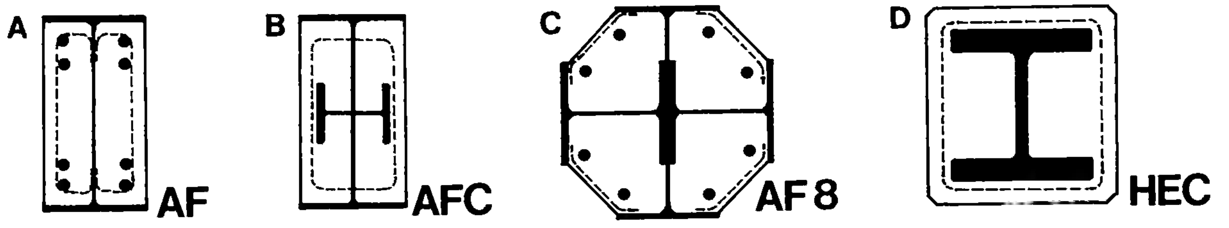
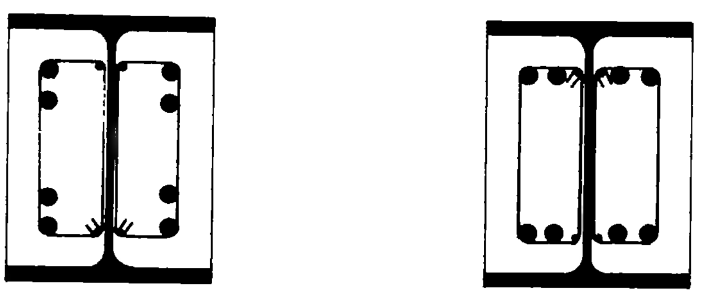


Figure 6.1

LAYOUT OF REINFORCEMENT

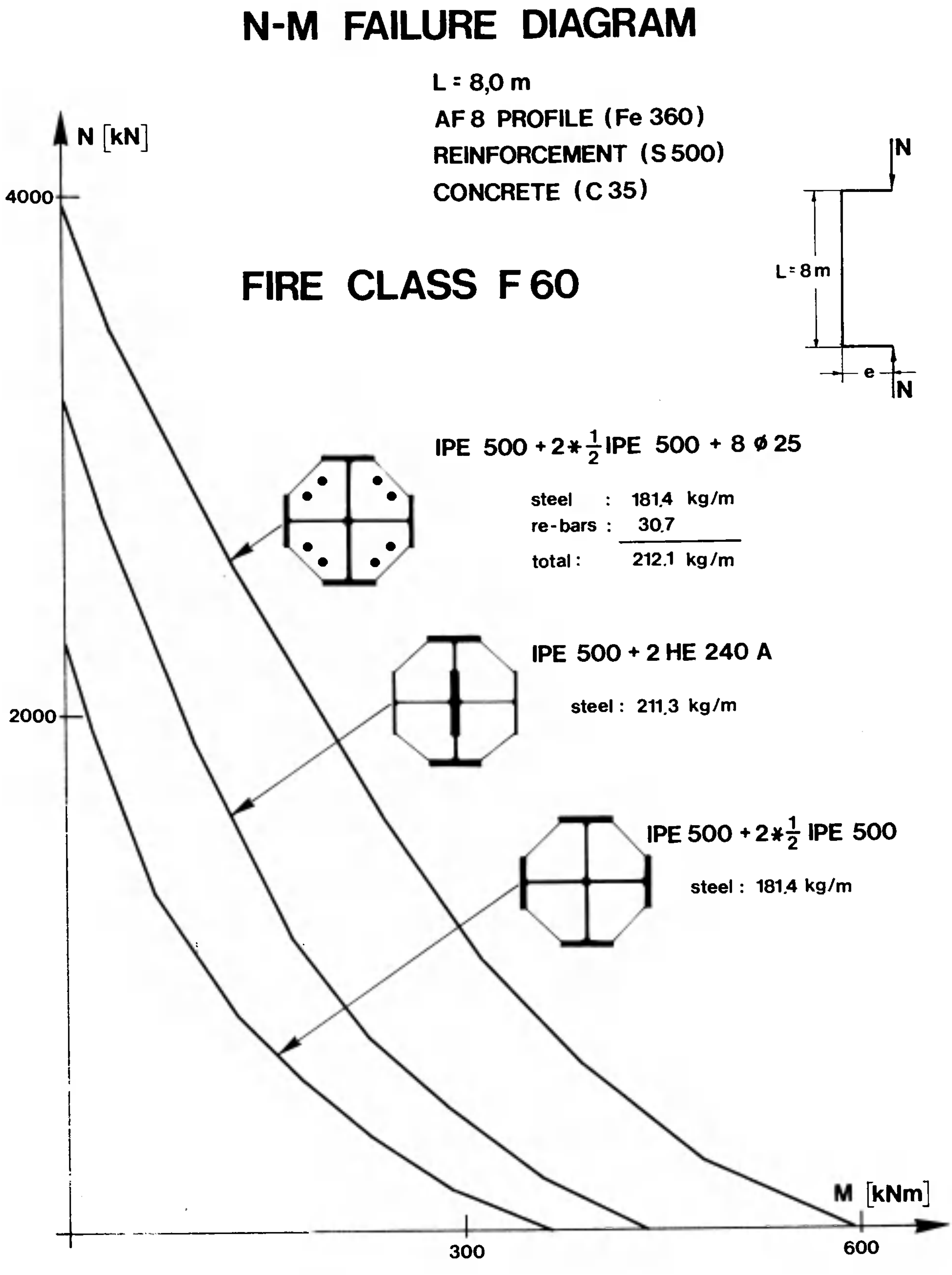
AF SECTION HEA 400 + 8 ø 20



a) for bending about minor axis

b) for bending about major axis

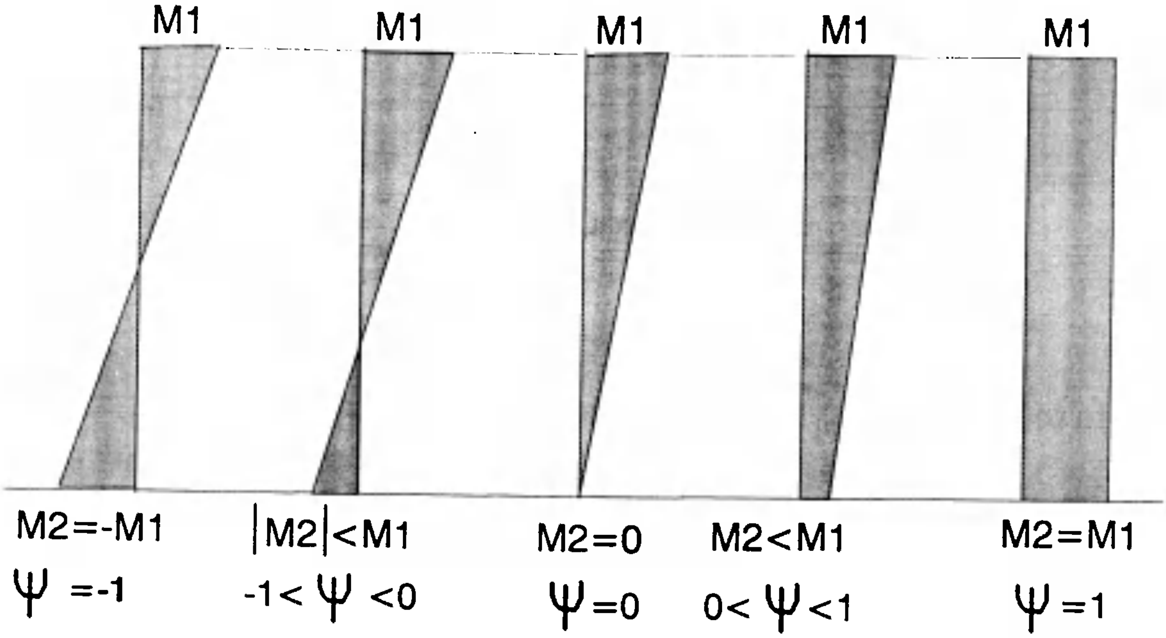
Figure 6.2



N-M FAILURE DIAGRAM
L = 8,0 m
AF 8 PROFILE (Fe 360)
REINFORCEMENT (S 500)
CONCRETE (C 35)
FIRE CLASS F 60
N [kN]
4000
2000
N
L = 8m
e
N
IPE 500 + 2∗½ IPE 500 + 8 ø 25
steel : 181.4 kg/m
re-bars : 30.7
total : 212.1 kg/m
IPE 500 + 2 HE 240 A
steel : 211.3 kg/m
IPE 500 + 2∗½ IPE 500
steel : 181.4 kg/m
M [kNm]
300
600

Figure 6.3

FORM OF BENDING MOMENT DISTRIBUTON



$$\Psi = \frac{M2}{M1}$$

FIGURE 6.4

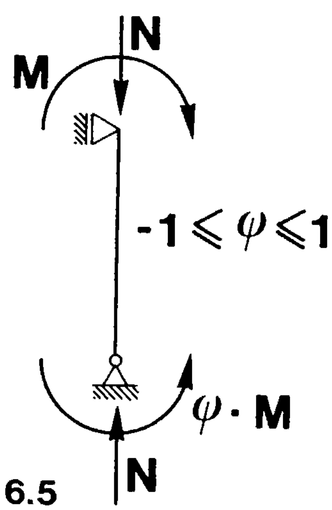


Figure 6.5

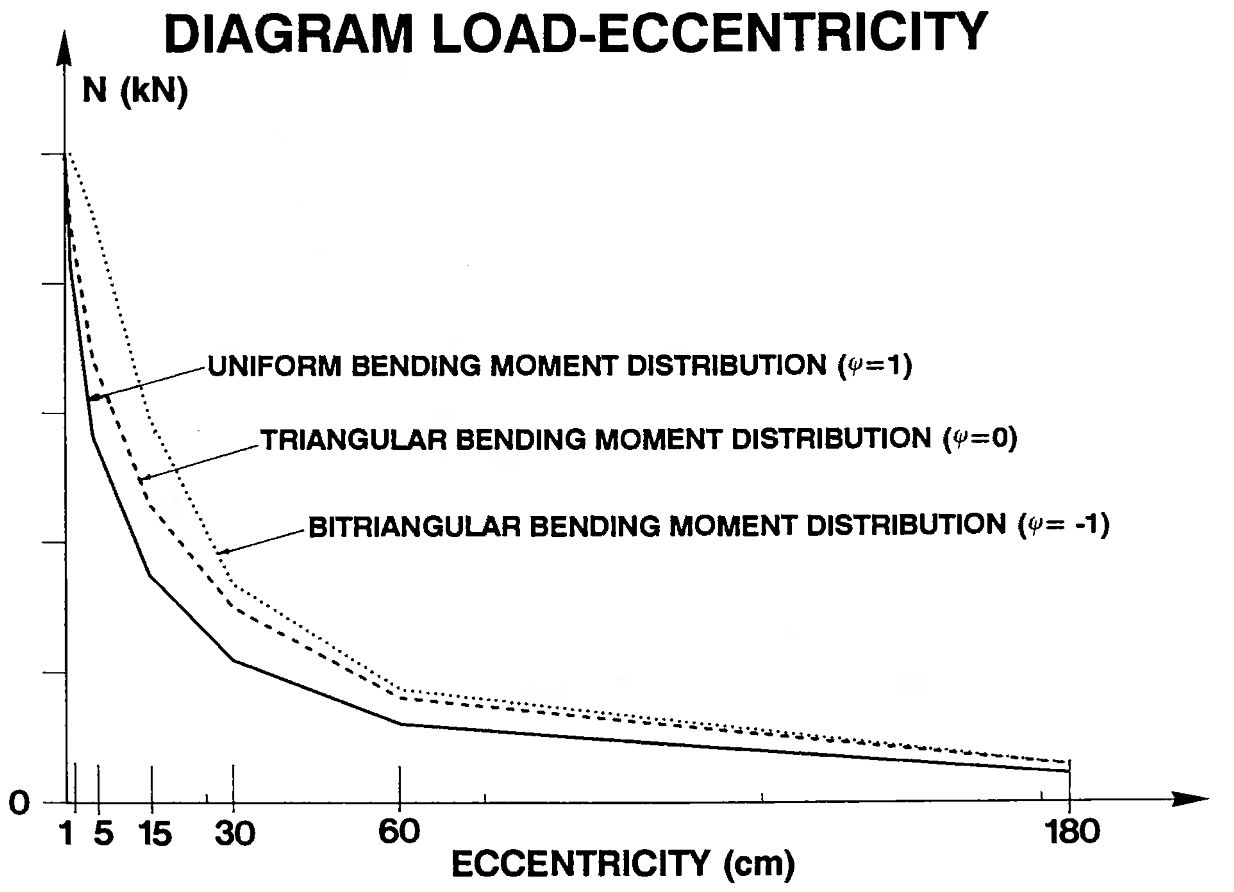


Figure 6.6

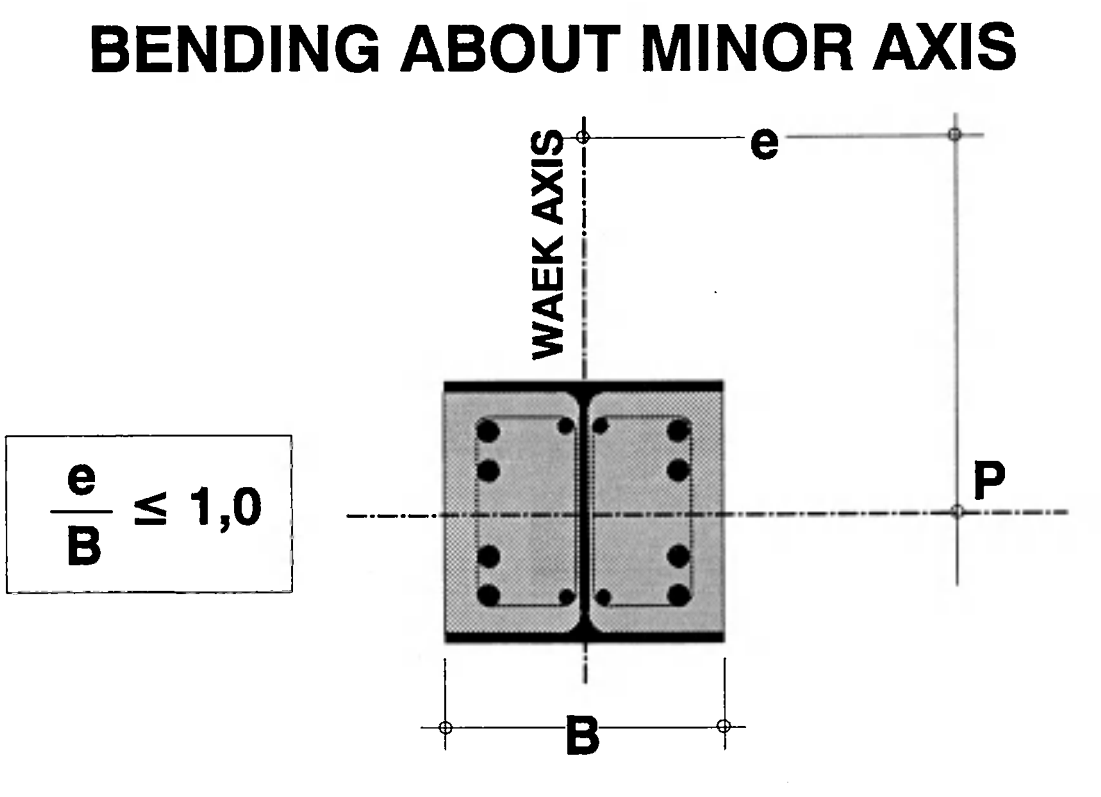
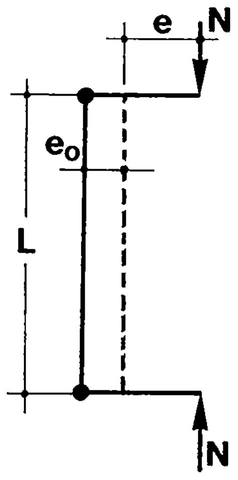


Figure 6.7

NOTATIONS USED FOR COLUMNS



e : eccentricity

N : vertical load,applied with the eccentricity e

e_o : initial imperfection of the column

L : buckling length

F*** : fire resistance class

M $= N \cdot e =$ first order bending moment

M_{PL} : plastic moment in normal service conditions

N_{PL} : plastic load in normal service conditions

$\bar{\lambda}$: slenderness ratio (in normal service conditions)

κ : reduction factor for buckling in the cold design

N_C : allowable pure axial load (e=0) for a given fire resistance class

H : height of the cross section

B : width of the cross section

Figure 7.1

N - t FAILURE DIAGRAM

BENDING ABOUT MAJOR AXIS

SECTION :........

INITIAL IMPERFECTION e = L/1000
Included in each calculation

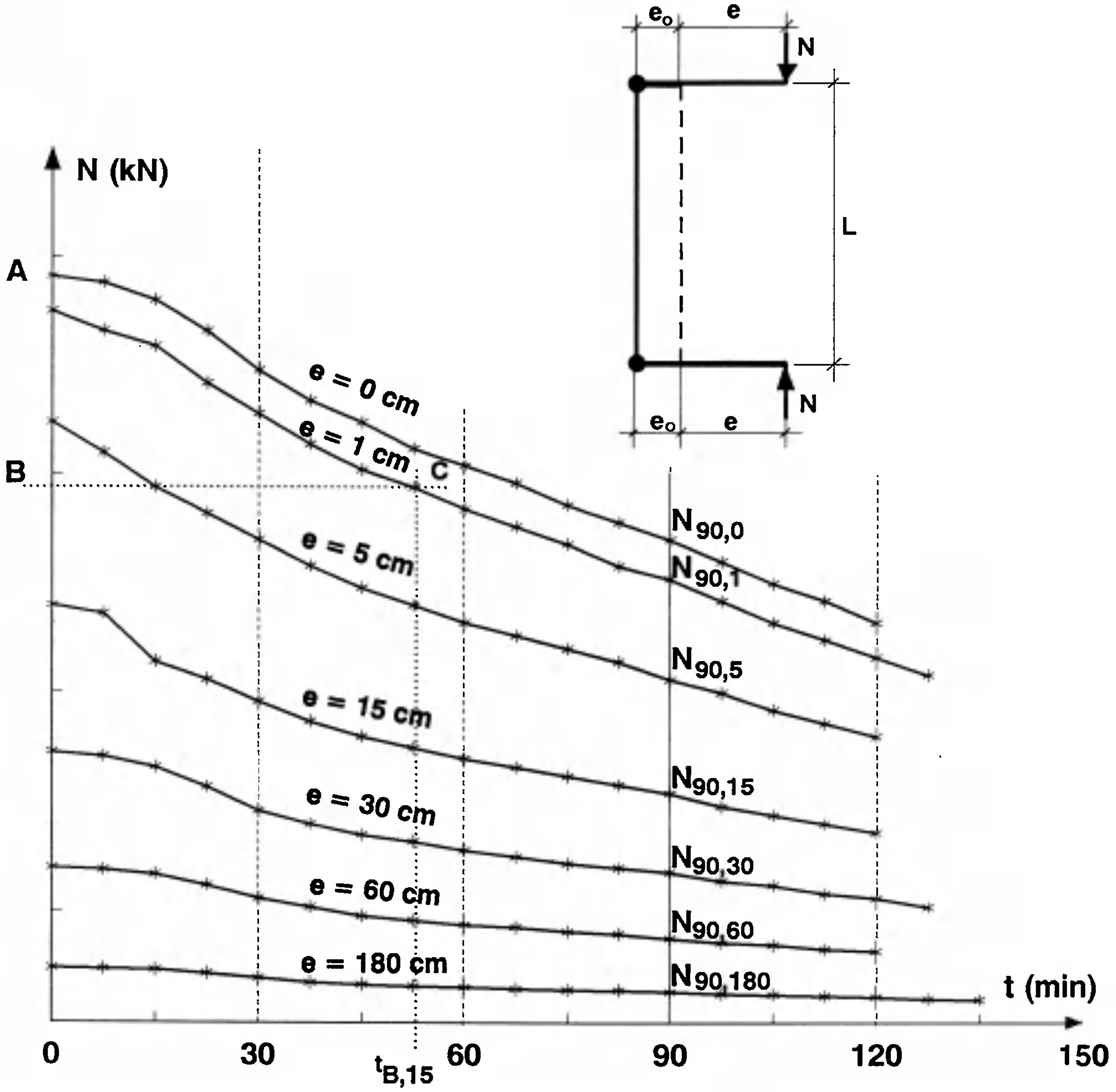


Figure 7.2

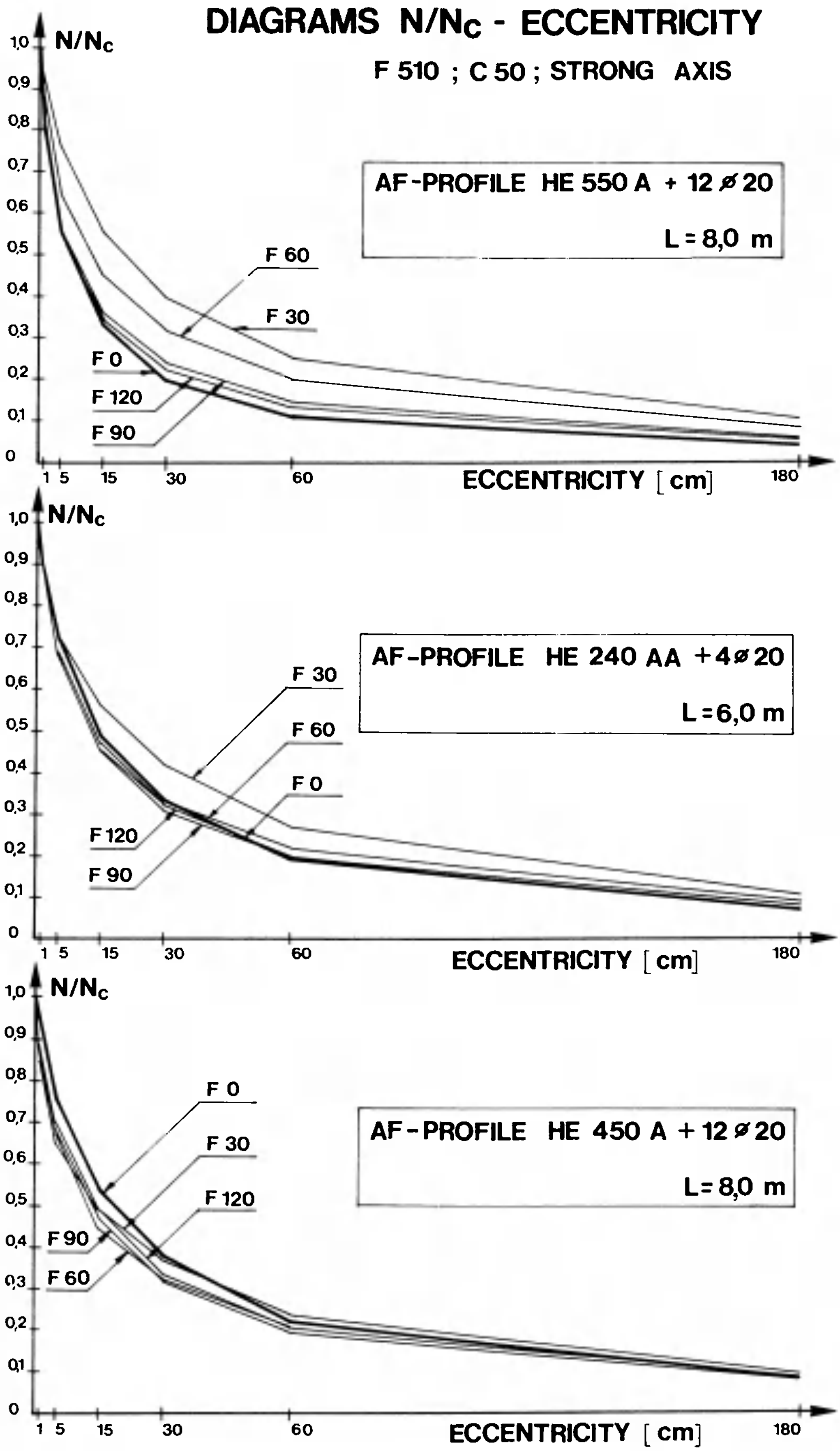

DIAGRAMS N/Nc - ECCENTRICITY
F 510 ; C 50 ; STRONG AXIS
AF-PROFILE HE 550 A + 12 ø 20
L = 8,0 m
N/Nc
F 60
F 30
F 0
F 120
F 90
ECCENTRICITY [cm]
AF-PROFILE HE 240 AA + 4 ø 20
L = 6,0 m
F 30
F 60
F 0
F 120
F 90
ECCENTRICITY [cm]
AF-PROFILE HE 450 A + 12 ø 20
L = 8,0 m
F 0
F 30
F 120
F 90
F 60
ECCENTRICITY [cm]

Figure 7.3

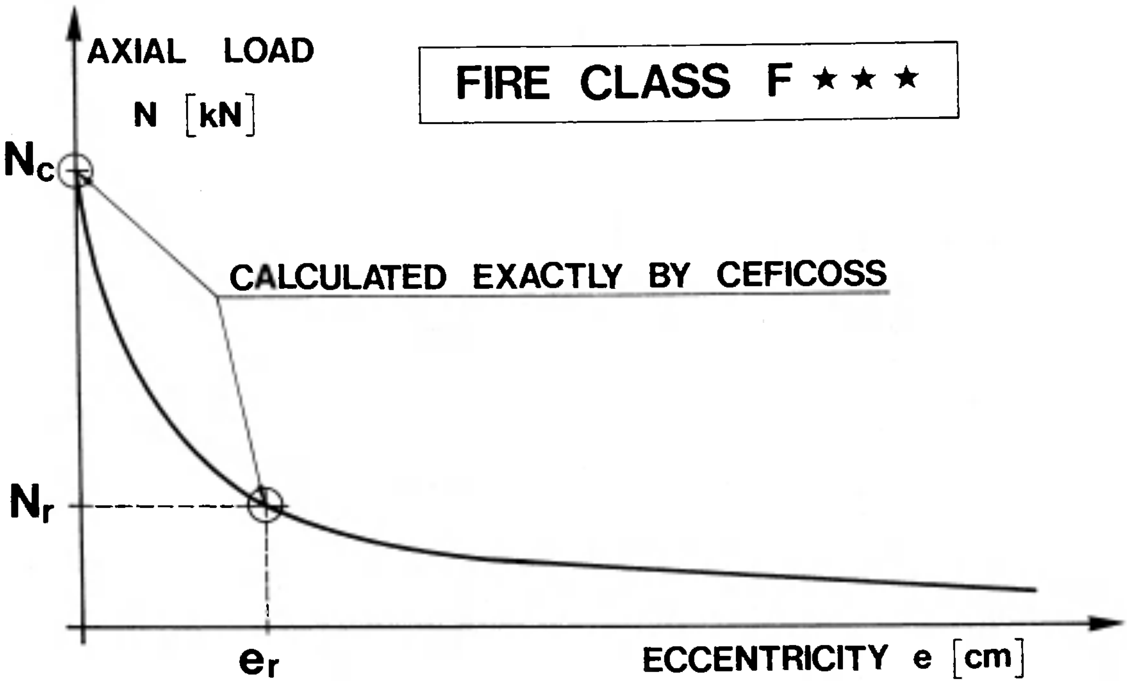


Figure 7.4

GENERAL FORM OF INTERACTION FORMULAS FOR COLD SERVICE

$$\boxed{\frac{N}{\chi \cdot N_{pl}} + \beta \cdot \frac{M}{M_{pl}} = 1}$$

or $1 - \Delta$

$$\frac{M}{M_{pl}} = \frac{N \cdot e}{M_{pl}}$$ and we can write : $M_{pl} = \alpha \cdot N_c$

$$\frac{N}{\chi \cdot N_{pl}} = \frac{N}{N_c}$$ where N_c is the pure axial load (e = 0)

$$\Longrightarrow \left(\frac{N}{N_c}\right) + \frac{\beta}{\alpha} \cdot \left(\frac{N}{N_c}\right) \cdot e = 1$$ and for $K = \frac{\beta}{\alpha}$

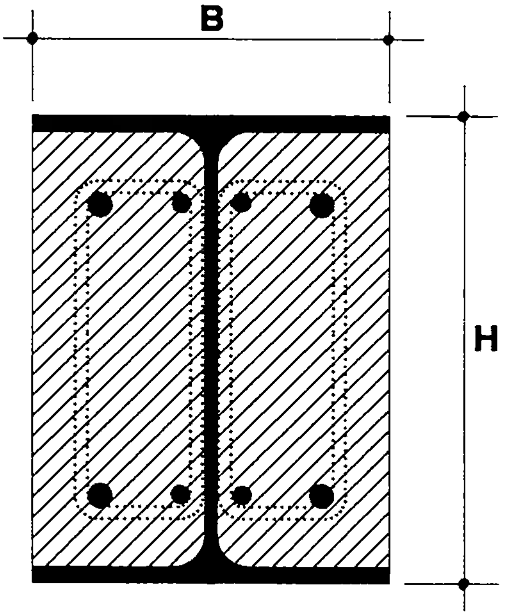
$$\Longrightarrow \boxed{\frac{N}{N_c} = \frac{1}{1 + K \cdot e}} \quad (5)$$

Eventual corrections :

$$\frac{N}{N_c} = \frac{1 - \Delta}{1 + K \cdot e}$$ with $\Delta = f\left(\frac{N}{N_c}\right)$, or $K = f\left(\frac{N}{N_c}\right)$

Figure 7.5

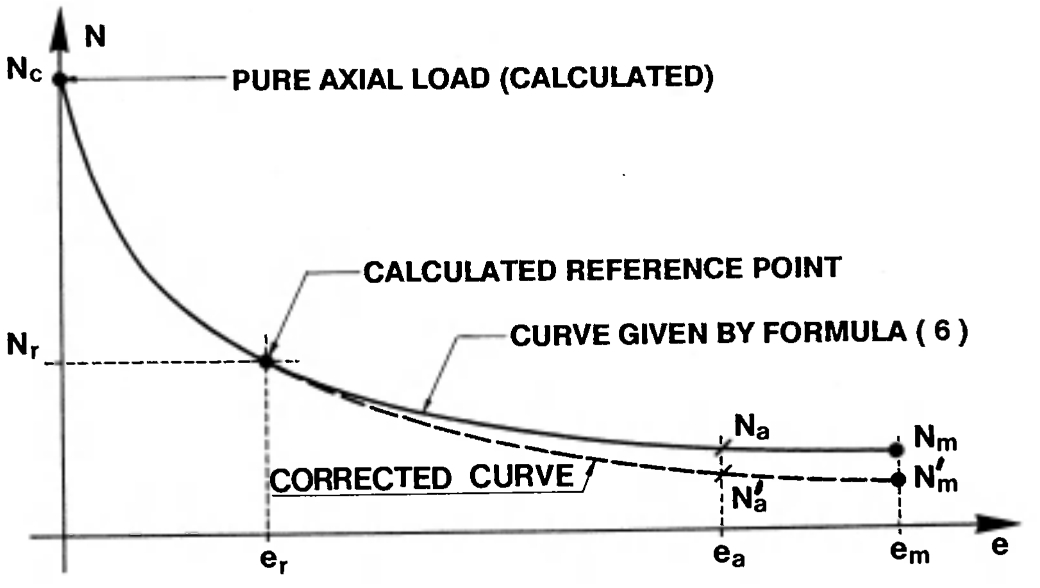
DEFINITION OF U/A



$$\frac{U}{A} = \frac{2(H+B)}{H \cdot B} \quad [\,m^{-1}\,]$$

for B and H in [m]

Figure 7.6



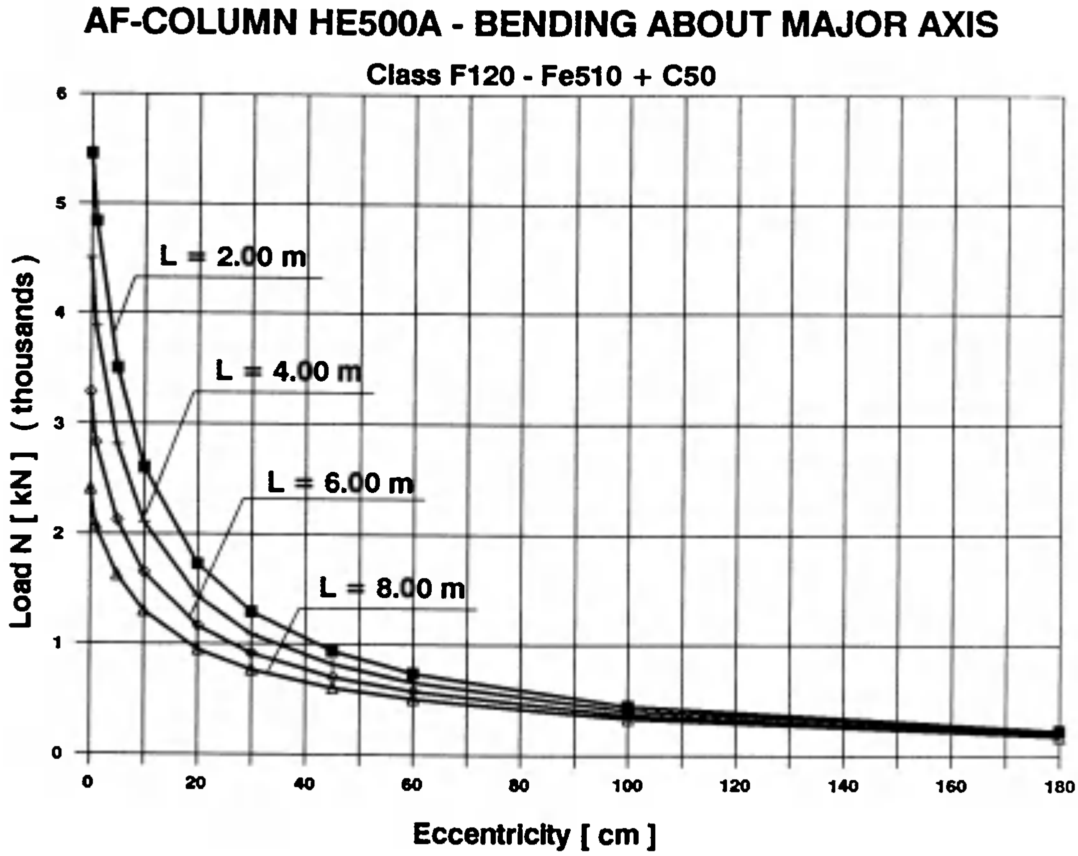
For any value $e_r < e_a < e_m$:

$$N'a = Na \left[1 - \frac{n}{100} \left(\frac{e_a - e_r}{e_m - e_r} \right) \right]$$

BUCKLING AXIS	Reference e_r	Load eccentricity e_m
STRONG AXIS	60 cm	180 cm
WEAK AXIS	15 cm	B

	Correction factor n (L and H in [m], U/A in [m^{-1}])	
TYPE OF SECTION	STRONG AXIS	WEAK AXIS
AF	$n = -0.50 \frac{U/A}{H} + 2(L-2.0) + 25.8$	$n = 5$
AFC	$n = -0.42 \frac{U/A}{H} + 1.5\,L + 18.5$	$n = 5$
AF 8	$n = -0.34 \frac{U/A}{H} + L + 15.5$	(no weak axis)
HEC	$n = -0.5 \frac{U/A}{H} + 2(L-2.0) + 25.8 + 11\ 10^{-4} \exp^{(0.15\ (U/A)/H)}$	$n = 5 + 420 \left(\frac{U/A}{B} \right)^{-1.5}$

Figure 7.7


AF-COLUMN HE500A - BENDING ABOUT MAJOR AXIS
Class F120 - Fe510 + C50
L = 2.00 m
L = 4.00 m
L = 6.00 m
L = 8.00 m
Load N [kN] (thousands)
Eccentricity [cm]
0
1
2
3
4
5
6
0
20
40
60
80
100
120
140
160
180

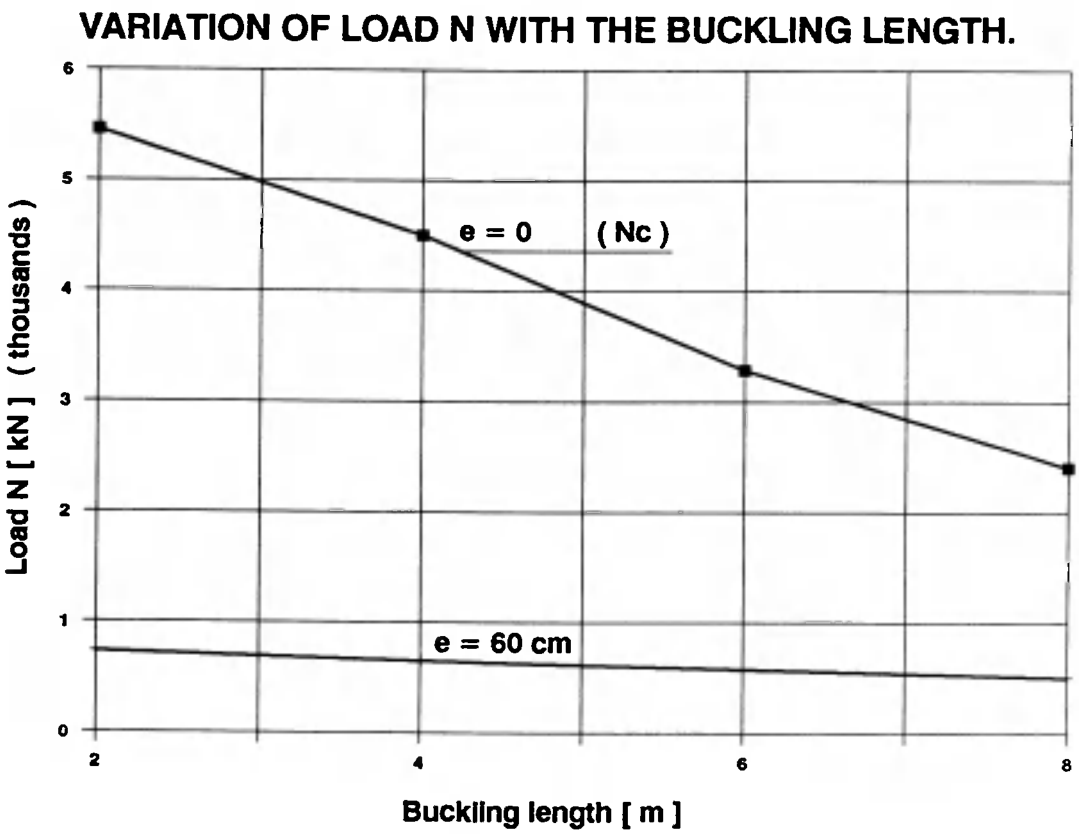
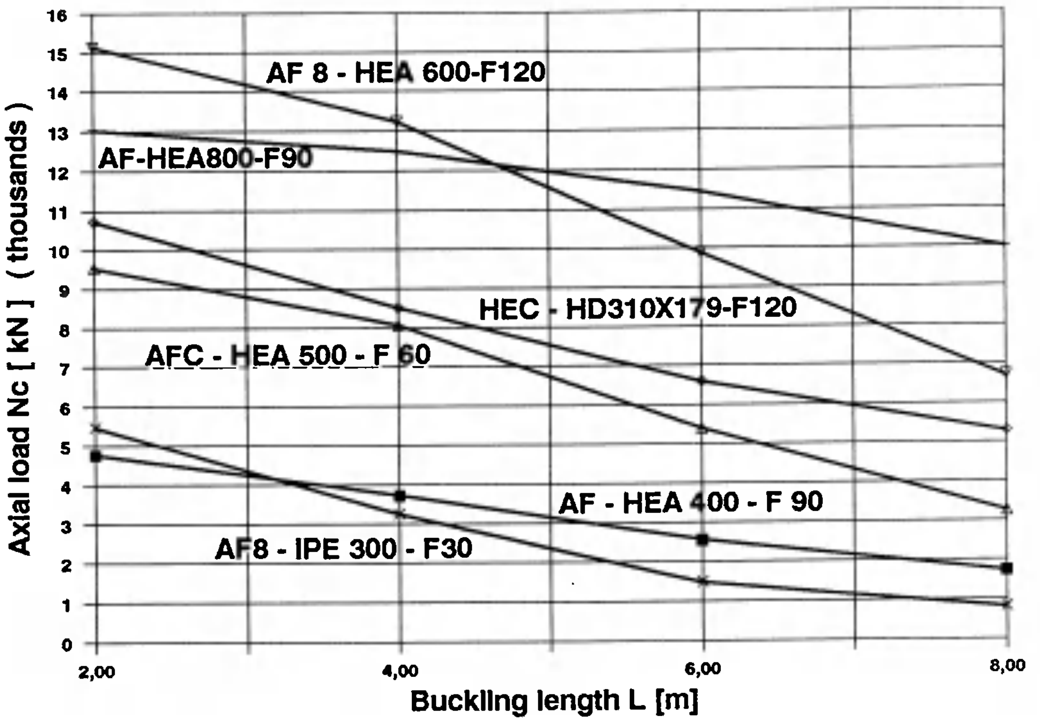

VARIATION OF LOAD N WITH THE BUCKLING LENGTH.
e = 0 (Nc)
e = 60 cm
Load N [kN] (thousands)
Buckling length [m]
0
1
2
3
4
5
6
2
4
6
8

Figure 7.8

DIAGRAM AXIAL LOAD - BUCKLING LENGTH

BENDING ABOUT MAJOR AXIS

Eccentricity e = 0.00 cm



Eccentricity e = 30.00 cm

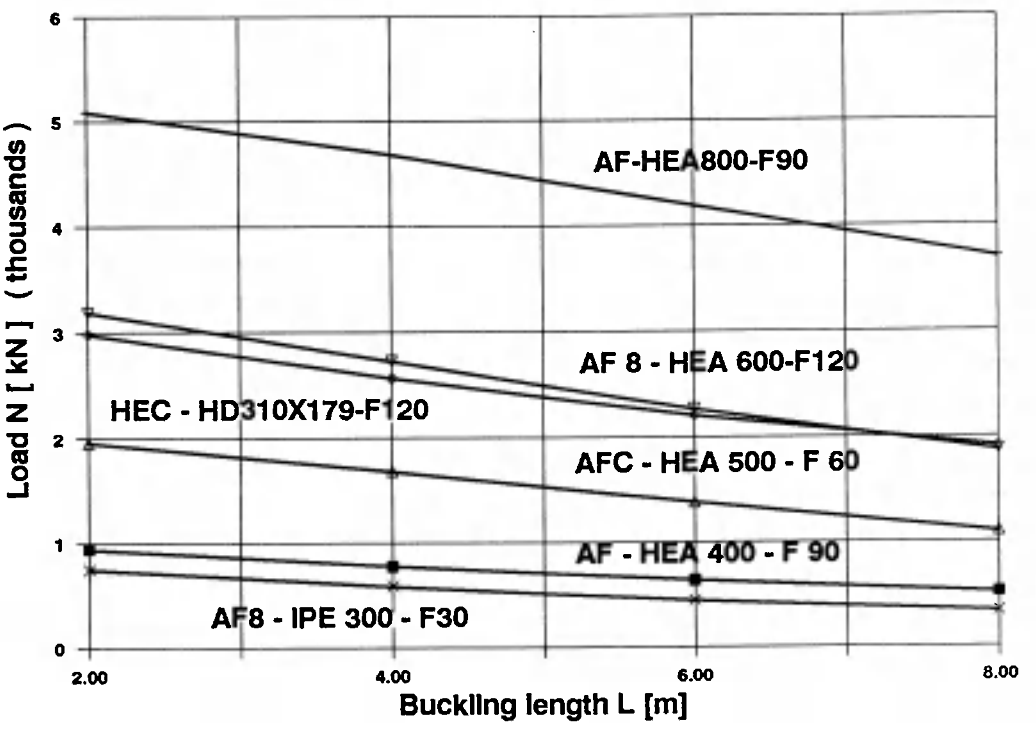
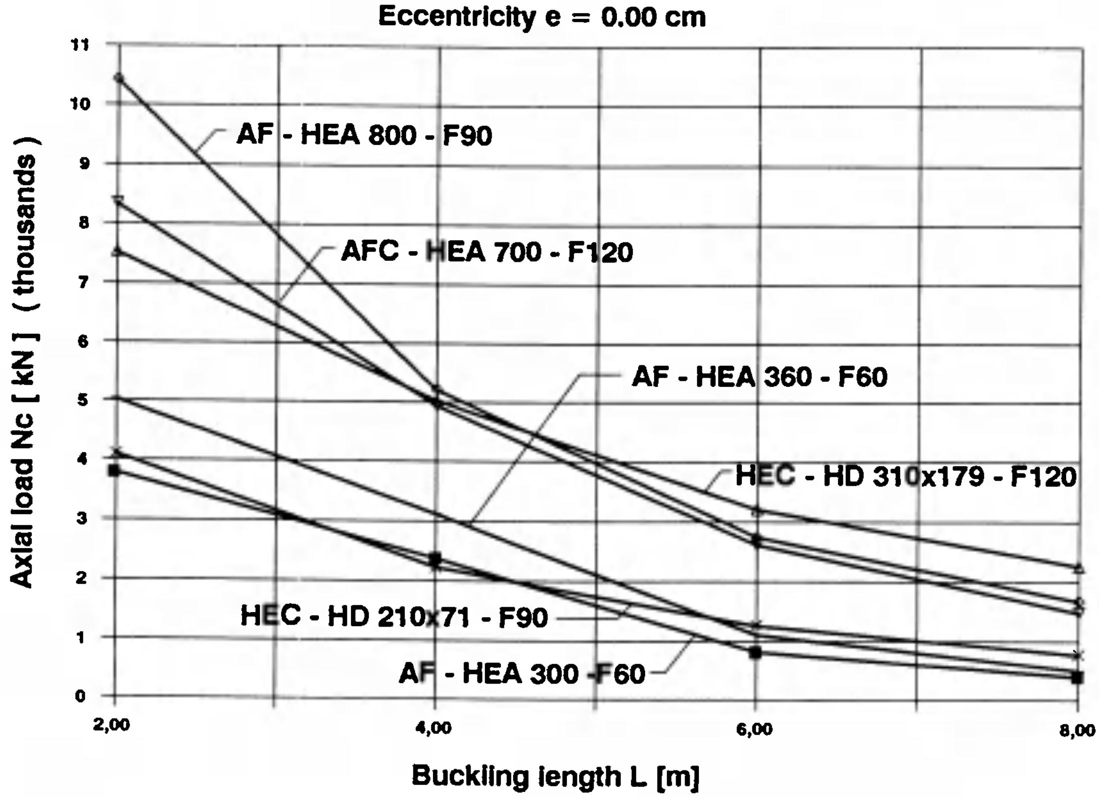


Figure 7.9

DIAGRAM AXIAL LOAD - BUCKLING LENGTH

BENDING ABOUT MINOR AXIS



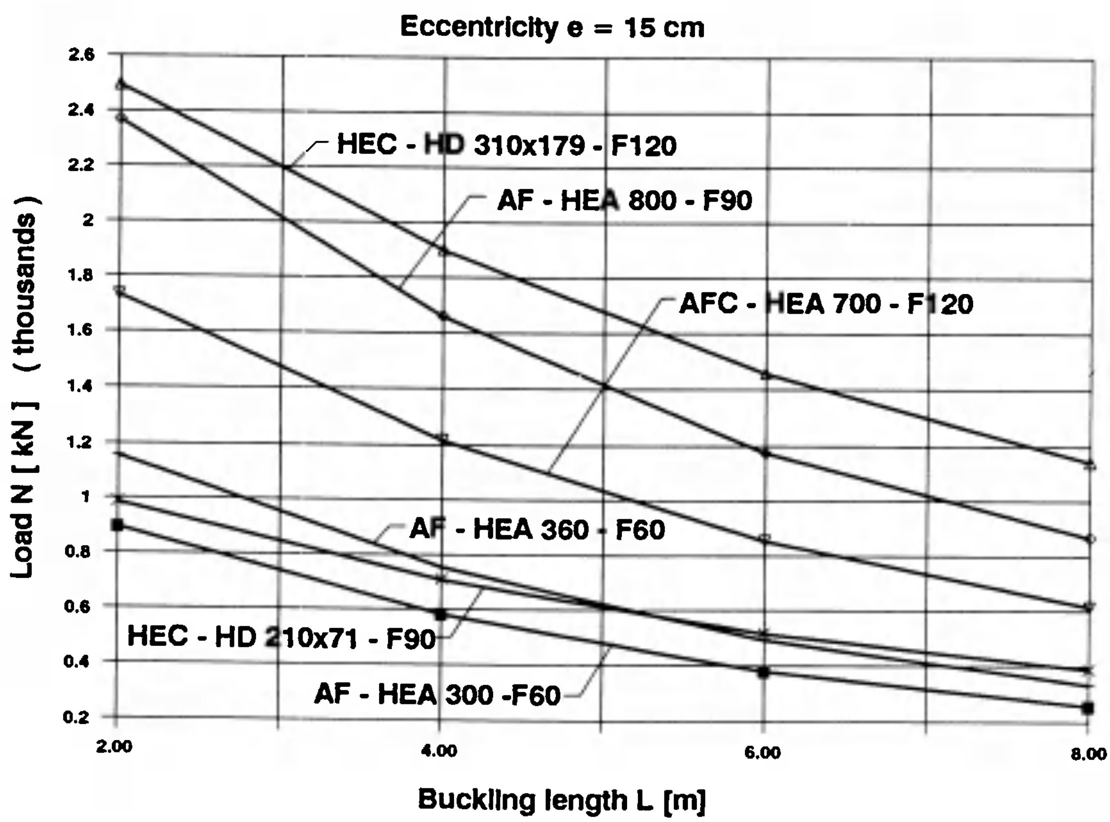


Figure 7.10

Method proposed in Eurocode N° 2 [17]

The eccentricity e_e is the larger of the following two values :

$$e_e = 0.6\ e_s + 0.4\ e_i$$

$$e_e \geq 0.4\ e_s$$

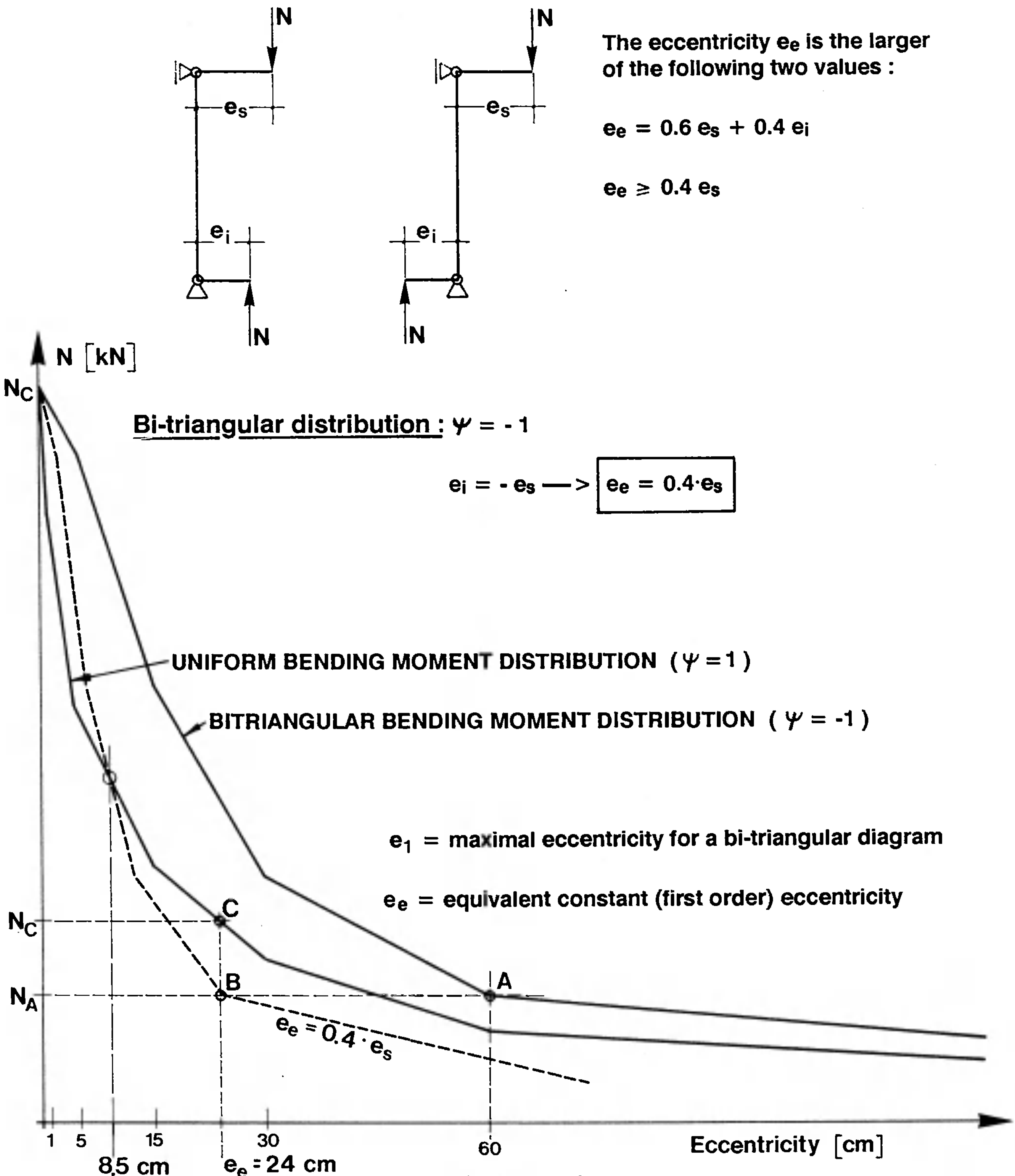
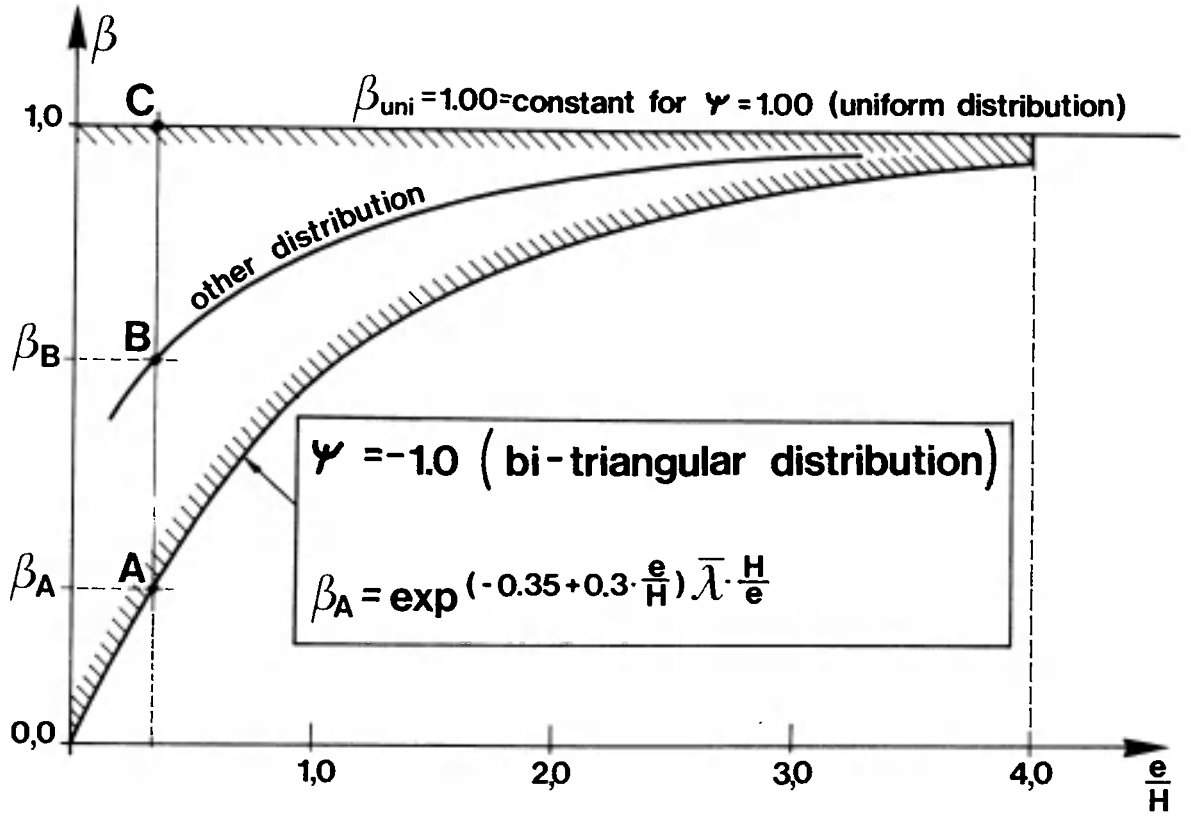


Figure 7.11



For any

$-1.0 < \Psi < 1.0$: linear interpolation :

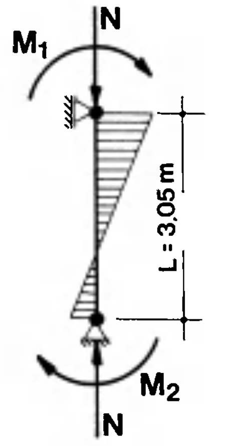
$$\frac{\overline{AB}}{\overline{AC}} = \frac{\Psi + 1.0}{2.0}$$

$$\frac{\beta_B - \beta_A}{1.0 - \beta_A} = \frac{\Psi + 1.0}{2.0}$$

$$\Longrightarrow \beta_B = \beta_A + (1.0 - \beta_A)\,\frac{(\Psi + 1.0)}{2.0}$$

Figure 7.12

1. GENERAL INDICATIONS



STEEL SECTION	:	HE 400 A, steel grade Fe 430
RE-BARS	:	8 D 20, steel grade S 500
CONCRETE	:	C 37.35 (45 N/mm^2 on cubes)
LENGTH	:	L = 3.05 m
LOADS	:	N = 1200 kN
		M_1 = 300 kNm----->e_1 = 25.00 cm
		M_2 = 180 kNm-----> e_2 = - 15.00 cm
		(strong axis)

2. CALCULATION OF THE EQUIVALENT ECCENTRICITY

SLENDERNESS RATIO : $\bar{\lambda}$ = 0.2405

RATIO : e_1/H = 25/39 = 0.641

DISTRIBUTION FACTOR : ψ = e_2/e_1 = - 15/25 = - 0.60

CORRECTION FACTOR : $\beta_{\bar{\lambda}} = \exp^{-(0.35 + 0.3 \cdot e1/H)\bar{\lambda} \cdot H/e1}$

$= \exp^{-(0.35 + 0.3 \cdot 0.641)\, 0.2405/0.641} = 0.8159$

INTERPOLATION :

ψ	β
- 1.0	0.8159
- 0.6	0.8527
+ 1.0	1.0

- 0.6 → 0.8527 ——→ by interpolation

EQUIVALENT ECCENTRICITY e = 0.8527· 25 = 21.32 cm

3. INTERPOLATIONS

MATERIAL STEEL	MATERIAL CONCRETE	LENGTH [m]	ECCENTRICITY [cm] 20	ECCENTRICITY [cm] 30	e=21.32 cm	L=3.05 m e=21.32 cm	Concrete C 37.35 L=3.05 m e=21.32 cm	Steel Fe 430 Concrete C 37.35 L=3.05 m e=21.32 cm
510	50	2.0	1278.6	940.0	1220.70	1101.94	1033.36	937.80
510	50	4.0	1027.8	775.5	994.50			
510	20	2.0	1071.5	805.5	1036.39	939.31		
510	20	4.0	878.6	673.1	851.47			
360	50	2.0	1111.2	813.0	1071.84	954.75	890.02	
360	50	4.0	877.7	658.8	848.81			
360	20	2.0	915.7	686.3	885.42	801.24		
360	20	4.0	748.4	571.7	725.08			

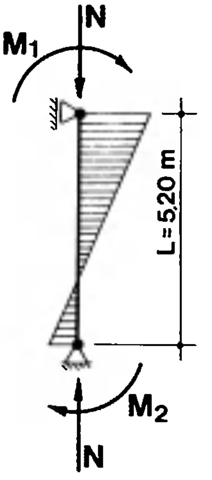
READ FROM TABLES FOR F 90

INTERPOLATION BASES

e=30 cm	L=4.00 m	50 N/mm^2	355 N/mm^2
e=21.32 cm	L=3.05 m	37.35 N/mm^2	275 N/mm^2
e=20 cm	L=2.00 m	20 N/mm^2	235 N/mm^2

Figure 7.13

1. GENERAL INDICATIONS



STEEL SECTION	:	HE 360 A, steel grade Fe 430
RE-BARS	:	8 D 20, steel grade S 500
CONCRETE	:	C 29.5 (35 N/mm^2 on cubes)
LENGTH	:	L = 5.20 m
LOADS	:	N = 880.0 kN
		M_1 = 132.0 kNm —> e_1 = 15.00 cm
		M_2 = 87.5 kNm —> e_2 = - 9.94 cm
		(weak axis)

2. CALCULATION OF THE EQUIVALENT ECCENTRICITY

SLENDERNESS RATIO : $\bar{\lambda}$ = 0.7278

RATIO : e_1/b = 15/30 = 0.50

DISTRIBUTION FACTOR : $\psi = e_2/e_1 = -9.94/15 = -0.6629$

CORRECTION FACTOR : $\beta_I = \exp^{-(0.35+0.3 \cdot e1/B)\bar{\lambda} \cdot B/e1}$

$= \exp^{-(0.35+0.3 \cdot 0.50)0.7278/0.50} = 0.4830$

INTERPOLATION :

ψ	β
- 1.0	0.4830
- 0.6629	0.5701
+ 1.0	1.0

—> by Interpolation

EQUIVALENT ECCENTRICITY e = 0.5701 · 15 = 8.55 cm

3. INTERPOLATIONS

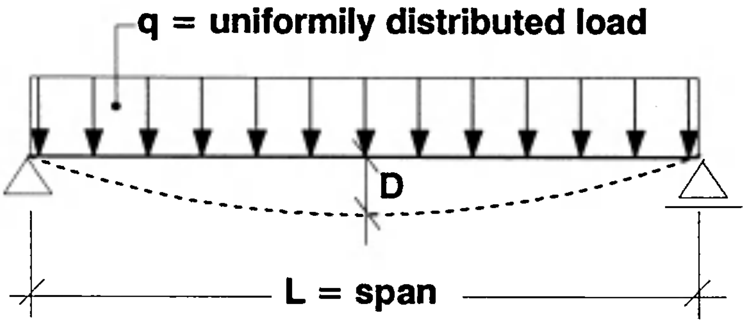
MATERIAL STEEL	MATERIAL CONCRETE	LENGTH [m]	ECCENTRICITY [cm]				Concrete C 29.05	Steel Fe 430 Concrete C 29.05
						L=5.20 m	L=5.20 m	L=5.20 m
			7.50	10	e=8.55 cm	e=8.55 cm	e=8.55 cm	e=8.55 cm
510	50	4	1125.7	963.1	1057.41	794.30	679.39	678.72
510	50	6	644.9	583.0	618.90			
510	20	4	885.6	760.9	833.23	629.75		
510	20	6	513.2	467.7	494.09			
360	50	4	1089.9	932.0	1023.58	785.74	678.02	
360	50	6	660.4	581.3	627.18			
360	20	4	859.3	739.4	808.94	631.48		
360	20	6	539.8	476.4	513.17			

READ FROM TABLES FOR F 60

INTERPOLATION BASES			
e=10 cm	L=6.00 m	50 N/mm^2	355 N/mm^2
e=8.55 cm	L=5.20 m	29.05 N/mm^2	275 N/mm^2
e=7.50 cm	L=4.00 m	20 N/mm^2	235 N/mm^2

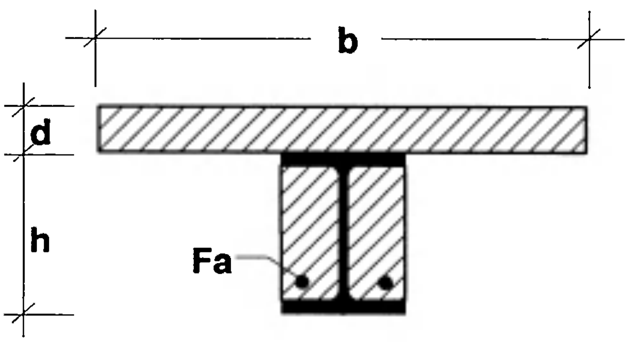
Figure 7.14

NOTATIONS FOR BEAMS



Max.bending moment :

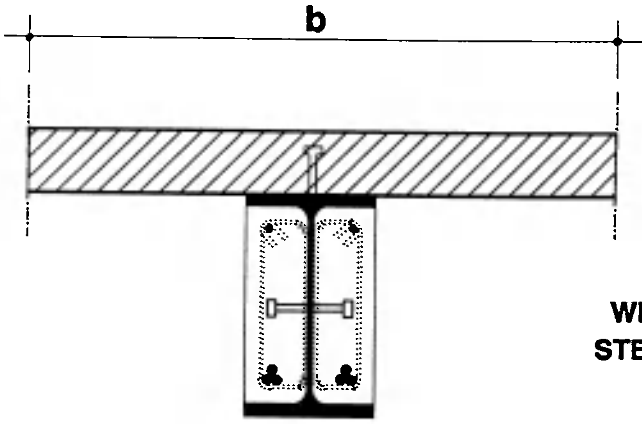
$$\boxed{M = \frac{q\,L^2}{8}}$$



b = effective width of the slab
d = thickness of the slab
h = height of steel profile
Fa = area of re-bars in the steel profile
D = deflection of the beam at the middle span

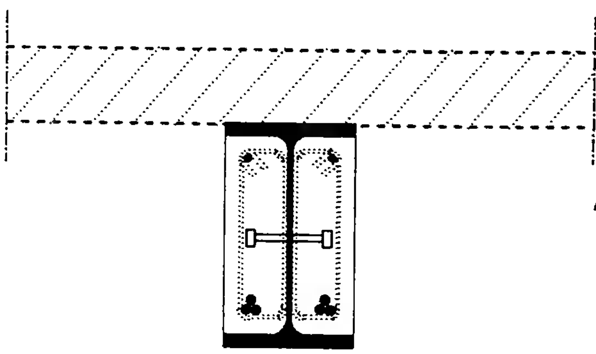
Figure 8.1

TYPES OF SECTIONS FOR BEAMS



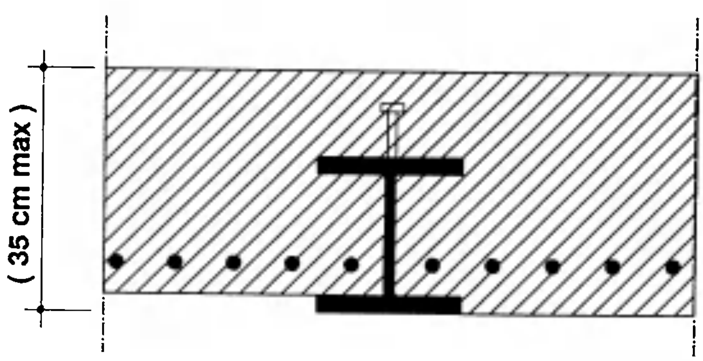
E

TRADITIONAL AF-BEAM WITH FULL INTERACTION BETWEEN STEEL SHAPE AND CONCRETE SLAB



F

AF-BEAM WITHOUT INTERACTION BETWEEN STEEL SHAPE AND CONCRETE SLAB



G

FULLY ENCASED SHAPE

Figure 8.2

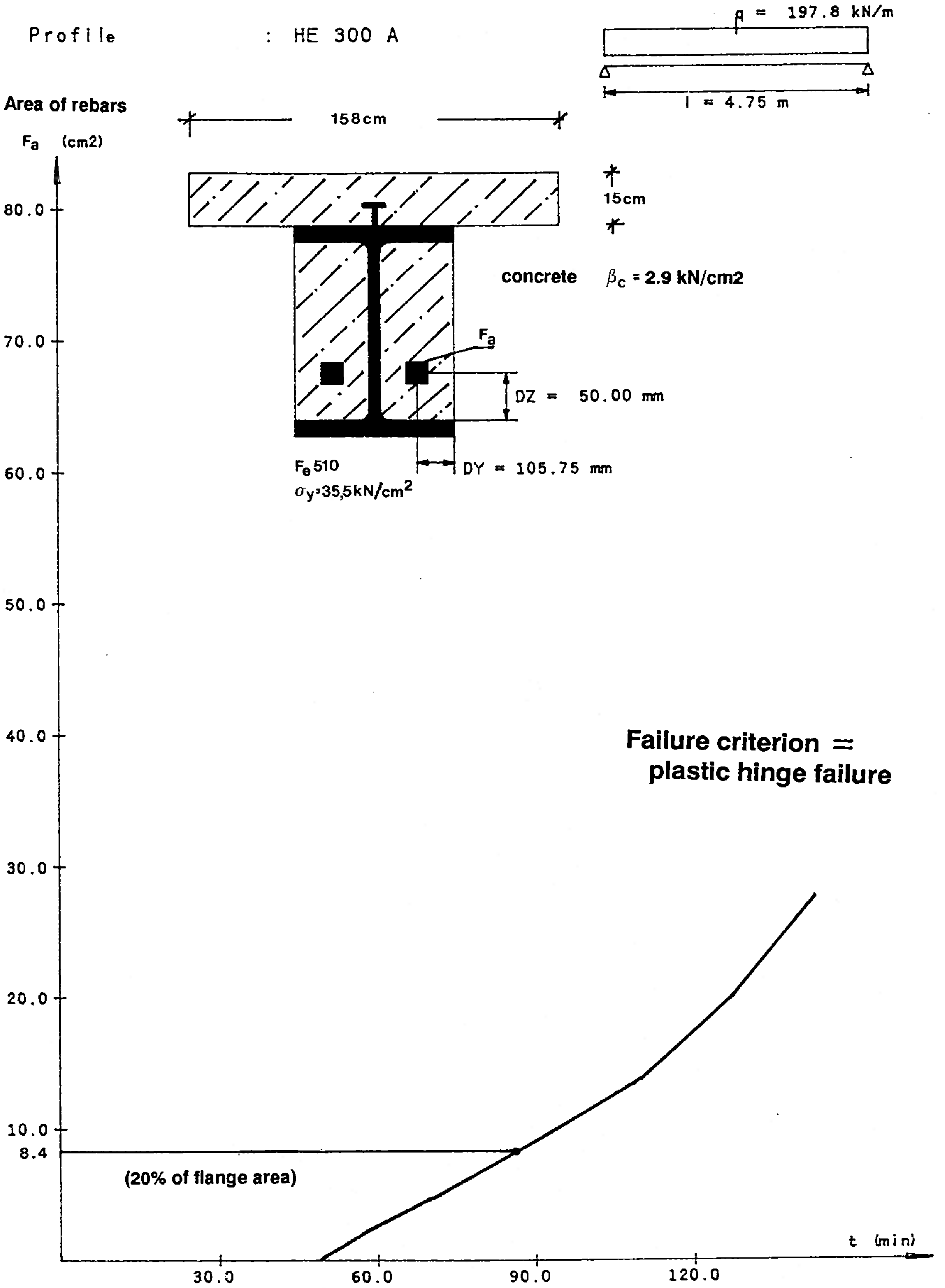

Profile : HE 300 A
q = 197.8 kN/m
l = 4.75 m
Area of rebars
F_a (cm2)
158cm
15cm
concrete β_c = 2.9 kN/cm2
F_a
DZ = 50.00 mm
F_e 510
σ_y=35,5kN/cm^2
DY = 105.75 mm
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
8.4
Failure criterion = plastic hinge failure
(20% of flange area)
t (min)
30.0
60.0
90.0
120.0

Figure 8.3

q - t FAILURE DIAGRAM
PLASTIC HINGE FAILURE
COMPOSITE AF - SECTION

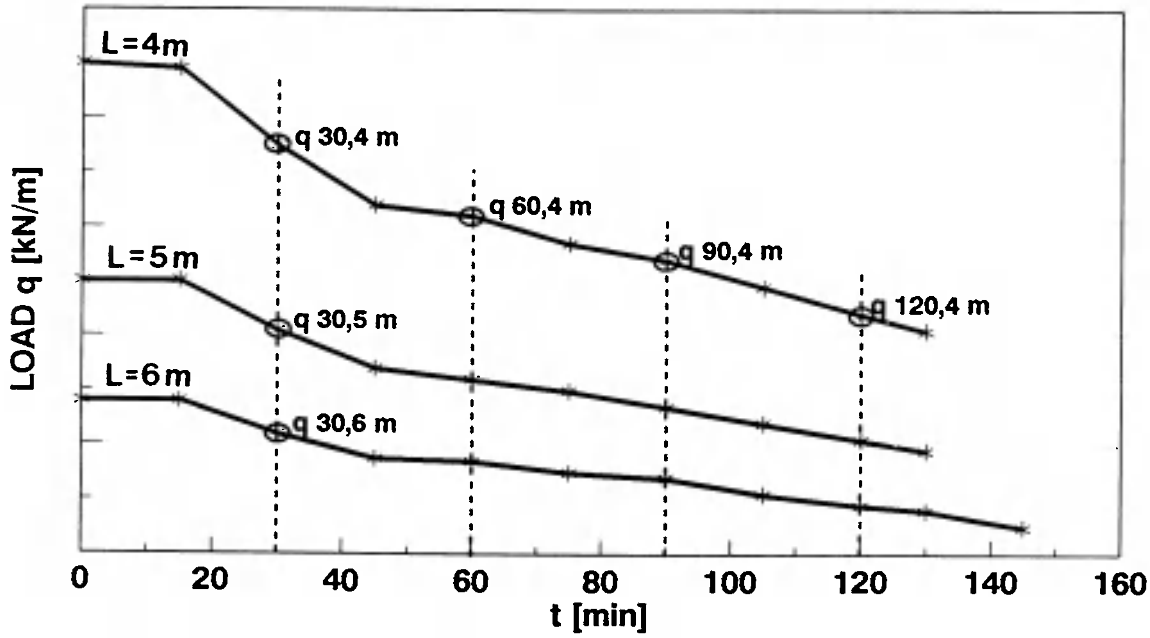


Figure 9.1

ULTIMATE BENDING MOMENTS

AF-BEAM HE 600 AA (Fe 510) + 4 D 25 (S500) CONCRETE (C25)

CONCRETE SLAB (14x200 cm)

Span	F 30		F 60		F 90		F 120	
L [m]	q_{30} [kN/cm]	M_{30} [kNm]	q_{60} [kN/cm]	M_{60} [kNm]	q_{90} [kN/cm]	M_{90} [kNm]	q_{120} [kN/cm]	M_{120} [kNm]
4	12.95	2589.6	10.51	2102.0	8.63	1725.6	7.26	1451.0
5	8.29	2589.7	6.72	2101.6	5.53	1727.2	4.65	1452.2
6	5.88	2644.2	4.67	2102.4	3.84	1728.5	3.23	1454.9
8	3.32	2653.6	2.64	2113.6	2.17	1738.4	1.83	1467.2
10	2.13	2662.5	1.70	2128.7	1.40	1755.0	1.19	1483.8
12	1.48	2671.2	1.20	2151.0	0.99	1776.6	0.83	1503.0
14	1.10	2687.6	0.89	2170.7	0.73	1798.3	0.62	1528.8
Highest differences		3.8 %		3.3 %		4.2 %		5.4 %

Figure 9.2

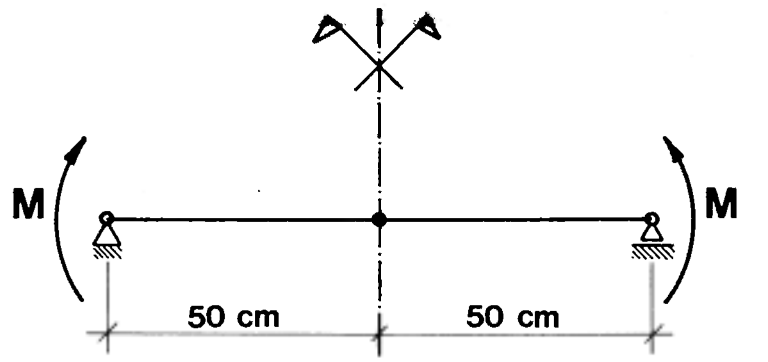


Figure 9.3

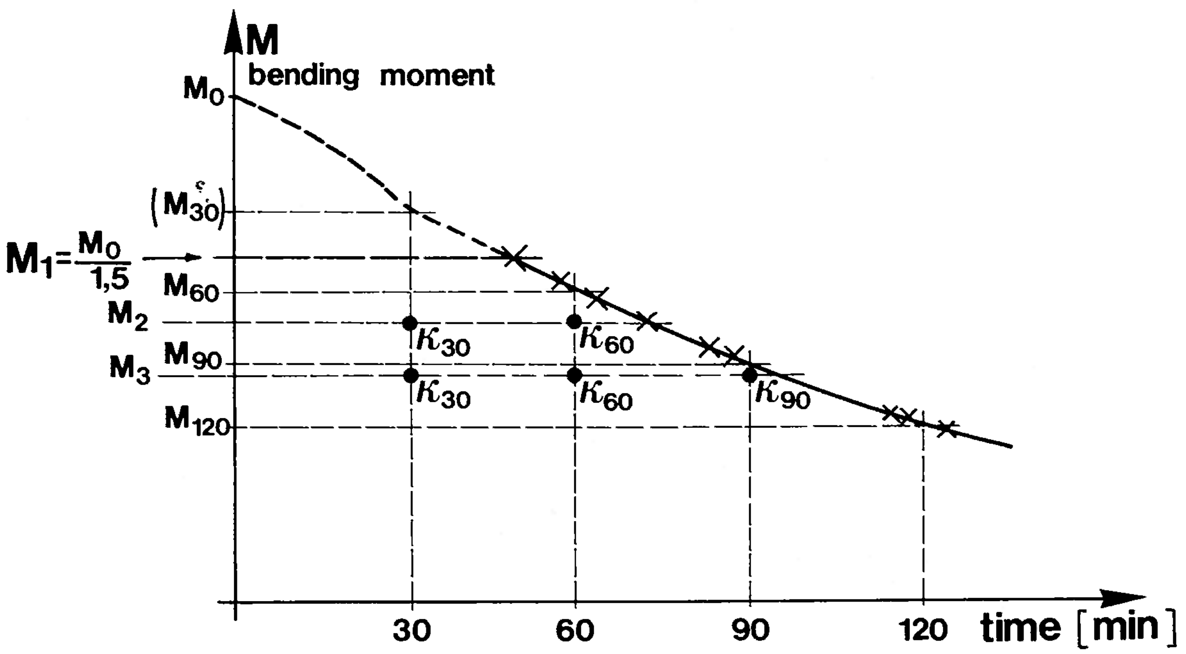
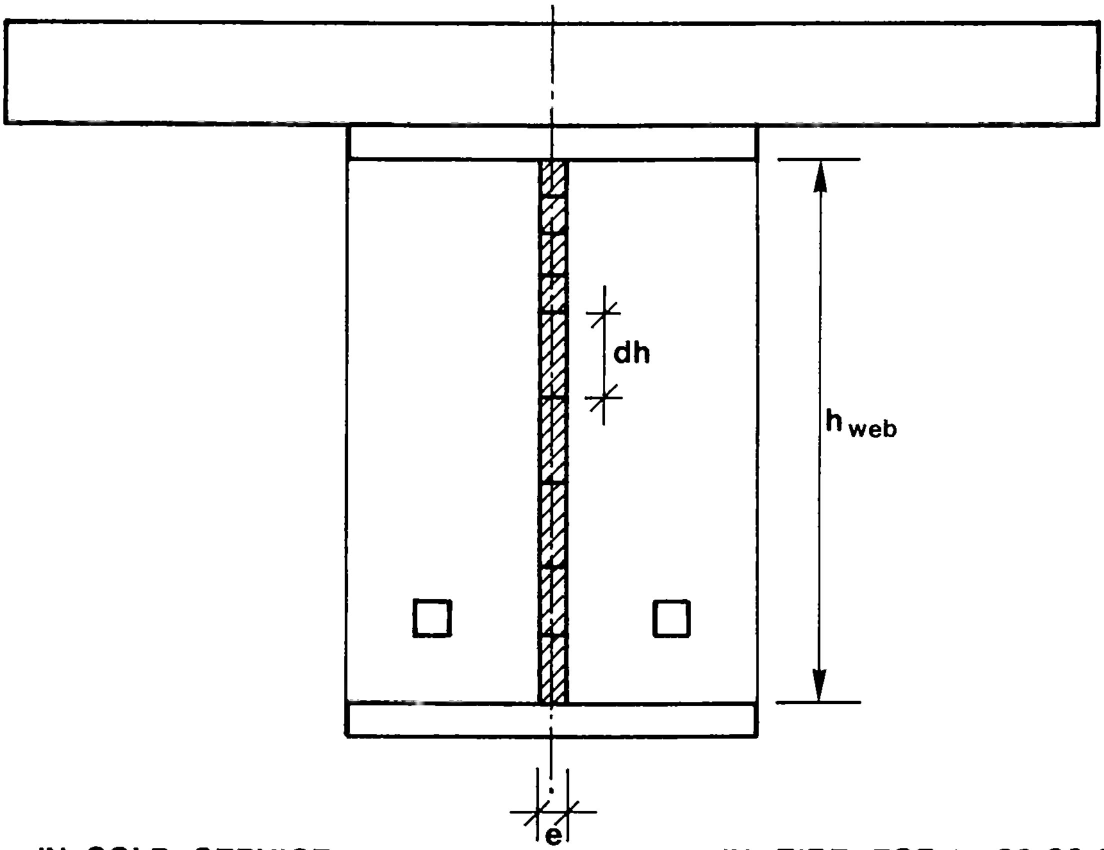


Figure 9.4



IN COLD SERVICE :

$$Q_{plast} = \Sigma_{web} \cdot e \cdot dh \cdot \frac{\sigma_y}{\sqrt{3}}$$

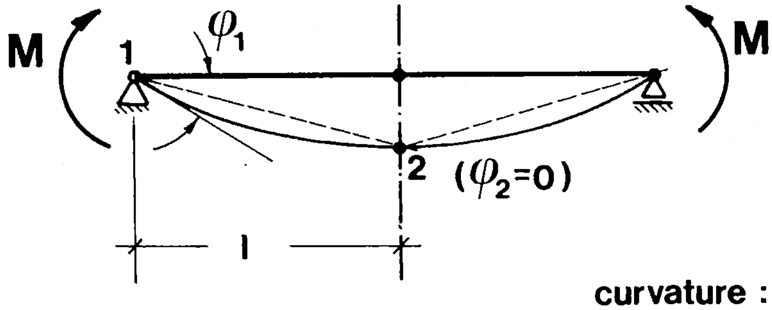
IN FIRE, FOR t = 30,60,90 or 120'

$$Q_{plast} = \Sigma_{web} \cdot e \cdot dh \cdot \frac{\sigma_{y,T}}{\sqrt{3}}$$

$\sigma_{y,T}$ is the reduced value of σ_y depending of the temperature T in the element given by CEFICOSS after the time t '.

CALCULATION OF $Q_{plast.}$ FOR SHEAR FAILURE.

Figure 9.5



curvature : $\kappa = \frac{\Delta\varphi}{l} = \frac{\varphi_2 - \varphi_1}{l} = \frac{-\varphi_1}{l}$

Figure 9.6

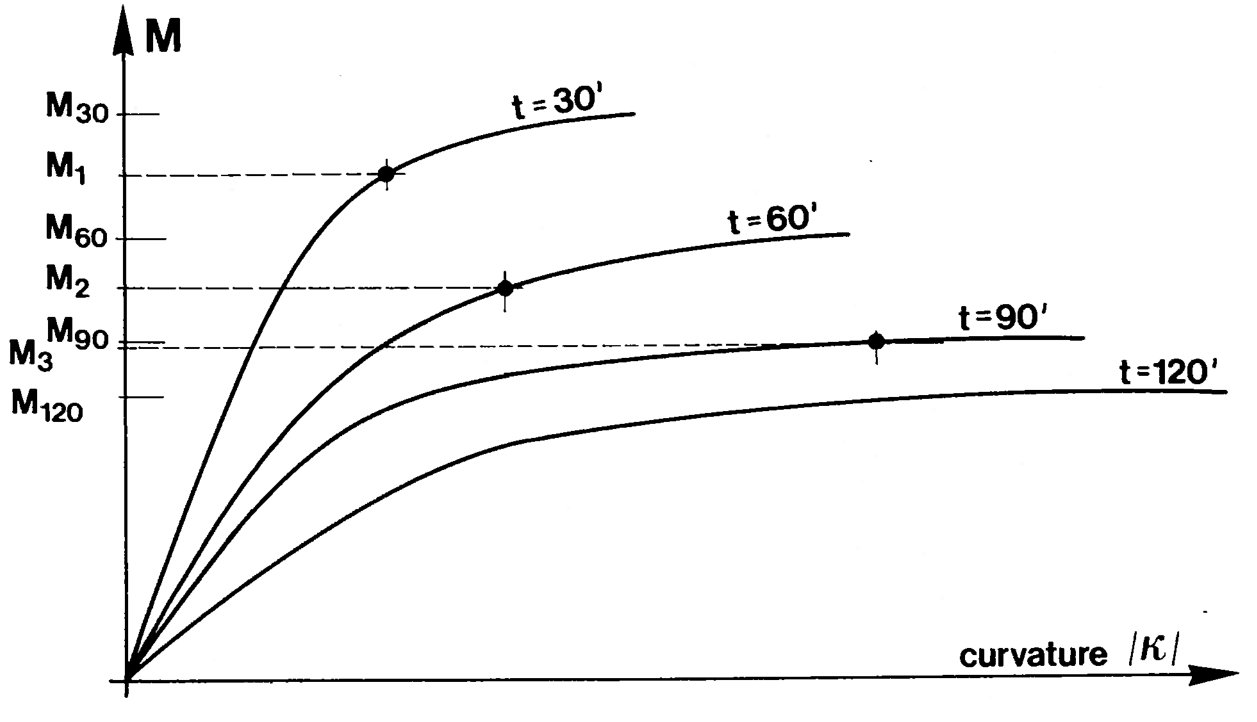


Figure 9.7

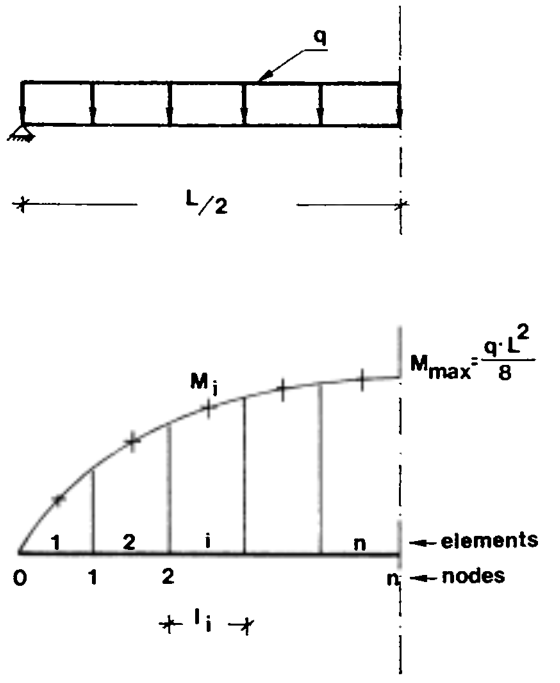


Figure 9.8

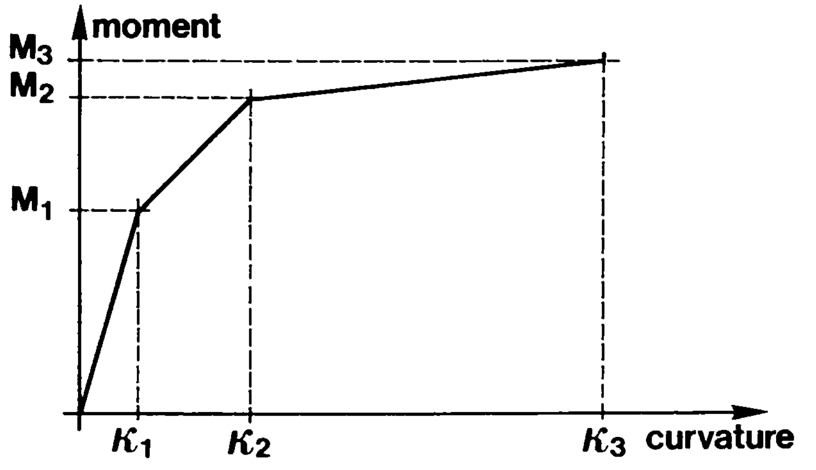


Figure 9.9

VARIATION OF THE ULTIMATE MOMENT

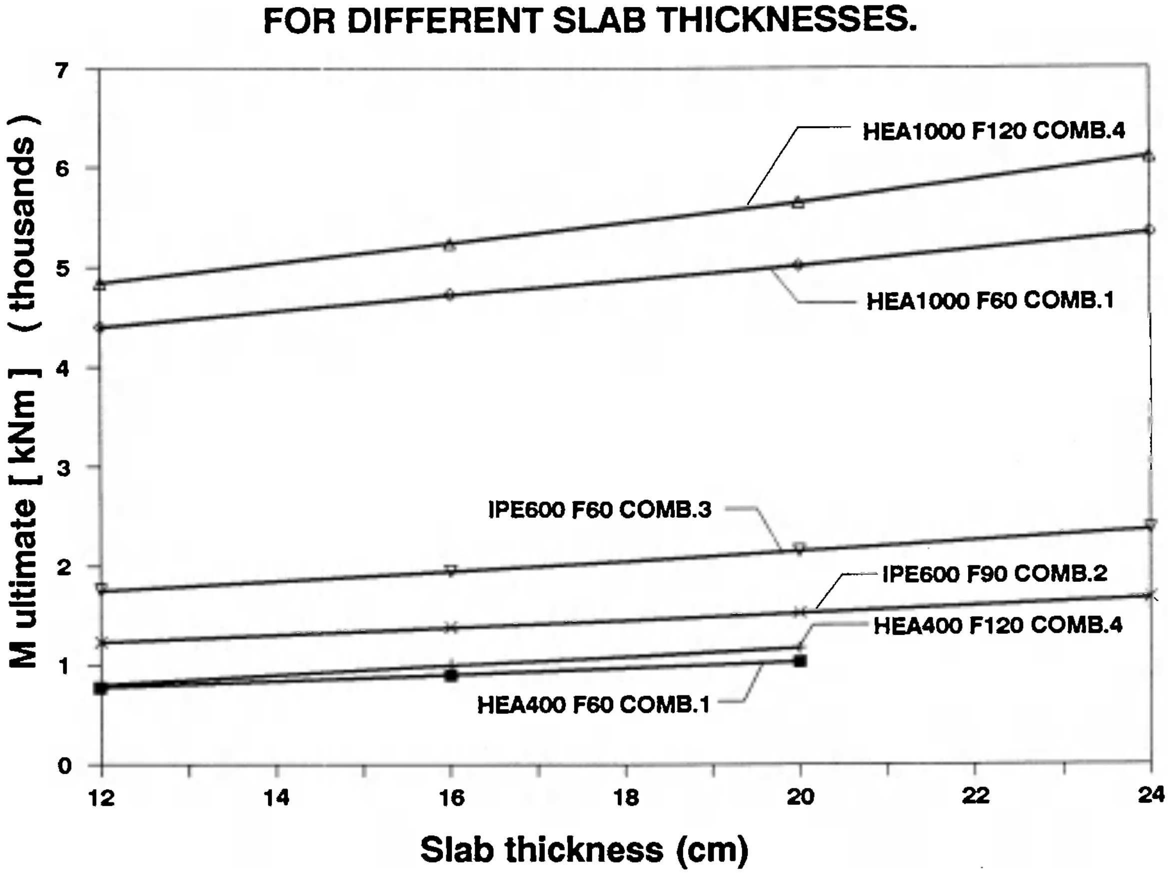
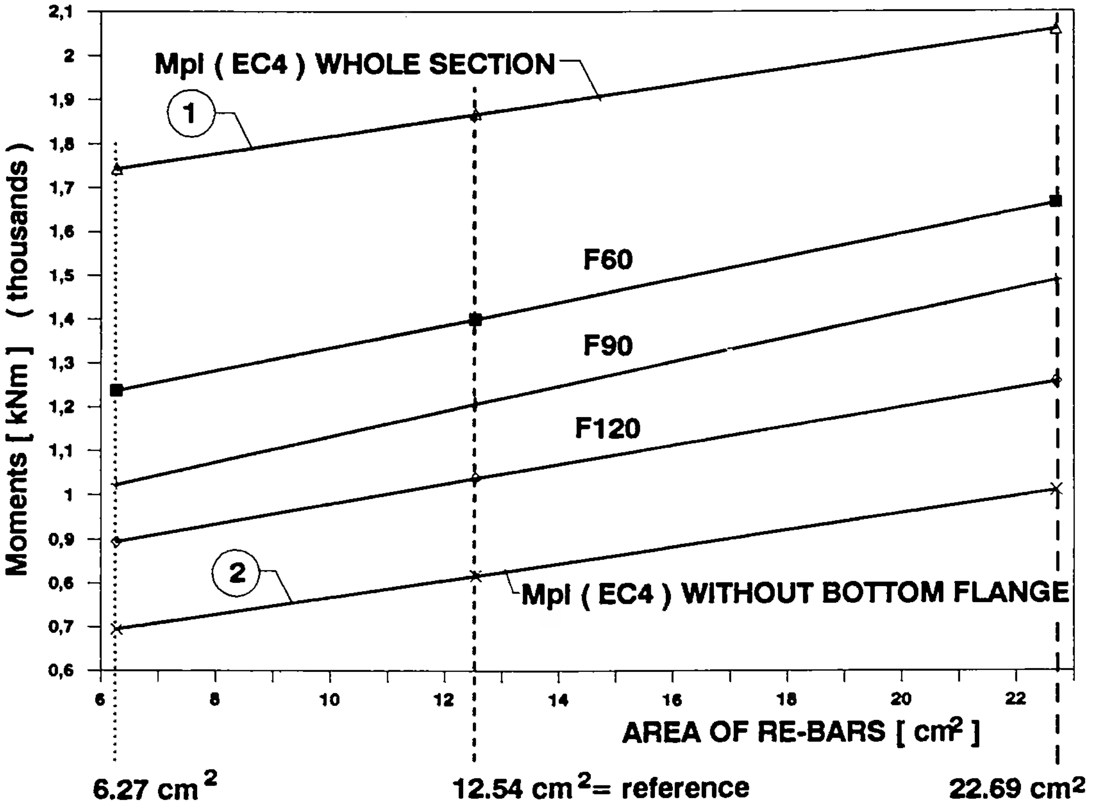
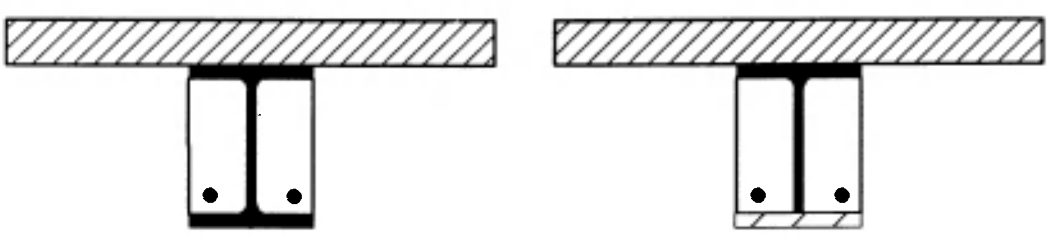


Figure 9.10

AF BEAM HEA 500 ; Fe 360 ; C 20 ; S 500

RELATION MOMENT-REINFORCEMENT AREA

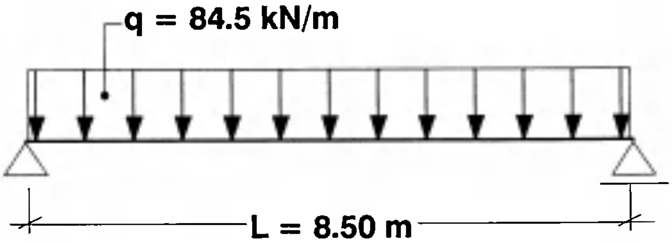




Section for 1 Section for 2

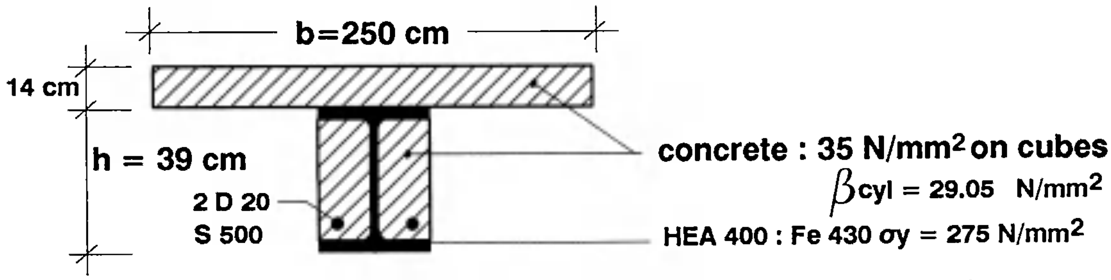
Figure 9.11

TABLES FOR BEAMS - EXAMPLE OF USE



$$M = \frac{q L^2}{8} = \boxed{76314} \text{ kNcm}$$

Cross section and material qualities



Fire resistance time reached by simulation of the beam : 89.5 minutes
Fire resistance class to be checked : F 90

AF-BEAM HE 400 A + 2 D 20
SUCCESSIVE INTERPOLATIONS

FROM TABLES

MATERIALS STEEL Fe	MATERIALS CONCRETE C	SLAB THICKNESS [cm]	M_{ult} F 90 for an effective width of 5 h = 195 cm	7.5 h = 292.5 cm	250 cm
360	**20**	**12.0**	**54085.0**	**59919.0**	
360	**20**	**16.0**	**64215.0**	**71010.0**	
360	20	14.0	59150.0	65464.5	62712.03
360	**50**	**12.0**	**65688.0**	**69972.0**	
360	**50**	**16.0**	**79098.0**	**82325.0**	
360	50	14.0	72393.0	76148.5	74511.49
510	**20**	**12.0**	**64207.0**	**75679.0**	
510	**20**	**16.0**	**79654.0**	**90229.0**	
510	20	14.0	71930.5	82954.0	78148.88
510	**50**	**12.0**	**84974.0**	**90545.0**	
510	**50**	**16.0**	**101635.0**	**110739.0**	
510	50	14.0	93304.5	100642.0	97443.6
360	50	14.0			74511.49
360	20	14.0			62712.03
360	29.05	14.0			66271.53
510	50	14.0			97443.6
510	20	14.0			78148.88
510	29.05	14.0			83969.45
510	29.05	14.0			83969.45
360	29.05	14.0			66271.53
430	29.05	14.0			72170.84

M_{90} BY INTERPOLATION : 72171 kNcm

M_{90} CALCULATED : ≃ 76314 kNcm

RATIO $\frac{72171}{76314} = 0.9457 \longrightarrow \sim 5$ % in the safe side

Figure 9.12

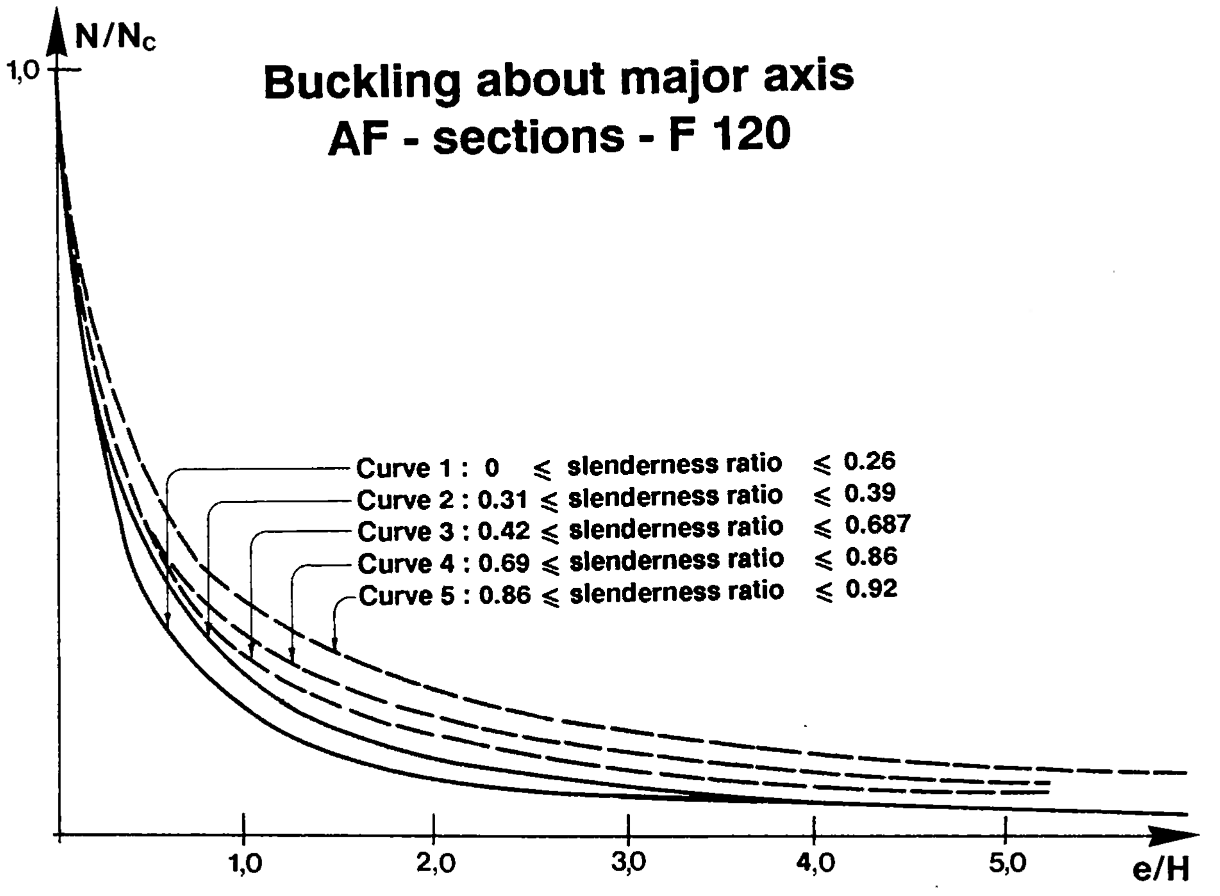

N/Nc
1,0
Buckling about major axis
AF - sections - F 120
Curve 1 : 0 ≤ slenderness ratio ≤ 0.26
Curve 2 : 0.31 ≤ slenderness ratio ≤ 0.39
Curve 3 : 0.42 ≤ slenderness ratio ≤ 0.687
Curve 4 : 0.69 ≤ slenderness ratio ≤ 0.86
Curve 5 : 0.86 ≤ slenderness ratio ≤ 0.92
1,0
2,0
3,0
4,0
5,0
e/H

Figure 10.1

PART II

PRACTICAL TOOLS FOR STRUCTURAL FIRE DESIGN

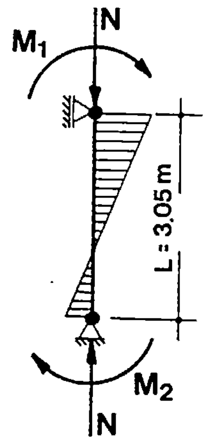
PART II

APPENDIX A. TABLES FOR COLUMNS

PART II: APPENDIX A. TABLES FOR COLUMNS

EXAMPLE OF USE:

1. GENERAL INDICATIONS



STEEL SECTION	:	HE 400 A, steel grade Fe 430
RE-BARS	:	8 D 20, steel grade S 500
CONCRETE	:	C 37.35 (45 N/mm^2 on cubes)
LENGTH	:	L = 3.05 m
LOADS	:	N = 1200 kN
		M_1 = 300 kNm----> e_1 = 25.00 cm
		M_2 = 180 kNm----> e_2 = - 15.00 cm
		(strong axis)

2. CALCULATION OF THE EQUIVALENT ECCENTRICITY

SLENDERNESS RATIO	:	$\bar{\lambda} = 0.2405$
RATIO	:	$e_1/H = 25/39 = 0.641$
DISTRIBUTION FACTOR	:	$\psi = e_2/e_1 = -15/25 = -0.60$
CORRECTION FACTOR	:	$\beta_\gamma = \exp^{-(0.35 + 0.3 \cdot e_1/H)\bar{\lambda} \cdot H/e_1}$
		$= \exp^{-(0.35 + 0.3 \cdot 0.641)\, 0.2405/0.641} = 0.8159$

INTERPOLATION :

ψ	β	
- 1.0	0.8159	
- 0.6	0.8527	⟶ by interpolation
+ 1.0	1.0	

EQUIVALENT ECCENTRICITY e = 0.8527 · 25 = 21.32 cm

3. INTERPOLATIONS

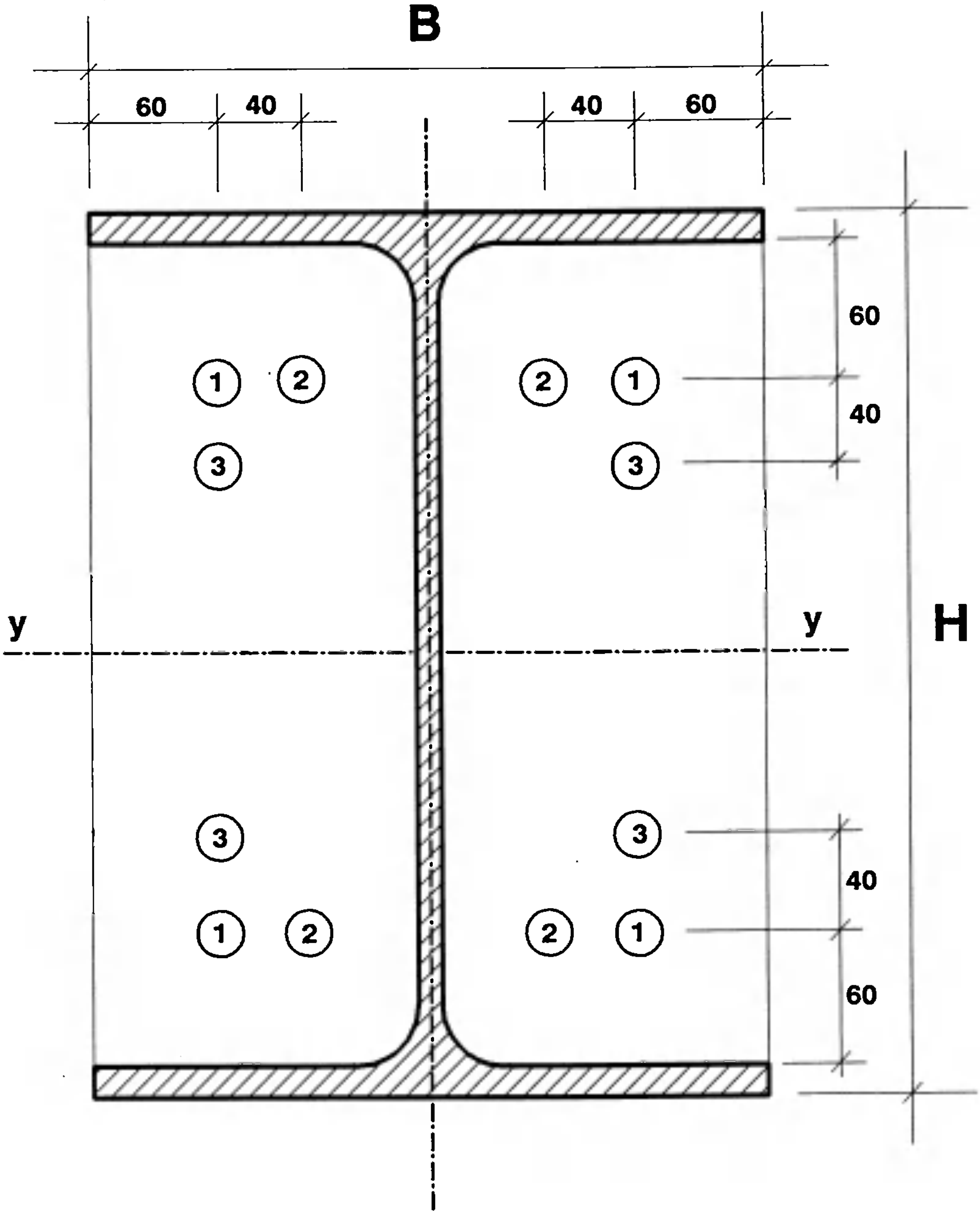
MATERIAL STEEL	MATERIAL CONCRETE	LENGTH [m]	ECCENTRICITY [cm] 20	ECCENTRICITY [cm] 30	e=21.32 cm	L=3.05 m e=21.32 cm	Concrete C 37.35 L=3.05 m e=21.32 cm	Steel Fe 430 Concrete C 37.35 L=3.05 m e=21.32 cm
510	50	2.0	1278.6	940.0	1220.70	1101.94	1033.36	937.80
510	50	4.0	1027.8	775.5	994.50			
510	20	2.0	1071.5	805.5	1036.39	939.31		
510	20	4.0	878.6	673.1	851.47			
360	50	2.0	1111.2	813.0	1071.84	954.75	890.02	
360	50	4.0	877.7	658.8	848.81			
360	20	2.0	915.7	686.3	885.42	801.24		
360	20	4.0	748.4	571.7	725.08			

READ FROM TABLES FOR F 90

INTERPOLATION BASES			
e=30 cm	L=4.00 m	50 N/mm^2	355 N/mm^2
e=21.32 cm	L=3.05 m	37.35 N/mm^2	275 N/mm^2
e=20 cm	L=2.00 m	20 N/mm^2	235 N/mm^2

COLUMN CROSS SECTION TYPE AF.

TYPICAL LAYOUT OF REINFORCING BARS
FOR BENDING ABOUT MAJOR AXIS ≡ STRONG AXIS yy



LAYOUT 1 WHEN 4 REINFORCING BARS
LAYOUT 1+2 WHEN 8 REINFORCING BARS
LAYOUT 1+2+3 WHEN 12 REINFORCING BARS

DESIGNATION	> AF-HE 300 A + 4 D 25	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	5837.8	4996.8	3379.0	2407.9	1531.4	1123.8	803.9	626.1	391.2	221.5
Fe510 C50	4.	3856.2	3306.9	2373.3	1773.2	1196.3	912.4	679.6	545.2	354.5	207.8
Fe510 C50	6.	1941.2	1756.6	1430.1	1171.9	875.7	708.0	557.2	463.7	315.9	191.4
Fe510 C50	8.	1214.7	1122.6	966.8	830.8	659.0	553.2	452.0	386.1	271.3	167.2
Fe510 C20	2.	4149.7	3680.0	2673.7	1994.1	1323.6	991.4	720.9	566.7	358.3	204.7
Fe510 C20	4.	2625.7	2357.9	1836.0	1448.4	1030.3	806.5	613.5	498.1	329.1	195.2
Fe510 C20	6.	1493.3	1382.4	1171.7	991.0	767.2	632.5	506.3	425.6	294.0	180.1
Fe510 C20	8.	976.0	916.7	811.2	713.4	581.9	496.6	411.9	355.1	252.8	157.4
Fe360 C50	2.	5214.7	4354.9	2813.5	1952.9	1213.6	881.3	625.3	484.9	301.2	169.8
Fe360 C50	4.	3587.6	2955.6	1993.1	1436.2	938.4	705.2	519.3	414.0	267.0	155.6
Fe360 C50	6.	1795.3	1575.9	1221.5	966.5	696.7	553.0	428.6	353.6	238.0	143.0
Fe360 C50	8.	1051.7	956.1	802.5	675.7	523.5	433.8	350.5	297.3	206.9	126.6
Fe360 C20	2.	3525.8	3086.9	2183.2	1599.7	1043.8	775.4	560.0	438.5	275.9	157.0
Fe360 C20	4.	2344.4	2062.7	1546.8	1188.8	823.8	636.4	478.9	386.4	253.2	149.2
Fe360 C20	6.	1291.2	1177.5	971.6	804.3	607.7	494.3	391.0	326.3	223.2	135.7
Fe360 C20	8.	812.3	756.1	658.9	571.8	458.9	387.8	318.8	273.3	193.0	119.4

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	3928.9	3224.9	2021.5	1380.4	846.1	610.6	431.2	333.5	206.5	116.2
Fe510 C50	4.	2434.5	2010.6	1360.8	982.5	643.0	483.6	356.3	284.2	183.4	106.9
Fe510 C50	6.	1224.2	1072.8	829.4	655.2	471.5	373.9	289.6	238.8	160.7	96.5
Fe510 C50	8.	684.3	623.5	525.2	443.3	344.5	285.9	231.3	196.4	136.9	83.8
Fe510 C20	2.	2719.3	2337.2	1593.0	1140.6	728.5	535.7	383.8	299.2	187.1	106.0
Fe510 C20	4.	1803.1	1549.6	1116.2	835.8	565.1	431.4	321.5	258.1	167.9	98.5
Fe510 C20	6.	975.9	874.2	699.9	566.4	417.7	335.4	262.5	217.7	147.6	89.2
Fe510 C20	8.	576.3	531.4	456.1	390.9	309.0	258.9	211.2	180.2	126.4	77.8
Fe360 C50	2.	3634.8	2924.2	1773.1	1190.1	719.3	516.0	362.7	279.8	172.7	96.9
Fe360 C50	4.	2309.4	1843.3	1189.1	836.9	536.2	399.6	292.3	232.2	149.1	86.6
Fe360 C50	6.	1167.9	992.2	733.1	562.6	393.9	308.3	236.3	193.7	129.3	77.2
Fe360 C50	8.	677.9	598.5	481.4	392.9	294.5	239.9	191.0	160.7	110.6	67.1
Fe360 C20	2.	2403.5	2044.2	1365.7	966.3	610.6	446.7	318.8	248.0	154.7	87.5
Fe360 C20	4.	1653.4	1394.0	973.5	715.5	475.7	360.3	266.9	213.5	138.3	80.8
Fe360 C20	6.	900.1	791.8	615.9	488.5	352.9	280.5	217.6	179.6	121.0	72.7
Fe360 C20	8.	553.2	499.0	414.0	345.4	265.1	218.5	175.7	148.7	103.1	62.9

DESIGNATION	> AF-HE 300 A + 4 D 25
SECTION	> AF-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	2766.8	2227.2	1351.8	907.8	548.8	393.8	276.9	213.6	131.8	74.0
Fe510 C50	4.	1761.0	1413.5	918.8	649.2	417.3	311.4	228.0	181.3	116.5	67.7
Fe510 C50	6.	1043.8	863.0	615.0	462.0	317.4	246.3	187.5	153.1	101.7	60.5
Fe510 C50	8.	585.2	509.1	401.4	323.2	239.0	193.4	153.1	128.4	88.0	53.2
Fe510 C20	2.	1863.7	1584.0	1057.0	747.3	471.9	345.2	246.3	191.6	119.5	67.6
Fe510 C20	4.	1358.3	1130.0	773.1	561.6	369.5	278.5	205.6	164.1	106.0	61.9
Fe510 C20	6.	854.4	724.6	534.0	409.2	286.1	223.8	171.4	140.5	93.8	56.0
Fe510 C20	8.	505.5	445.5	357.5	291.3	218.0	177.4	141.2	118.7	81.6	49.5
Fe360 C50	2.	2583.4	2041.8	1203.8	796.9	476.4	340.1	238.3	183.5	113.0	63.3
Fe360 C50	4.	1651.4	1288.1	806.4	559.1	354.0	262.5	191.3	151.7	97.1	56.3
Fe360 C50	6.	983.7	788.6	541.1	398.2	268.8	206.9	156.6	127.4	84.3	50.0
Fe360 C50	8.	573.6	481.3	362.8	283.9	204.4	163.3	128.0	106.8	72.6	43.7
Fe360 C20	2.	1690.1	1420.7	928.7	648.9	405.6	295.3	209.9	163.0	101.3	57.2
Fe360 C20	4.	1237.8	1013.6	677.4	485.8	316.1	237.1	174.4	138.9	89.5	52.1
Fe360 C20	6.	789.6	656.3	470.9	355.1	244.8	190.2	145.0	118.5	78.8	46.9
Fe360 C20	8.	483.3	415.4	322.5	257.0	188.2	151.6	119.6	100.1	68.4	41.3

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	1895.2	1515.5	910.1	607.9	366.0	262.1	184.0	141.9	87.5	49.1
Fe510 C50	4.	1240.1	980.7	624.9	437.1	278.7	207.2	151.3	120.1	77.0	44.7
Fe510 C50	6.	817.0	651.0	443.5	325.1	218.7	168.2	127.1	103.4	68.4	40.5
Fe510 C50	8.	455.8	386.4	294.9	232.5	168.6	135.1	106.2	88.7	60.4	36.4
Fe510 C20	2.	1271.7	1075.1	710.2	499.2	313.6	228.9	163.0	126.7	78.9	44.6
Fe510 C20	4.	967.3	793.1	531.2	381.3	248.3	186.4	137.1	109.2	70.4	41.0
Fe510 C20	6.	684.2	558.5	391.7	291.6	198.8	153.7	116.7	95.2	63.1	37.5
Fe510 C20	8.	409.8	350.1	269.6	213.8	155.9	125.2	98.6	82.5	56.3	33.9
Fe360 C50	2.	1787.1	1399.0	812.9	534.4	317.7	226.3	158.3	121.8	74.9	41.9
Fe360 C50	4.	1162.6	894.0	549.7	378.0	237.7	175.8	127.8	101.2	64.7	37.5
Fe360 C50	6.	757.2	586.0	386.5	278.7	185.1	141.5	106.5	86.5	57.0	33.7
Fe360 C50	8.	445.3	362.8	264.6	203.1	143.8	114.0	88.8	73.9	50.0	30.0
Fe360 C20	2.	1159.0	968.9	627.2	435.8	271.0	196.9	139.8	108.4	67.3	38.0
Fe360 C20	4.	873.5	707.1	465.0	330.6	213.6	159.7	117.2	93.2	60.0	34.9
Fe360 C20	6.	629.7	504.2	345.4	254.0	171.3	131.9	99.8	81.2	53.7	31.9
Fe360 C20	8.	386.8	322.0	240.5	187.2	134.1	106.9	83.7	69.7	47.3	28.5

DESIGNATION	> AF-HE 320 A + 4 D 25
SECTION	> AF-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	6478.8	5617.1	3894.9	2818.4	1817.6	1342.6	965.4	754.1	469.3	262.4
Fe510 C50	4.	4647.9	3997.7	2883.3	2160.9	1462.0	1116.4	832.4	668.2	431.5	249.0
Fe510 C50	6.	2379.7	2155.6	1758.1	1442.6	1079.5	873.5	687.9	572.7	387.4	230.8
Fe510 C50	8.	1533.2	1414.3	1214.3	1041.0	823.3	690.0	563.0	480.5	334.5	202.2
Fe510 C20	2.	4629.2	4145.4	3076.0	2327.6	1567.5	1182.6	865.0	682.2	430.0	242.7
Fe510 C20	4.	3179.1	2854.8	2222.9	1753.5	1247.3	976.3	742.7	603.0	395.4	230.7
Fe510 C20	6.	1826.6	1690.3	1431.9	1210.4	936.6	771.9	617.7	519.1	355.8	214.1
Fe510 C20	8.	1235.2	1157.6	1020.3	894.2	726.3	618.2	511.5	440.3	310.3	189.4
Fe360 C50	2.	5652.2	4814.0	3224.5	2285.0	1445.8	1058.5	755.8	588.1	364.2	202.9
Fe360 C50	4.	4227.3	3511.4	2397.0	1739.0	1142.9	861.1	635.4	507.1	325.1	186.5
Fe360 C50	6.	2244.5	1964.9	1516.9	1197.0	860.5	682.2	528.2	435.4	290.7	171.5
Fe360 C50	8.	1312.0	1191.0	997.3	838.1	648.1	536.4	433.0	367.2	253.3	152.1
Fe360 C20	2.	3864.5	3427.6	2490.9	1858.2	1233.6	924.1	672.0	528.2	331.5	186.5
Fe360 C20	4.	2801.4	2467.6	1854.3	1427.1	990.2	765.4	576.3	465.2	302.6	175.5
Fe360 C20	6.	1597.1	1457.0	1203.0	996.5	753.4	613.0	485.0	404.9	274.9	164.3
Fe360 C20	8.	1006.8	936.9	816.2	708.1	568.1	480.0	394.5	338.2	237.0	143.9

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	4338.9	3620.3	2335.3	1619.5	1005.7	730.1	517.9	401.5	247.5	137.4
Fe510 C50	4.	2909.6	2412.5	1642.5	1189.8	781.0	588.1	433.7	346.1	221.8	127.2
Fe510 C50	6.	1510.1	1321.2	1019.1	803.7	577.4	457.6	354.2	292.0	194.9	114.9
Fe510 C50	8.	864.2	784.7	657.4	552.7	427.6	354.0	285.8	242.4	167.3	100.4
Fe510 C20	2.	2991.6	2606.9	1826.2	1330.0	862.9	639.2	460.6	360.3	224.6	125.7
Fe510 C20	4.	2134.3	1840.4	1333.1	1001.8	679.4	519.4	387.7	311.3	201.2	116.1
Fe510 C20	6.	1198.4	1071.1	854.2	689.4	507.0	406.5	317.7	263.3	177.0	105.0
Fe510 C20	8.	718.7	660.8	564.4	481.8	379.1	316.9	257.9	219.8	152.7	92.1
Fe360 C50	2.	3988.3	3264.5	2036.8	1387.4	848.6	611.9	431.9	333.9	205.1	113.6
Fe360 C50	4.	2733.1	2190.2	1420.4	1002.4	643.7	480.1	351.5	279.4	178.1	101.8
Fe360 C50	6.	1448.0	1225.1	900.2	688.5	480.5	375.6	287.5	235.5	155.9	91.4
Fe360 C50	8.	844.4	742.5	594.0	482.9	360.6	293.2	233.1	195.9	133.6	79.5
Fe360 C20	2.	2624.1	2263.9	1554.6	1118.2	717.1	528.3	379.1	295.8	183.8	102.6
Fe360 C20	4.	1935.4	1637.7	1150.3	848.4	565.7	429.1	318.2	254.7	163.8	94.3
Fe360 C20	6.	1106.7	970.1	750.3	592.9	426.7	338.5	262.2	216.2	144.4	85.2
Fe360 C20	8.	683.6	615.1	508.4	423.1	323.7	266.4	214.0	181.0	124.4	74.4

DESIGNATION	> AF-HE 320 A + 4 D 25
SECTION	> AF-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	3109.0	2540.6	1580.8	1075.2	656.9	473.4	334.0	258.2	158.5	87.8
Fe510 C50	4.	2056.3	1666.4	1097.5	780.8	504.8	377.5	277.0	220.4	140.7	80.5
Fe510 C50	6.	1269.2	1051.3	750.9	564.8	388.4	301.5	229.6	187.6	123.7	72.3
Fe510 C50	8.	723.1	628.8	495.6	398.8	294.9	238.5	188.9	158.4	107.7	63.9
Fe510 C20	2.	2091.9	1798.1	1225.8	877.9	560.7	412.3	295.4	230.3	143.0	79.8
Fe510 C20	4.	1554.8	1307.3	909.0	666.5	442.1	334.5	247.6	198.0	127.2	73.1
Fe510 C20	6.	1037.4	879.2	647.5	495.9	346.5	271.0	207.6	170.1	112.6	66.1
Fe510 C20	8.	623.0	547.7	438.0	356.0	265.8	216.1	171.8	144.4	98.4	58.6
Fe360 C50	2.	2885.9	2318.3	1402.3	940.1	567.6	407.0	286.0	220.6	135.1	74.7
Fe360 C50	4.	1910.7	1509.5	960.5	671.4	427.8	318.0	232.2	184.3	117.3	67.0
Fe360 C50	6.	1193.0	958.1	658.8	485.2	327.8	252.5	191.1	155.6	102.2	59.6
Fe360 C50	8.	720.2	600.9	449.9	350.7	251.6	200.7	157.1	130.9	88.3	52.1
Fe360 C20	2.	1865.1	1590.1	1067.1	757.0	479.5	351.2	250.9	195.2	120.9	67.4
Fe360 C20	4.	1403.6	1163.2	791.3	573.0	375.9	283.0	208.7	166.5	106.7	61.2
Fe360 C20	6.	950.1	790.3	567.6	428.3	295.4	229.6	175.0	143.0	94.4	55.2
Fe360 C20	8.	602.2	514.6	396.7	314.6	229.5	184.4	145.2	121.4	82.2	48.7

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	2160.2	1751.4	1075.5	726.5	441.4	317.3	223.5	172.6	105.8	58.5
Fe510 C50	4.	1422.0	1142.4	743.5	525.6	338.1	252.3	184.8	146.9	93.7	53.6
Fe510 C50	6.	976.2	784.3	539.5	397.4	268.6	206.9	156.6	127.5	83.7	48.8
Fe510 C50	8.	590.6	496.0	374.2	293.0	211.1	168.7	132.3	110.3	74.5	44.0
Fe510 C20	2.	1440.9	1231.8	830.9	591.3	375.5	275.4	196.9	153.3	95.0	53.0
Fe510 C20	4.	1090.6	907.8	621.7	451.9	297.5	224.3	165.6	132.2	84.8	48.7
Fe510 C20	6.	815.2	668.0	470.7	351.4	240.1	185.8	141.2	115.2	75.8	44.3
Fe510 C20	8.	509.3	433.1	331.7	262.1	190.4	152.8	120.2	100.4	67.9	40.2
Fe360 C50	2.	2027.8	1610.8	957.2	636.0	381.3	272.6	191.2	147.3	90.0	49.7
Fe360 C50	4.	1314.8	1031.7	650.7	452.9	287.6	213.5	155.7	123.5	78.5	44.8
Fe360 C50	6.	920.8	714.2	472.1	340.8	226.5	173.3	130.5	105.9	69.3	40.3
Fe360 C50	8.	568.8	458.6	330.7	252.2	177.7	140.5	109.3	90.8	60.9	35.8
Fe360 C20	2.	1298.4	1099.2	728.0	512.5	322.4	235.4	167.7	130.4	80.6	44.9
Fe360 C20	4.	972.6	801.2	540.2	389.2	254.3	191.1	140.7	112.2	71.8	41.2
Fe360 C20	6.	748.6	602.0	414.5	305.5	206.6	159.1	120.5	98.1	64.4	37.6
Fe360 C20	8.	492.2	405.6	299.5	231.5	165.0	131.1	102.4	85.2	57.3	33.8

DESIGNATION > AF-HE 360 A + 8 D 20
SECTION > AF-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	7823.0	6932.3	5028.3	3746.1	2483.9	1859.5	1351.5	1062.1	658.5	361.1
Fe510 C50	4.	6300.2	5466.3	4000.7	3026.2	2065.2	1583.5	1184.6	952.6	609.4	342.9
Fe510 C50	6.	3714.5	3328.3	2665.6	2158.1	1592.0	1278.6	1000.6	830.0	551.9	318.4
Fe510 C50	8.	2300.6	2116.3	1809.2	1545.5	1217.3	1017.8	828.7	706.4	485.0	284.0
Fe510 C20	2.	5672.3	5157.3	3960.7	3072.0	2122.5	1622.6	1199.9	952.4	598.5	331.4
Fe510 C20	4.	4562.8	4088.1	3169.6	2492.7	1767.6	1381.3	1049.4	851.3	551.0	312.7
Fe510 C20	6.	2783.9	2557.5	2138.0	1788.1	1366.6	1118.5	889.6	745.0	501.9	292.4
Fe510 C20	8.	1825.7	1706.9	1498.5	1308.8	1058.5	898.7	741.9	637.7	443.0	261.9
Fe360 C50	2.	6836.6	5969.7	4199.3	3066.3	1994.3	1479.0	1066.9	834.9	514.7	281.1
Fe360 C50	4.	5622.2	4747.2	3323.2	2446.1	1628.1	1233.8	914.5	731.6	464.9	260.3
Fe360 C50	6.	3560.4	3071.2	2319.2	1804.0	1279.1	1007.1	775.6	637.4	418.7	239.4
Fe360 C50	8.	2069.4	1859.0	1532.6	1273.0	972.0	799.1	641.3	542.0	367.7	213.4
Fe360 C20	2.	4717.2	4258.0	3216.4	2464.7	1681.4	1276.9	939.1	743.0	464.8	256.6
Fe360 C20	4.	3929.8	3473.2	2625.8	2029.0	1413.5	1094.8	825.7	667.0	429.3	242.6
Fe360 C20	6.	2492.6	2248.9	1821.9	1487.4	1107.1	893.2	701.7	583.4	389.1	225.0
Fe360 C20	8.	1601.3	1476.7	1267.4	1086.2	858.7	719.5	586.9	500.9	344.4	201.9

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	5439.6	4662.6	3161.4	2256.5	1437.1	1055.3	755.3	588.5	360.8	196.2
Fe510 C50	4.	4161.2	3482.1	2403.7	1755.0	1159.8	876.0	647.6	517.4	328.2	183.5
Fe510 C50	6.	2470.2	2130.1	1607.7	1250.2	886.1	697.6	537.2	441.5	290.0	165.8
Fe510 C50	8.	1473.7	1314.4	1072.4	884.0	669.6	548.2	438.5	369.8	250.2	144.9
Fe510 C20	2.	3804.7	3379.2	2462.9	1840.9	1224.5	918.2	668.2	525.5	326.1	178.9
Fe510 C20	4.	3059.8	2652.9	1939.2	1465.6	999.4	766.1	572.9	460.6	294.6	165.7
Fe510 C20	6.	1940.2	1711.0	1335.7	1062.1	769.3	612.1	475.3	392.5	259.5	149.0
Fe510 C20	8.	1213.6	1096.6	911.9	762.3	586.1	483.6	389.3	329.6	224.2	130.4
Fe360 C50	2.	4957.8	4190.6	2767.4	1944.9	1221.7	891.5	634.9	493.3	301.3	163.5
Fe360 C50	4.	3851.6	3142.6	2089.8	1494.5	970.2	727.1	534.3	425.4	268.7	149.8
Fe360 C50	6.	2352.0	1965.2	1419.8	1075.0	743.6	578.8	441.7	361.2	235.7	134.1
Fe360 C50	8.	1414.6	1224.9	960.0	769.7	567.1	457.9	362.1	303.4	203.5	117.1
Fe360 C20	2.	3319.2	2929.6	2107.1	1561.0	1029.4	768.6	557.4	437.5	270.8	148.3
Fe360 C20	4.	2724.7	2333.2	1670.5	1246.4	839.8	640.0	476.5	382.1	243.6	136.7
Fe360 C20	6.	1798.4	1555.9	1180.1	920.5	654.4	515.9	397.7	327.1	215.0	123.0
Fe360 C20	8.	1127.3	1001.7	813.0	667.7	503.8	411.6	328.7	276.9	187.1	108.3

DESIGNATION > AF-HE 360 A + 8 D 20
SECTION > AF-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	4049.4	3418.1	2251.6	1580.1	991.3	722.9	514.6	399.8	244.1	132.4
Fe510 C50	4.	2983.2	2460.2	1661.6	1198.3	783.5	589.0	433.8	345.9	218.8	122.2
Fe510 C50	6.	1984.7	1648.9	1182.5	891.4	614.3	477.3	363.7	297.2	193.8	110.2
Fe510 C50	8.	1289.1	1095.4	838.4	662.2	481.0	385.7	303.3	253.4	169.3	97.2
Fe510 C20	2.	2786.8	2448.7	1744.9	1284.8	842.2	627.0	453.7	355.6	219.7	120.2
Fe510 C20	4.	2223.6	1901.1	1357.6	1011.3	680.4	518.2	385.6	309.1	197.0	110.5
Fe510 C20	6.	1603.9	1362.2	1006.1	771.9	540.3	422.9	324.1	265.6	173.9	99.2
Fe510 C20	8.	1083.5	933.7	727.3	580.8	426.3	343.6	271.3	227.1	152.2	87.5
Fe360 C50	2.	3759.1	3132.8	2016.5	1396.8	866.5	628.7	445.8	345.6	210.5	113.9
Fe360 C50	4.	2750.5	2228.1	1466.6	1043.1	674.2	504.2	369.9	294.3	185.7	103.5
Fe360 C50	6.	1887.4	1526.4	1058.4	783.1	531.0	409.7	310.5	252.9	164.2	93.1
Fe360 C50	8.	1214.7	1005.6	746.4	578.7	413.4	328.9	257.1	214.1	142.4	81.5
Fe360 C20	2.	2476.3	2164.7	1526.1	1115.9	726.7	539.3	389.2	304.7	187.9	102.6
Fe360 C20	4.	1984.1	1682.3	1185.4	875.9	585.0	444.1	329.5	263.8	167.8	94.0
Fe360 C20	6.	1487.3	1242.3	897.1	679.1	469.6	365.5	278.9	228.1	148.8	84.7
Fe360 C20	8.	1005.3	852.5	650.9	513.3	372.3	298.4	234.5	195.9	130.8	75.0

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	2920.5	2447.8	1591.7	1108.9	691.3	502.7	357.0	277.0	168.9	91.5
Fe510 C50	4.	2069.6	1704.3	1148.6	827.4	540.4	406.1	299.0	238.4	150.8	84.1
Fe510 C50	6.	1465.8	1202.9	849.1	634.4	433.8	335.9	255.3	208.3	135.5	77.0
Fe510 C50	8.	1014.5	841.8	626.4	486.4	347.9	277.1	216.7	180.5	120.1	68.7
Fe510 C20	2.	1994.0	1743.4	1229.5	899.3	585.8	434.8	313.8	245.6	151.5	82.8
Fe510 C20	4.	1559.3	1330.1	946.3	703.3	472.2	359.3	267.1	214.1	136.3	76.5
Fe510 C20	6.	1211.2	1013.7	734.0	556.5	385.4	300.1	229.1	187.4	122.3	69.6
Fe510 C20	8.	871.7	732.5	553.2	433.3	312.4	249.6	195.8	163.3	108.9	62.4
Fe360 C50	2.	2715.0	2246.4	1427.7	982.2	605.7	438.4	310.2	240.2	146.1	79.0
Fe360 C50	4.	1910.6	1549.0	1020.9	726.5	469.8	351.4	257.9	205.2	129.5	72.1
Fe360 C50	6.	1394.2	1114.3	761.8	559.4	377.0	290.1	219.4	178.5	115.8	65.6
Fe360 C50	8.	947.9	768.1	556.8	426.0	300.8	238.2	185.4	154.0	102.2	58.3
Fe360 C20	2.	1785.1	1552.1	1082.3	786.0	508.6	376.2	270.9	211.7	130.4	71.1
Fe360 C20	4.	1398.0	1184.6	833.9	615.8	411.1	312.0	231.5	185.3	117.8	66.0
Fe360 C20	6.	1121.9	925.4	657.6	493.1	338.3	262.3	199.6	162.9	106.1	60.3
Fe360 C20	8.	802.8	666.1	495.7	385.0	275.4	219.3	171.5	142.8	95.0	54.4

DESIGNATION	> AF-HE 400 A + 8 D 20
SECTION	> AF-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	8894.1	7990.4	5972.0	4541.9	3074.4	2325.5	1704.6	1346.1	832.6	449.9
Fe510 C50	4..	7631.9	6692.5	4989.3	3819.6	2636.6	2032.9	1527.5	1231.5	783.4	432.8
Fe510 C50	6.	5277.1	4665.1	3656.0	2914.8	2116.8	1686.5	1311.1	1083.4	710.3	399.4
Fe510 C50	8.	3161.8	2895.2	2457.0	2086.5	1632.4	1359.7	1103.6	938.9	637.0	363.6
Fe510 C20	2.	6436.3	5913.4	4654.9	3678.6	2593.8	2004.5	1496.0	1193.9	749.2	409.2
Fe510 C20	4.	5564.9	5015.0	3931.6	3116.7	2228.5	1749.0	1333.4	1084.0	697.3	388.5
Fe510 C20	6.	3781.4	3448.0	2844.5	2354.4	1778.7	1446.6	1144.2	955.0	634.7	360.5
Fe510 C20	8.	2477.4	2304.5	2006.0	1739.3	1394.3	1177.5	967.4	829.2	568.4	327.2
Fe360 C50	2.	7722.2	6857.4	4996.4	3733.7	2483.1	1861.6	1354.6	1065.3	655.3	352.6
Fe360 C50	4.	6773.0	5804.1	4160.7	3106.6	2094.5	1596.9	1189.1	953.8	602.7	331.4
Fe360 C50	6.	4968.0	4231.1	3137.5	2412.8	1692.7	1326.1	1017.1	834.1	541.4	302.2
Fe360 C50	8.	2986.8	2646.1	2138.6	1751.0	1317.2	1074.6	856.9	721.5	482.6	272.6
Fe360 C20	2.	5286.7	4832.6	3758.3	2942.6	2053.9	1578.6	1172.6	933.3	583.4	317.7
Fe360 C20	4.	4676.1	4173.5	3212.5	2513.5	1773.0	1381.9	1047.5	848.7	543.5	301.8
Fe360 C20	6.	3368.3	3016.2	2413.1	1952.2	1439.0	1155.2	903.7	749.5	493.7	278.6
Fe360 C20	8.	2204.1	2015.7	1707.3	1447.7	1130.7	940.9	763.0	648.8	439.9	251.0

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	6254.7	5461.3	3841.2	2804.7	1824.0	1352.7	975.7	763.5	466.6	249.9
Fe510 C50	4.	5102.0	4320.0	3037.5	2241.6	1495.4	1134.5	841.6	673.6	424.5	232.9
Fe510 C50	6.	3388.7	2898.7	2162.7	1669.6	1175.4	922.3	708.4	581.3	377.7	211.0
Fe510 C50	8.	2096.3	1848.4	1484.1	1209.6	905.6	737.1	586.7	493.4	329.6	186.0
Fe510 C20	2.	4349.8	3918.8	2947.3	2251.6	1531.1	1160.8	852.5	674.0	417.5	225.8
Fe510 C20	4.	3680.6	3229.1	2409.4	1845.5	1274.6	983.0	738.8	595.7	379.0	209.4
Fe510 C20	6.	2590.6	2274.6	1763.9	1396.1	1006.7	799.2	619.5	511.0	334.3	187.7
Fe510 C20	8.	1687.3	1510.3	1238.6	1024.8	779.3	639.4	512.2	432.4	290.3	164.4
Fe360 C50	2.	5662.9	4880.7	3344.8	2402.9	1539.3	1133.5	813.0	634.2	386.0	206.1
Fe360 C50	4.	4652.1	3858.0	2627.3	1903.5	1249.5	941.0	694.0	553.8	347.5	190.2
Fe360 C50	6.	3195.1	2653.3	1901.6	1433.1	987.2	767.0	584.4	477.5	308.5	171.6
Fe360 C50	8.	2003.8	1713.9	1322.3	1049.6	765.9	615.6	485.0	405.6	268.8	150.8
Fe360 C20	2.	3749.0	3360.1	2498.0	1892.7	1276.3	963.6	705.1	556.3	343.7	185.5
Fe360 C20	4.	3211.6	2791.9	2050.0	1553.9	1062.5	815.5	610.5	491.2	311.6	171.8
Fe360 C20	6.	2361.2	2037.9	1540.1	1198.6	850.3	669.6	515.8	423.9	276.0	154.4
Fe360 C20	8.	1564.1	1374.5	1098.5	892.4	666.1	541.3	430.2	361.6	241.2	136.0

DESIGNATION	> AF-HE 400 A + 8 D 20
SECTION	> AF-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	4781.3	4107.9	2798.0	2002.6	1278.6	940.0	673.4	524.9	319.2	170.3
Fe510 C50	4.	3740.4	3119.3	2142.1	1559.4	1027.8	775.5	572.8	457.4	287.3	157.3
Fe510 C50	6.	2574.0	2151.2	1554.7	1177.3	814.5	634.0	483.9	395.7	255.9	142.5
Fe510 C50	8.	1755.5	1485.9	1131.8	891.2	645.6	517.0	406.2	339.2	224.4	125.7
Fe510 C20	2.	3259.1	2904.7	2133.2	1602.6	1071.5	805.5	587.4	462.5	285.0	153.5
Fe510 C20	4.	2703.7	2341.6	1708.5	1289.8	878.6	673.1	503.1	404.5	256.3	141.2
Fe510 C20	6.	2008.9	1724.2	1292.5	1000.8	706.5	555.1	426.8	350.4	227.8	127.3
Fe510 C20	8.	1453.8	1249.8	970.4	773.4	566.6	456.2	360.0	301.2	199.9	112.3
Fe360 C50	2.	4374.8	3720.7	2485.5	1758.5	1111.2	813.0	580.2	451.4	273.7	145.8
Fe360 C50	4.	3409.5	2797.5	1875.4	1347.0	877.7	658.8	484.7	386.2	241.9	132.2
Fe360 C50	6.	2397.5	1960.0	1377.0	1026.1	700.1	541.5	411.3	335.4	216.2	120.1
Fe360 C50	8.	1671.2	1376.1	1015.1	784.3	558.6	443.9	346.6	288.4	189.9	106.1
Fe360 C20	2.	2854.1	2533.5	1844.5	1377.6	915.7	686.3	499.3	392.6	241.5	129.9
Fe360 C20	4.	2372.3	2041.7	1474.1	1105.5	748.4	571.7	426.3	342.3	216.5	119.2
Fe360 C20	6.	1841.4	1556.2	1141.7	872.3	608.4	475.3	363.8	297.9	193.1	107.7
Fe360 C20	8.	1344.2	1135.7	863.2	678.8	491.1	393.1	308.7	257.7	170.4	95.4

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	3535.6	3013.0	2020.4	1432.6	907.0	664.2	474.4	369.2	224.0	119.3
Fe510 C50	4.	2615.3	2181.4	1498.5	1091.0	719.2	542.6	400.8	320.1	201.1	110.1
Fe510 C50	6.	1818.9	1520.7	1099.5	832.8	576.3	448.7	342.4	280.0	181.1	100.8
Fe510 C50	8.	1336.0	1115.9	836.8	652.7	468.7	373.9	292.8	244.1	161.1	90.1
Fe510 C20	2.	2389.5	2117.2	1535.4	1143.7	758.3	567.6	412.5	324.2	199.2	107.1
Fe510 C20	4.	1903.2	1647.8	1201.6	906.8	617.5	473.0	353.5	284.2	180.1	99.2
Fe510 C20	6.	1451.2	1242.0	927.3	716.2	504.4	395.9	304.1	249.6	162.2	90.6
Fe510 C20	8.	1122.5	951.2	725.6	571.8	414.5	332.1	261.0	218.0	144.2	80.8
Fe360 C50	2.	3270.1	2752.4	1803.7	1262.0	789.7	575.2	409.1	317.6	192.2	102.2
Fe360 C50	4.	2383.6	1961.2	1320.1	950.2	620.3	466.0	343.1	273.4	171.4	93.7
Fe360 C50	6.	1699.0	1391.2	979.5	730.8	499.1	386.2	293.4	239.3	154.3	85.7
Fe360 C50	8.	1261.2	1028.0	750.0	575.9	407.9	323.3	252.0	209.5	137.8	76.9
Fe360 C20	2.	2105.5	1857.6	1335.0	988.4	651.5	486.3	352.6	276.7	169.7	91.2
Fe360 C20	4.	1674.0	1442.1	1042.7	782.7	530.4	405.3	302.4	242.8	153.6	84.6
Fe360 C20	6.	1335.9	1127.3	825.4	629.8	438.7	342.6	262.1	214.6	139.0	77.5
Fe360 C20	8.	1039.5	866.9	648.9	505.6	362.7	289.2	226.5	188.7	124.5	69.6

DESIGNATION	> AF-HE 450 A + 12 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	10692.1	9756.4	7556.2	5897.8	4102.6	3147.5	2334.6	1856.3	1149.5	613.8
Fe510 C50	4.	9649.9	8574.7	6546.3	5092.7	3571.7	2775.6	2098.9	1698.3	1076.5	585.2
Fe510 C50	6.	7626.1	6702.4	5205.0	4124.0	2976.4	2364.1	1833.2	1512.7	981.5	539.6
Fe510 C50	8.	4911.2	4433.2	3681.1	3073.9	2360.5	1946.5	1566.2	1325.6	885.4	491.5
Fe510 C20	2.	7884.2	7313.4	5893.3	4744.3	3415.9	2670.4	2013.1	1616.2	1014.2	547.1
Fe510 C20	4.	7164.5	6504.7	5173.9	4145.7	2998.2	2367.1	1813.8	1478.8	947.1	518.8
Fe510 C20	6.	5578.2	5040.0	4092.8	3347.4	2496.1	2016.0	1585.1	1318.4	864.7	479.2
Fe510 C20	8.	3742.6	3445.9	2950.0	2522.8	1989.6	1664.7	1356.4	1156.6	780.5	436.8
Fe360 C50	2.	9333.4	8429.7	6376.0	4890.6	3339.7	2537.6	1866.9	1477.5	909.1	483.1
Fe360 C50	4.	8489.7	7423.8	5507.2	4202.3	2891.7	2226.2	1670.7	1346.0	848.3	459.2
Fe360 C50	6.	6862.5	5897.5	4429.3	3433.5	2426.5	1907.7	1467.3	1205.1	777.1	425.3
Fe360 C50	8.	4738.2	4126.9	3259.2	2626.6	1944.8	1574.1	1247.2	1046.2	690.4	379.9
Fe360 C20	2.	6539.2	6043.7	4826.5	3857.5	2754.6	2143.6	1609.5	1289.1	806.2	433.8
Fe360 C20	4.	6061.4	5460.6	4278.1	3389.8	2422.6	1900.8	1448.9	1177.7	751.1	410.2
Fe360 C20	6.	4869.5	4341.9	3449.7	2776.9	2036.4	1630.5	1272.7	1054.2	687.4	379.3
Fe360 C20	8.	3392.8	3065.9	2549.8	2131.8	1639.2	1352.7	1089.0	922.0	616.1	342.2

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	7747.3	6902.9	5066.2	3804.5	2542.6	1910.9	1393.3	1096.9	670.2	354.4
Fe510 C50	4.	6650.2	5748.2	4180.2	3149.1	2140.9	1638.6	1224.0	983.5	617.7	333.5
Fe510 C50	6.	5023.9	4291.5	3195.6	2463.9	1732.6	1359.0	1043.2	855.9	551.2	301.4
Fe510 C50	8.	3321.9	2892.6	2283.6	1839.9	1362.0	1102.3	873.3	732.5	483.4	266.0
Fe510 C20	2.	5529.5	5046.4	3909.8	3052.5	2124.0	1629.8	1209.0	961.4	595.4	318.0
Fe510 C20	4.	4871.1	4330.4	3308.9	2575.7	1807.5	1405.1	1062.8	860.1	545.3	296.5
Fe510 C20	6.	3801.9	3333.7	2579.7	2039.0	1468.1	1164.7	902.3	744.2	482.5	265.1
Fe510 C20	8.	2655.7	2348.4	1893.0	1547.1	1161.6	946.8	754.4	634.9	420.8	232.3
Fe360 C50	2.	7035.4	6208.0	4462.6	3304.8	2178.6	1626.2	1179.2	925.5	563.1	296.8
Fe360 C50	4.	6082.7	5175.0	3666.4	2718.0	1820.7	1383.8	1028.0	823.5	515.2	277.4
Fe360 C50	6.	4694.6	3916.2	2823.3	2135.0	1475.2	1147.7	875.4	715.7	458.8	250.0
Fe360 C50	8.	3161.5	2678.3	2042.1	1609.1	1166.2	934.3	734.2	613.1	402.1	220.3
Fe360 C20	2.	4798.9	4363.7	3352.2	2600.6	1797.2	1374.1	1016.2	806.7	498.4	265.7
Fe360 C20	4.	4285.4	3785.3	2858.6	2207.4	1536.7	1189.8	897.0	724.5	458.2	248.7
Fe360 C20	6.	3448.6	2986.3	2267.9	1770.5	1259.7	993.5	766.1	630.1	407.1	223.1
Fe360 C20	8.	2459.3	2140.9	1689.6	1361.1	1007.3	815.1	645.7	541.6	357.4	196.6

DESIGNATION	> AF-HE 450 A + 12 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	6093.0	5357.5	3823.0	2817.5	1848.6	1376.8	996.5	781.3	474.7	250.0
Fe510 C50	4.	5058.7	4313.8	3067.7	2279.4	1530.0	1164.0	865.4	693.5	434.1	233.8
Fe510 C50	6.	3706.1	3136.8	2306.1	1764.2	1231.7	962.8	737.2	603.9	388.2	211.9
Fe510 C50	8.	2672.8	2268.2	1733.1	1367.3	992.2	795.3	625.3	522.2	342.7	187.8
Fe510 C20	2.	4293.4	3883.9	2948.2	2267.2	1552.4	1181.2	870.1	689.0	424.3	225.7
Fe510 C20	4.	3703.6	3258.8	2444.2	1878.6	1301.9	1005.7	756.8	610.7	385.7	209.1
Fe510 C20	6.	2878.1	2498.7	1904.9	1490.8	1063.2	839.5	647.9	533.2	344.7	189.0
Fe510 C20	8.	2184.4	1885.4	1471.4	1176.6	864.6	697.3	550.8	461.3	303.7	166.9
Fe360 C50	2.	5599.7	4887.0	3433.9	2505.6	1628.5	1207.4	870.7	681.3	412.9	217.0
Fe360 C50	4.	4625.5	3899.9	2723.8	2002.1	1331.0	1008.1	746.9	597.4	373.0	200.5
Fe360 C50	6.	3447.3	2871.7	2066.6	1561.1	1077.7	838.1	639.1	522.4	334.8	182.4
Fe360 C50	8.	2541.5	2110.1	1571.3	1220.7	873.4	695.6	544.1	453.1	296.2	161.9
Fe360 C20	2.	3782.0	3412.2	2574.8	1971.6	1343.9	1020.2	750.0	593.3	364.8	193.8
Fe360 C20	4.	3275.3	2871.0	2138.9	1636.7	1129.3	870.5	654.0	527.2	332.5	180.1
Fe360 C20	6.	2642.1	2270.1	1704.4	1321.0	933.4	733.8	564.3	463.5	298.9	163.6
Fe360 C20	8.	2036.2	1734.7	1331.7	1053.8	766.8	615.4	484.3	404.8	265.8	145.7

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	4665.2	4071.5	2861.0	2087.7	1357.0	1006.1	725.5	567.7	344.0	180.8
Fe510 C50	4.	3637.0	3104.6	2211.5	1644.8	1105.1	841.1	625.5	501.4	313.9	169.1
Fe510 C50	6.	2621.2	2234.2	1658.6	1276.4	896.0	702.2	538.7	441.8	284.4	155.4
Fe510 C50	8.	1930.0	1648.3	1269.4	1006.4	733.6	589.3	464.1	388.0	254.9	139.8
Fe510 C20	2.	3267.5	2938.9	2202.3	1678.0	1138.0	861.6	632.1	499.4	306.5	162.6
Fe510 C20	4.	2682.4	2362.5	1775.0	1365.8	947.6	732.4	551.4	445.1	281.2	152.5
Fe510 C20	6.	2055.7	1795.0	1380.2	1086.3	778.9	616.7	477.0	393.0	254.5	139.7
Fe510 C20	8.	1594.2	1383.1	1086.7	872.8	644.1	520.5	411.8	345.2	227.6	125.1
Fe360 C50	2.	4307.8	3730.4	2580.7	1864.7	1201.0	886.5	637.1	497.5	300.7	157.8
Fe360 C50	4.	3310.5	2802.4	1969.6	1453.1	969.2	735.2	545.3	436.5	272.7	146.7
Fe360 C50	6.	2442.8	2053.6	1495.9	1138.0	790.6	616.6	471.2	385.7	247.6	135.0
Fe360 C50	8.	1836.2	1538.3	1157.4	904.7	650.9	519.7	407.3	339.6	222.3	121.6
Fe360 C20	2.	2893.3	2595.3	1933.0	1466.5	990.2	748.1	547.7	432.3	265.0	140.4
Fe360 C20	4.	2379.2	2089.0	1560.9	1196.7	827.3	638.3	479.9	387.0	244.2	132.3
Fe360 C20	6.	1889.4	1635.1	1240.6	968.0	688.3	542.7	418.4	344.1	222.3	121.8
Fe360 C20	8.	1501.8	1285.3	992.4	788.1	575.4	462.5	364.5	304.8	200.3	109.9

DESIGNATION	> AF-HE 500 A + 12 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	11980.7	11057.1	8799.6	7013.7	4992.9	3878.7	2907.9	2327.0	1444.6	765.5
Fe510 C50	4.	11141.7	10030.2	7847.4	6211.7	4434.6	3477.6	2649.5	2153.1	1364.2	733.5
Fe510 C50	6.	9424.8	8343.7	6553.6	5233.2	3806.4	3035.0	2361.0	1951.7	1261.3	683.4
Fe510 C50	8.	6927.5	6166.1	5016.5	4126.8	3119.2	2551.1	2038.4	1718.4	1134.1	616.2
Fe510 C20	2.	8811.3	8248.6	6802.6	5581.9	4110.4	3254.7	2481.7	2006.3	1263.5	677.0
Fe510 C20	4.	8204.4	7527.2	6114.5	4978.8	3664.8	2921.0	2256.4	1848.6	1184.3	642.1
Fe510 C20	6.	6939.2	6284.9	5124.8	4204.4	3145.7	2545.0	2004.1	1668.4	1088.6	594.0
Fe510 C20	8.	5047.0	4610.2	3897.7	3300.2	2573.3	2139.6	1733.7	1473.5	983.5	538.9
Fe360 C50	2.	10408.8	9533.9	7450.0	5854.4	4102.4	3159.7	2351.5	1873.5	1156.1	609.8
Fe360 C50	4.	9740.5	8655.2	6607.8	5140.5	3605.2	2801.7	2118.7	1714.3	1079.8	578.1
Fe360 C50	6.	8386.9	7274.7	5538.2	4330.6	3085.7	2435.5	1879.1	1546.1	993.0	535.6
Fe360 C50	8.	6499.7	5600.9	4362.2	3483.5	2556.5	2060.4	1626.8	1362.0	890.8	480.8
Fe360 C20	2.	7233.1	6752.6	5529.9	4511.0	3298.5	2601.3	1976.3	1594.2	1000.8	534.9
Fe360 C20	4.	6835.5	6238.3	5013.5	4048.6	2952.9	2341.9	1801.4	1472.1	939.8	508.2
Fe360 C20	6.	5924.5	5311.5	4257.9	3449.5	2546.5	2045.9	1601.6	1328.7	862.9	469.2
Fe360 C20	8.	4532.8	4069.7	3352.6	2783.1	2123.7	1745.4	1400.4	1183.4	783.5	426.8

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	8767.9	7920.9	5994.4	4599.8	3142.4	2388.2	1757.3	1390.9	850.6	445.7
Fe510 C50	4.	7769.9	6816.5	5085.6	3895.2	2690.1	2074.7	1559.2	1257.2	788.2	420.5
Fe510 C50	6.	6304.9	5413.3	4060.3	3144.8	2220.8	1745.3	1341.9	1102.0	706.0	380.1
Fe510 C50	8.	4511.0	3891.3	3034.8	2425.6	1781.6	1436.5	1134.5	950.1	621.5	335.5
Fe510 C20	2.	6176.3	5702.9	4543.8	3624.9	2583.1	2007.8	1506.0	1205.5	748.7	396.8
Fe510 C20	4.	5577.9	5027.7	3942.9	3126.4	2236.0	1755.1	1338.3	1088.0	689.8	371.0
Fe510 C20	6.	4636.5	4099.0	3212.5	2561.4	1860.2	1482.1	1152.3	952.1	615.1	333.1
Fe510 C20	8.	3491.7	3078.6	2471.7	2014.4	1508.2	1227.5	976.9	821.7	540.6	293.1
Fe360 C50	2.	7890.1	7071.1	5256.3	3982.3	2685.2	2027.1	1483.4	1170.3	712.6	372.2
Fe360 C50	4.	7034.0	6092.2	4445.5	3356.3	2286.3	1751.6	1309.4	1052.6	657.3	349.7
Fe360 C50	6.	5807.7	4890.2	3569.6	2719.2	1891.2	1475.7	1128.3	923.6	589.3	316.3
Fe360 C50	8.	4261.5	3581.4	2704.8	2118.9	1527.5	1220.8	957.4	798.6	519.7	279.5
Fe360 C20	2.	5310.8	4890.1	3869.8	3070.8	2175.2	1685.2	1260.4	1007.2	624.1	330.2
Fe360 C20	4.	4855.4	4354.5	3382.3	2663.4	1891.2	1478.9	1124.2	912.3	577.0	309.8
Fe360 C20	6.	4127.7	3614.3	2790.9	2202.8	1583.9	1255.7	972.3	801.6	516.2	279.0
Fe360 C20	8.	3187.1	2769.0	2179.5	1752.6	1294.8	1046.9	828.8	694.9	455.4	246.1

DESIGNATION	> AF-HE 500 A + 12 D 20
SECTION	> AF-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	6984.8	6232.6	4588.8	3453.6	2313.2	1740.4	1270.1	1000.4	607.9	317.0
Fe510 C50	4.	6061.0	5236.7	3805.5	2865.6	1947.3	1490.1	1112.9	894.2	558.0	296.7
Fe510 C50	6.	4640.0	3959.1	2943.4	2267.2	1592.8	1248.8	958.3	786.1	502.9	270.5
Fe510 C50	8.	3421.4	2917.1	2241.7	1775.0	1292.3	1037.5	816.7	682.6	445.4	240.0
Fe510 C20	2.	4853.0	4444.9	3473.0	2729.0	1912.2	1472.7	1095.9	873.1	538.8	284.2
Fe510 C20	4.	4327.3	3859.2	2966.3	2318.6	1633.9	1272.7	964.4	781.2	492.8	264.1
Fe510 C20	6.	3450.7	3033.7	2357.0	1868.1	1348.7	1071.4	830.9	685.7	442.1	239.1
Fe510 C20	8.	2678.1	2338.0	1852.1	1495.7	1109.7	899.1	712.9	598.3	392.5	212.4
Fe360 C50	2.	6363.0	5641.1	4095.8	3053.4	2025.9	1517.1	1102.9	866.9	525.2	273.3
Fe360 C50	4.	5541.0	4733.7	3376.2	2513.1	1689.6	1286.4	957.0	767.2	477.4	253.3
Fe360 C50	6.	4273.5	3593.7	2618.6	1992.6	1384.6	1079.9	825.4	675.6	430.9	231.3
Fe360 C50	8.	3196.0	2673.9	2008.8	1568.6	1127.7	900.0	705.1	587.8	382.3	205.5
Fe360 C20	2.	4237.6	3873.3	3011.8	2357.9	1645.5	1264.6	939.4	747.6	460.6	242.7
Fe360 C20	4.	3787.7	3367.9	2574.2	2004.3	1406.8	1093.7	827.4	669.6	421.9	225.9
Fe360 C20	6.	3110.5	2713.8	2084.2	1639.1	1174.4	929.4	718.6	592.0	380.8	205.7
Fe360 C20	8.	2457.7	2121.2	1655.5	1323.7	972.7	784.4	619.7	518.9	339.5	183.3

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	5464.0	4839.1	3505.7	2609.6	1728.9	1293.8	940.0	738.6	447.3	232.7
Fe510 C50	4.	4501.7	3881.8	2811.5	2112.7	1432.9	1095.5	817.6	656.6	409.5	217.7
Fe510 C50	6.	3285.6	2826.8	2126.5	1650.2	1167.3	918.2	706.4	580.3	372.0	200.3
Fe510 C50	8.	2411.7	2081.9	1625.1	1299.6	955.1	770.3	608.5	509.6	333.4	180.0
Fe510 C20	2.	3781.6	3443.4	2653.6	2063.5	1429.7	1094.5	810.4	643.7	395.6	208.0
Fe510 C20	4.	3218.6	2867.0	2198.8	1715.9	1207.3	939.7	711.5	576.2	363.3	194.6
Fe510 C20	6.	2472.0	2187.7	1717.5	1371.0	996.8	794.7	618.1	510.9	330.1	178.9
Fe510 C20	8.	1901.4	1677.8	1348.4	1099.8	824.0	670.9	534.1	449.3	295.7	160.3
Fe360 C50	2.	5012.8	4408.8	3147.7	2320.6	1523.1	1134.5	821.3	644.0	388.9	201.9
Fe360 C50	4.	4117.6	3514.2	2502.5	1860.9	1250.0	951.4	707.5	567.1	352.8	187.2
Fe360 C50	6.	3007.5	2558.1	1893.4	1454.5	1019.3	798.2	612.0	501.7	320.8	172.4
Fe360 C50	8.	2251.9	1913.6	1464.6	1156.7	840.2	673.8	529.9	442.7	288.7	155.5
Fe360 C20	2.	3313.0	3009.8	2307.3	1787.2	1233.0	941.9	696.1	552.3	338.9	178.0
Fe360 C20	4.	2823.4	2509.1	1916.0	1490.7	1045.7	812.7	614.6	497.3	313.3	167.7
Fe360 C20	6.	2211.4	1947.0	1516.1	1203.5	870.2	691.8	536.9	443.2	285.9	154.7
Fe360 C20	8.	1751.7	1530.4	1213.6	980.8	728.1	590.2	468.1	392.9	257.8	139.5

DESIGNATION	> AF-HE 600 A + 12 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	14220.6	13329.8	11029.9	9076.1	6706.3	5320.7	4064.3	3289.4	2057.1	1081.2
Fe510 C50	4.	13511.9	12416.8	10120.0	8261.8	6099.2	4869.1	3766.5	3088.3	1963.6	1042.6
Fe510 C50	6.	12343.5	11101.5	8946.0	7275.2	5392.4	4341.2	3404.3	2827.1	1822.4	969.2
Fe510 C50	8.	10590.8	9376.6	7571.5	6195.5	4657.4	3798.4	3028.1	2549.3	1664.5	881.0
Fe510 C20	2.	10327.2	9783.4	8324.0	7017.7	5344.1	4317.0	3352.7	2741.7	1740.3	925.7
Fe510 C20	4.	9808.8	9147.5	7690.9	6439.4	4895.2	3973.0	3118.4	2579.5	1660.4	890.1
Fe510 C20	6.	9089.5	8313.8	6895.7	5731.8	4350.5	3547.1	2811.8	2349.9	1528.0	818.0
Fe510 C20	8.	7715.4	6988.1	5832.0	4888.6	3769.7	3115.5	2511.5	2128.0	1401.7	746.8
Fe360 C50	2.	12331.0	11483.6	9346.0	7584.7	5512.6	4332.3	3281.2	2641.9	1640.0	857.1
Fe360 C50	4.	11826.1	10758.4	8591.2	6904.2	5009.1	3961.5	3039.8	2480.6	1566.9	827.8
Fe360 C50	6.	10830.5	9604.3	7563.8	6050.9	4409.5	3519.1	2739.8	2265.8	1452.3	769.1
Fe360 C50	8.	9458.0	8200.7	6438.1	5168.1	3811.9	3079.7	2436.3	2042.0	1325.5	698.6
Fe360 C20	2.	8442.8	7984.7	6762.9	5678.5	4302.1	3464.5	2682.8	2189.8	1386.3	735.8
Fe360 C20	4.	8151.7	7572.8	6314.3	5250.4	3958.8	3197.9	2499.5	2062.3	1322.7	707.0
Fe360 C20	6.	7575.1	6895.7	5672.0	4684.2	3530.0	2867.0	2265.0	1889.2	1225.1	654.5
Fe360 C20	8.	6602.2	5918.7	4865.0	4032.0	3071.4	2522.1	2022.0	1707.9	1120.0	594.8

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	10672.6	9833.6	7794.5	6192.9	4393.0	3405.9	2549.2	2037.8	1252.5	649.6
Fe510 C50	4.	9859.9	8857.8	6902.8	5448.3	3878.1	3036.5	2310.5	1876.2	1177.2	618.9
Fe510 C50	6.	8572.5	7509.5	5802.5	4581.8	3295.9	2613.5	2023.9	1668.7	1065.3	562.5
Fe510 C50	8.	7088.3	6086.3	4718.6	3757.1	2749.7	2213.2	1745.6	1460.6	946.0	497.7
Fe510 C20	2.	7395.7	6935.0	5743.8	4730.1	3498.4	2777.1	2122.4	1718.3	1075.0	565.3
Fe510 C20	4.	6903.6	6344.1	5170.6	4221.2	3116.3	2487.8	1924.5	1577.9	1003.3	532.7
Fe510 C20	6.	6070.6	5467.8	4417.0	3598.6	2672.4	2153.6	1690.3	1404.4	905.9	482.0
Fe510 C20	8.	5106.1	4522.0	3652.9	2989.9	2248.3	1833.9	1462.2	1231.0	803.8	425.5
Fe360 C50	2.	9554.3	8747.5	6828.7	5362.1	3754.3	2890.3	2150.1	1712.7	1047.5	541.2
Fe360 C50	4.	8860.8	7878.8	6022.6	4689.3	3291.6	2559.1	1935.9	1566.7	978.6	512.7
Fe360 C50	6.	7798.6	6726.3	5078.3	3949.7	2800.1	2204.6	1697.7	1395.2	887.0	466.9
Fe360 C50	8.	6517.4	5479.8	4140.8	3244.9	2340.0	1870.3	1467.0	1223.7	789.4	414.1
Fe360 C20	2.	6278.6	5877.2	4845.7	3975.3	2926.6	2317.0	1766.5	1428.0	891.5	468.0
Fe360 C20	4.	5896.4	5403.8	4379.8	3560.1	2615.5	2082.4	1607.2	1316.0	835.1	442.8
Fe360 C20	6.	5291.9	4740.0	3793.8	3070.1	2263.8	1817.7	1422.2	1179.5	759.0	403.1
Fe360 C20	8.	4530.7	3975.6	3171.0	2572.7	1917.5	1557.2	1237.0	1039.3	676.7	357.5

DESIGNATION	> AF-HE 600 A + 12 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	8692.5	7927.5	6131.9	4781.5	3322.6	2547.7	1888.8	1501.5	915.8	472.2
Fe510 C50	4.	7977.5	7063.8	5358.5	4150.3	2898.0	2247.1	1696.2	1371.1	855.0	447.4
Fe510 C50	6.	6619.9	5741.3	4370.0	3416.7	2434.2	1921.2	1482.2	1219.5	776.3	409.1
Fe510 C50	8.	5156.3	4436.5	3448.5	2750.4	2016.1	1624.0	1281.6	1072.7	695.1	365.8
Fe510 C20	2.	5961.2	5552.3	4520.4	3669.6	2668.0	2097.2	1588.7	1279.3	794.3	415.1
Fe510 C20	4.	5529.1	5033.8	4025.9	3239.2	2353.1	1862.2	1429.7	1167.1	737.5	389.8
Fe510 C20	6.	4670.9	4184.6	3350.5	2712.0	2000.3	1606.3	1256.9	1042.5	670.9	356.4
Fe510 C20	8.	3768.9	3346.0	2712.3	2225.5	1677.6	1370.2	1093.6	921.3	602.1	318.9
Fe360 C50	2.	7870.4	7138.0	5450.5	4209.7	2895.6	2208.4	1629.9	1292.2	785.4	403.8
Fe360 C50	4.	7223.9	6337.6	4728.6	3621.9	2501.5	1929.2	1449.9	1169.0	726.6	379.3
Fe360 C50	6.	6073.3	5191.9	3870.2	2986.0	2101.0	1648.4	1265.7	1038.6	658.9	346.3
Fe360 C50	8.	4751.0	4019.5	3059.9	2408.6	1744.1	1396.7	1097.2	916.0	591.5	310.6
Fe360 C20	2.	5114.5	4758.7	3863.9	3129.8	2269.8	1781.5	1347.8	1084.5	672.6	351.2
Fe360 C20	4.	4772.4	4337.4	3457.1	2774.3	2009.7	1588.1	1217.8	993.3	627.1	331.2
Fe360 C20	6.	4119.2	3673.7	2919.8	2350.9	1724.5	1380.9	1078.1	893.0	573.6	304.3
Fe360 C20	8.	3343.2	2952.0	2374.8	1938.2	1453.1	1183.5	942.5	792.9	517.3	273.6

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	7067.4	6398.3	4865.8	3746.9	2569.2	1956.3	1441.8	1142.2	693.4	356.3
Fe510 C50	4.	6280.2	5525.9	4144.4	3185.4	2207.4	1705.2	1283.3	1035.5	644.2	336.6
Fe510 C50	6.	4958.8	4308.7	3288.7	2575.9	1838.4	1452.1	1121.1	922.7	587.7	309.8
Fe510 C50	8.	3699.7	3221.4	2543.0	2048.8	1516.5	1227.3	972.3	815.6	529.9	279.5
Fe510 C20	2.	4813.7	4459.3	3581.7	2875.8	2064.4	1611.1	1212.7	972.8	600.8	312.7
Fe510 C20	4.	4344.8	3939.1	3124.5	2498.3	1802.7	1421.6	1088.2	886.7	559.0	294.9
Fe510 C20	6.	3507.3	3149.2	2530.8	2054.1	1519.3	1221.8	957.2	794.5	511.8	272.0
Fe510 C20	8.	2720.1	2439.9	2007.3	1664.7	1269.0	1042.4	836.0	706.2	463.2	246.0
Fe360 C50	2.	6408.3	5769.2	4331.9	3305.4	2245.0	1701.1	1248.6	986.8	597.2	306.1
Fe360 C50	4.	5689.2	4959.0	3658.3	2781.4	1907.3	1465.9	1098.6	884.4	548.5	285.9
Fe360 C50	6.	4513.4	3874.0	2904.6	2249.1	1587.9	1247.8	959.3	787.7	500.2	263.1
Fe360 C50	8.	3373.9	2898.8	2249.3	1792.0	1312.1	1056.4	833.3	697.4	451.7	237.7
Fe360 C20	2.	4136.2	3826.4	3062.9	2452.5	1755.0	1367.3	1027.6	823.6	508.0	264.1
Fe360 C20	4.	3745.2	3390.3	2681.1	2139.0	1539.8	1212.7	927.3	755.2	475.7	250.8
Fe360 C20	6.	3077.4	2752.7	2198.4	1776.2	1307.5	1048.9	820.1	679.9	437.2	232.1
Fe360 C20	8.	2391.2	2136.8	1748.2	1443.9	1096.0	898.3	719.1	606.8	397.5	210.9

DESIGNATION > AF-HE 800 A + 12 D 25
SECTION > AF-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	19742.9	18843.8	16362.4	14052.7	10963.7	8991.6	7084.3	5846.8	3726.3	1957.7
Fe510 C50	4.	19269.3	18135.3	15557.9	13253.1	10290.2	8456.1	6713.0	5592.0	3600.7	1897.4
Fe510 C50	6.	18630.0	17224.7	14566.5	12296.8	9500.1	7822.2	6254.1	5253.9	3407.1	1785.4
Fe510 C50	8.	17506.3	15872.1	13266.5	11133.6	8596.2	7109.2	5734.3	4860.5	3171.1	1642.1
Fe510 C20	2.	14375.4	13805.3	12194.6	10644.3	8489.7	7062.9	5643.2	4700.4	3037.5	1614.5
Fe510 C20	4.	14096.1	13372.6	11681.5	10113.1	8015.8	6670.7	5358.6	4497.2	2927.5	1556.3
Fe510 C20	6.	13635.1	12740.7	10989.5	9431.7	7431.6	6189.0	4999.0	4225.8	2764.6	1458.8
Fe510 C20	8.	12944.5	11884.1	10127.4	8629.0	6776.5	5656.5	4599.3	3917.1	2572.6	1338.9
Fe360 C50	2.	17181.2	16357.3	14105.0	12036.5	9311.3	7595.4	5953.5	4897.2	3105.7	1625.0
Fe360 C50	4.	16788.7	15751.8	13420.0	11363.5	8757.5	7164.6	5664.6	4706.6	3019.6	1586.5
Fe360 C50	6.	16254.9	14957.4	12540.1	10512.4	8056.1	6603.3	5258.5	4406.9	2848.2	1488.7
Fe360 C50	8.	15413.6	13866.5	11456.3	9530.7	7289.4	5998.3	4817.6	4073.3	2648.4	1367.9
Fe360 C20	2.	11811.6	11335.5	9994.1	8707.7	6927.7	5753.9	4589.8	3818.7	2463.7	1307.7
Fe360 C20	4.	11583.5	10980.6	9575.2	8276.4	6546.4	5440.9	4365.3	3660.7	2380.3	1264.2
Fe360 C20	6.	11287.6	10528.8	9051.6	7746.5	6082.9	5055.6	4076.1	3441.7	2248.0	1184.7
Fe360 C20	8.	10821.4	9906.5	8404.2	7135.1	5580.4	4647.6	3771.5	3208.3	2103.6	1093.4

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	15527.5	14687.8	12446.7	10455.9	7926.1	6385.1	4946.0	4038.0	2532.7	1313.4
Fe510 C50	4.	14921.1	13872.9	11587.4	9648.9	7287.5	5892.5	4609.6	3805.3	2418.8	1261.6
Fe510 C50	6.	13849.8	12625.8	10411.6	8615.1	6506.3	5290.3	4183.7	3491.7	2243.8	1167.6
Fe510 C50	8.	12570.0	11212.5	9150.0	7543.5	5714.8	4679.3	3742.7	3156.8	2045.8	1054.1
Fe510 C20	2.	10935.0	10443.5	9083.7	7813.8	6109.2	5017.0	3958.0	3269.4	2086.3	1097.2
Fe510 C20	4.	10490.3	9882.2	8495.4	7250.2	5642.3	4643.0	3690.6	3076.8	1983.5	1046.2
Fe510 C20	6.	9810.7	9095.3	7730.2	6552.5	5086.7	4199.8	3366.0	2831.9	1840.2	965.9
Fe510 C20	8.	8937.4	8144.5	6860.7	5792.4	4502.0	3736.7	3023.3	2567.3	1679.2	871.2
Fe360 C50	2.	13862.5	13084.7	11025.0	9215.0	6941.2	5570.2	4299.5	3502.3	2189.6	1132.5
Fe360 C50	4.	13316.0	12345.2	10248.8	8491.6	6375.9	5138.2	4007.6	3302.4	2093.8	1090.0
Fe360 C50	6.	12487.7	11327.7	9261.2	7613.1	5708.4	4623.7	3644.5	3035.7	1945.6	1010.4
Fe360 C50	8.	11402.7	10093.4	8147.9	6665.8	5009.9	4085.5	3256.7	2741.6	1772.1	911.3
Fe360 C20	2.	9258.3	8842.2	7691.1	6616.0	5172.8	4248.2	3351.5	2768.4	1766.6	929.1
Fe360 C20	4.	8925.6	8409.5	7231.8	6173.7	4806.3	3956.0	3145.2	2622.4	1690.9	892.0
Fe360 C20	6.	8449.0	7827.8	6644.7	5626.7	4362.7	3599.6	2883.2	2424.8	1574.9	826.3
Fe360 C20	8.	7795.6	7095.5	5966.1	5029.9	3903.2	3236.8	2616.9	2221.2	1451.9	752.9

DESIGNATION	> AF-HE 800 A + 12 D 25	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

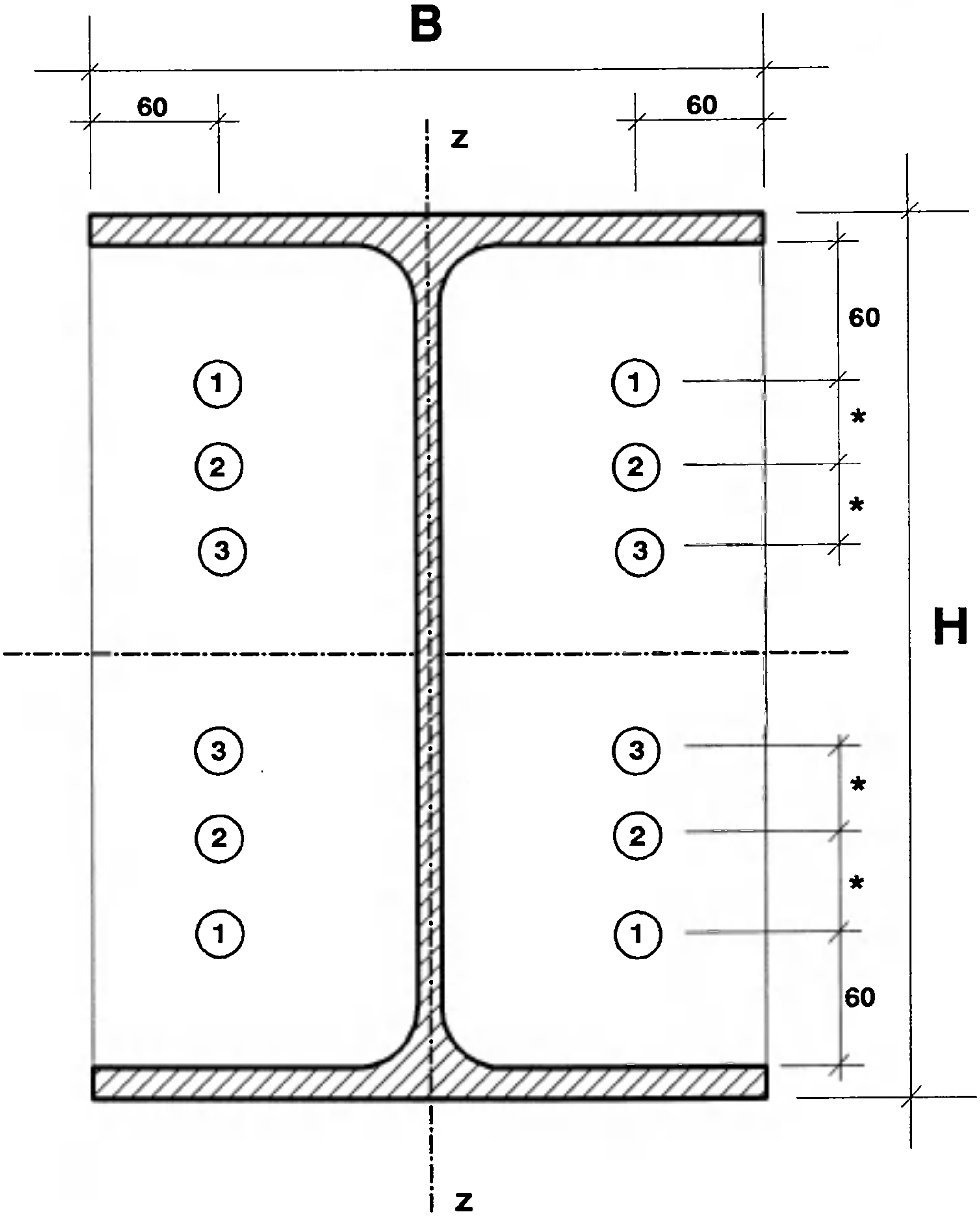
MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	13046.0	12280.5	10273.6	8533.5	6378.2	5094.7	3915.6	3181.1	1981.2	1021.5
Fe510 C50	4.	12505.8	11550.6	9513.4	7831.8	5836.9	4684.2	3640.2	2992.9	1891.7	982.4
Fe510 C50	6.	11449.6	10368.5	8452.7	6933.4	5186.5	4195.7	3303.6	2750.1	1761.0	914.0
Fe510 C50	8.	10014.2	8921.4	7267.2	5983.5	4526.9	3704.1	2960.9	2496.5	1617.2	833.0
Fe510 C20	2.	9111.1	8681.3	7502.7	6415.6	4976.5	4066.4	3192.6	2628.9	1669.8	874.8
Fe510 C20	4.	8770.9	8235.0	7027.1	5958.4	4599.7	3766.8	2980.9	2478.2	1591.2	836.6
Fe510 C20	6.	8074.0	7468.3	6320.8	5339.4	4128.2	3400.6	2719.9	2285.5	1482.6	777.1
Fe510 C20	8.	7088.0	6483.9	5494.2	4660.2	3641.0	3030.6	2458.1	2090.4	1370.0	711.9
Fe360 C50	2.	11711.2	11001.1	9153.5	7567.8	5624.0	4477.1	3430.3	2781.5	1727.6	888.8
Fe360 C50	4.	11222.5	10334.4	8458.8	6929.1	5134.9	4107.9	3183.5	2613.1	1647.9	854.3
Fe360 C50	6.	10385.9	9354.7	7557.0	6156.8	4572.2	3684.6	2891.9	2402.8	1534.6	794.9
Fe360 C50	8.	9147.1	8082.6	6508.9	5315.8	3988.4	3249.6	2588.5	2178.2	1407.1	723.3
Fe360 C20	2.	7759.4	7395.5	6396.5	5473.6	4249.9	3474.8	2729.7	2248.5	1429.0	749.0
Fe360 C20	4.	7485.1	7032.7	6010.4	5103.2	3946.1	3234.8	2562.2	2131.3	1369.6	720.5
Fe360 C20	6.	6994.8	6470.2	5476.4	4626.3	3577.0	2946.6	2356.9	1980.5	1284.7	673.4
Fe360 C20	8.	6221.4	5684.4	4807.8	4072.1	3176.3	2641.4	2140.7	1819.6	1191.8	619.0

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	11021.9	10321.4	8519.0	6995.0	5155.3	4084.0	3115.4	2519.3	1558.7	799.5
Fe510 C50	4.	10390.5	9545.8	7775.8	6345.4	4682.1	3736.8	2890.0	2369.3	1491.6	772.2
Fe510 C50	6.	9285.6	8379.2	6789.9	5544.6	4127.6	3330.6	2616.8	2175.6	1390.8	720.9
Fe510 C50	8.	7791.1	6962.4	5696.7	4705.5	3571.8	2927.7	2343.6	1977.7	1282.6	661.1
Fe510 C20	2.	7642.7	7257.5	6214.6	5269.5	4042.7	3280.7	2558.9	2098.2	1324.5	690.4
Fe510 C20	4.	7265.1	6796.6	5753.6	4845.3	3709.3	3022.7	2381.2	1974.2	1262.5	661.7
Fe510 C20	6.	6520.0	6019.6	5077.3	4277.1	3296.2	2710.3	2164.3	1816.8	1176.9	616.2
Fe510 C20	8.	5525.4	5063.5	4302.6	3657.5	2864.8	2387.8	1939.0	1650.2	1082.6	563.0
Fe360 C50	2.	9875.5	9228.9	7577.4	6194.5	4541.3	3586.6	2728.5	2202.7	1359.5	696.0
Fe360 C50	4.	9319.4	8531.3	6898.9	5597.9	4104.4	3264.4	2517.1	2059.9	1293.6	668.5
Fe360 C50	6.	8415.4	7546.9	6052.7	4905.2	3622.5	2910.8	2279.0	1890.9	1205.4	623.5
Fe360 C50	8.	7115.6	6305.5	5097.8	4175.0	3141.3	2563.1	2044.1	1721.2	1112.9	572.4
Fe360 C20	2.	6505.5	6178.8	5293.7	4490.9	3447.5	2798.7	2183.8	1791.1	1131.0	589.7
Fe360 C20	4.	6180.0	5785.4	4904.8	4135.7	3170.9	2586.3	2039.1	1691.4	1082.4	567.6
Fe360 C20	6.	5635.9	5201.5	4384.4	3691.5	2843.1	2336.9	1865.6	1565.8	1014.0	530.9
Fe360 C20	8.	4820.2	4413.8	3745.9	3181.2	2488.9	2073.2	1682.7	1431.6	938.8	488.0

COLUMN CROSS SECTION TYPE AF.

TYPICAL LAYOUT OF REINFORCING BARS
FOR BENDING ABOUT MINOR AXIS ≡ WEAK AXIS zz



* to be selected in accordance with minimum values in use for reinforced concrete,and construction details for stirrups.(see EUROCODE 4)

LAYOUT 1 WHEN 4 REINFORCING BARS
LAYOUT 1+2 WHEN 8 REINFORCING BARS
LAYOUT 1+2+3 WHEN 12 REINFORCING BARS

DESIGNATION	> AF-HE 300 A + 4 D 25	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	5738.7	4505.1	3657.1	2778.9	2237.7	1871.1	1406.8	1106.7	905.7	761.8
Fe510 C50	4.	3499.5	2590.5	2153.3	1701.4	1419.6	1225.4	972.7	800.2	680.3	591.4
Fe510 C50	6.	1161.6	1031.3	960.7	865.9	791.1	730.3	637.1	559.0	498.3	449.5
Fe510 C50	8.	637.1	590.1	566.8	532.7	503.4	477.9	435.6	395.1	361.5	333.1
Fe510 C20	2.	4090.4	3286.4	2711.8	2096.7	1706.8	1437.9	1091.6	863.9	709.8	598.8
Fe510 C20	4.	2364.6	1845.9	1573.4	1275.1	1080.4	942.2	757.6	628.1	536.8	468.4
Fe510 C20	6.	888.2	801.7	753.4	686.9	633.1	588.5	518.7	458.4	410.9	372.2
Fe510 C20	8.	512.5	477.5	459.9	434.0	411.5	391.8	358.8	326.6	299.7	276.7
Fe360 C50	2.	5166.2	4059.0	3296.9	2506.7	2019.2	1688.8	1270.2	999.4	818.0	688.1
Fe360 C50	4.	3546.7	2488.8	2022.0	1563.3	1288.1	1102.9	866.8	708.9	600.3	520.4
Fe360 C50	6.	1433.5	1144.0	1014.5	861.9	755.4	676.2	565.3	482.2	421.3	374.4
Fe360 C50	8.	607.8	550.2	522.8	484.1	452.0	424.8	381.2	341.7	309.9	283.5
Fe360 C20	2.	3447.4	2801.0	2330.1	1817.6	1488.0	1258.6	960.4	762.5	627.9	530.5
Fe360 C20	4.	2355.2	1751.1	1458.5	1154.6	964.5	833.2	662.0	544.9	463.4	403.0
Fe360 C20	6.	1011.2	842.7	761.4	660.8	587.5	531.3	450.3	387.5	340.6	304.0
Fe360 C20	8.	466.9	429.3	410.8	384.2	361.6	342.1	310.2	280.1	255.5	234.8

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	3809.4	2955.7	2380.2	1793.7	1437.0	1197.4	896.4	703.2	574.5	482.6
Fe510 C50	4.	2389.2	1675.1	1360.5	1051.5	866.2	741.6	582.7	476.6	403.5	349.8
Fe510 C50	6.	812.9	688.0	626.0	547.9	490.0	445.1	379.4	327.7	288.9	258.3
Fe510 C50	8.	398.6	363.5	346.6	322.5	302.3	285.0	257.0	231.2	210.2	192.7
Fe510 C20	2.	2594.5	2089.1	1726.6	1337.2	1089.7	918.8	698.2	552.9	454.5	383.5
Fe510 C20	4.	1767.8	1277.5	1050.7	821.8	681.6	586.1	463.0	379.8	322.3	279.8
Fe510 C20	6.	613.1	531.2	488.8	433.7	391.7	358.4	308.6	268.4	237.8	213.4
Fe510 C20	8.	322.9	296.4	283.4	264.7	248.9	235.3	213.0	192.2	175.2	160.9
Fe360 C50	2.	3515.8	2759.0	2239.1	1701.0	1369.5	1145.0	860.8	677.1	554.1	466.1
Fe360 C50	4.	2321.1	1623.1	1316.8	1016.7	837.2	716.4	562.7	460.1	389.5	337.7
Fe360 C50	6.	1197.8	858.2	731.2	595.7	508.7	447.4	365.6	307.6	266.2	235.0
Fe360 C50	8.	538.3	438.9	399.7	350.8	314.8	286.9	246.4	214.2	190.0	170.9
Fe360 C20	2.	2286.4	1880.1	1577.9	1242.9	1024.1	870.1	667.9	532.2	439.4	371.9
Fe360 C20	4.	1666.3	1219.0	1008.0	792.4	659.2	567.9	449.7	369.4	313.8	272.6
Fe360 C20	6.	942.5	689.0	591.0	484.8	415.7	366.5	300.5	253.3	219.6	194.0
Fe360 C20	8.	364.5	320.2	300.2	273.1	251.5	233.8	206.4	182.9	164.4	149.3

DESIGNATION	> AF-HE 300 A + 4 D 25	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	2600.6	2042.6	1658.7	1260.9	1015.5	849.3	638.7	502.5	411.3	346.0
Fe510 C50	4.	1590.1	1158.1	955.8	749.9	623.2	536.5	424.5	348.5	295.9	257.0
Fe510 C50	6.	699.7	565.1	503.6	430.2	378.4	339.6	284.9	243.5	213.1	189.5
Fe510 C50	8.	343.4	303.3	285.0	260.1	240.1	223.6	197.9	175.7	158.2	143.8
Fe510 C20	2.	1738.8	1425.8	1194.2	938.4	772.0	655.2	502.3	399.9	329.9	279.1
Fe510 C20	4.	1192.9	893.2	746.3	592.7	496.0	429.0	341.4	281.3	239.3	208.2
Fe510 C20	6.	515.4	431.9	391.2	340.5	303.3	274.8	233.3	201.0	176.9	158.0
Fe510 C20	8.	274.8	245.4	231.7	212.7	197.3	184.5	164.2	146.3	132.1	120.4
Fe360 C50	2.	2438.4	1929.7	1575.3	1204.1	973.1	815.7	615.3	485.0	397.4	334.6
Fe360 C50	4.	1521.3	1119.5	928.2	731.5	609.4	525.5	416.7	342.5	291.1	252.9
Fe360 C50	6.	914.3	660.3	564.0	460.7	394.0	346.9	283.8	238.9	206.9	182.7
Fe360 C50	8.	514.3	390.1	346.8	296.1	261.0	234.8	198.2	170.5	150.1	134.2
Fe360 C20	2.	1559.6	1302.2	1105.7	882.5	733.5	627.1	485.4	388.8	322.2	273.4
Fe360 C20	4.	1098.9	846.8	717.3	577.5	487.3	423.8	339.6	281.0	239.8	209.0
Fe360 C20	6.	740.4	542.5	465.7	382.4	328.0	289.3	237.3	200.1	173.5	153.3
Fe360 C20	8.	363.5	298.0	271.9	239.1	214.9	196.1	168.6	146.8	130.3	117.2

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	1806.6	1415.2	1147.2	870.4	700.2	585.1	439.6	345.6	282.8	237.8
Fe510 C50	4.	1129.0	820.3	676.3	530.1	440.3	378.9	299.6	246.0	208.8	181.3
Fe510 C50	6.	531.4	422.9	374.6	317.8	278.3	249.0	208.0	177.3	154.9	137.6
Fe510 C50	8.	279.9	240.4	223.3	200.8	183.3	169.2	147.9	130.2	116.4	105.4
Fe510 C20	2.	1190.3	976.7	818.4	643.5	529.6	449.6	344.7	274.5	226.5	191.7
Fe510 C20	4.	853.8	638.5	533.2	423.2	354.0	306.1	243.5	200.6	170.7	148.5
Fe510 C20	6.	407.3	333.5	299.0	257.2	227.2	204.6	172.3	147.7	129.5	115.4
Fe510 C20	8.	222.1	194.6	182.2	165.5	152.3	141.5	124.7	110.4	99.2	90.1
Fe360 C50	2.	1698.0	1342.7	1095.6	836.9	676.2	566.7	427.3	336.7	275.9	232.3
Fe360 C50	4.	1063.9	787.3	654.3	516.9	431.3	372.3	295.5	243.1	206.6	179.6
Fe360 C50	6.	687.0	491.2	418.2	340.5	290.6	255.5	208.8	175.6	151.9	134.1
Fe360 C50	8.	415.3	305.4	268.9	227.4	199.1	178.4	149.7	128.3	112.7	100.6
Fe360 C20	2.	1073.6	897.0	762.0	608.5	505.9	432.6	335.0	268.4	222.4	188.8
Fe360 C20	4.	771.7	599.6	509.9	412.3	348.8	303.9	244.0	202.2	172.7	150.6
Fe360 C20	6.	559.6	408.1	349.8	286.7	245.7	216.6	177.5	149.6	129.6	114.5
Fe360 C20	8.	335.1	255.4	227.4	194.5	171.6	154.5	130.5	112.3	98.9	88.5

DESIGNATION	> AF-HE 320 A + 4 D 25
SECTION	> AF-COLUMN
BUCKLING	> WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	6278.5	4919.9	3988.8	3027.0	2435.4	2035.3	1529.2	1202.5	983.8	827.3
Fe510 C50	4.	3619.9	2722.4	2279.4	1813.9	1519.9	1315.6	1048.0	864.0	735.5	640.0
Fe510 C50	6.	1261.0	1121.7	1046.2	944.2	863.5	797.8	696.8	611.9	545.8	492.6
Fe510 C50	8.	698.1	647.5	622.3	585.4	553.7	526.0	480.0	435.7	398.9	367.7
Fe510 C20	2.	4463.3	3578.3	2948.0	2275.5	1850.4	1557.8	1181.5	934.4	767.5	647.3
Fe510 C20	4.	2370.7	1898.9	1639.9	1347.6	1151.8	1010.5	818.8	682.2	584.8	511.5
Fe510 C20	6.	972.2	876.6	823.3	750.1	690.9	642.0	565.5	499.5	447.5	405.3
Fe510 C20	8.	562.1	523.8	504.6	476.2	451.6	430.0	393.8	358.4	328.9	303.7
Fe360 C50	2.	5495.8	4328.1	3521.2	2681.8	2162.5	1810.0	1362.6	1072.7	878.4	739.1
Fe360 C50	4.	3748.4	2646.6	2155.6	1670.4	1378.2	1181.0	929.1	760.4	644.1	558.6
Fe360 C50	6.	1454.8	1189.9	1066.2	916.5	809.6	728.7	613.6	525.9	460.9	410.5
Fe360 C50	8.	639.6	584.0	557.2	518.8	486.5	458.9	414.1	372.7	339.0	310.9
Fe360 C20	2.	3722.7	3019.5	2508.8	1954.3	1598.5	1351.2	1030.3	817.5	673.0	568.5
Fe360 C20	4.	2433.3	1838.0	1542.1	1229.7	1031.6	893.7	712.6	587.8	500.6	435.7
Fe360 C20	6.	956.3	830.0	764.5	679.0	613.7	561.9	484.3	421.5	373.5	335.4
Fe360 C20	8.	500.2	460.8	441.5	413.5	389.6	369.0	335.0	302.9	276.5	254.3

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	4125.9	3170.7	2536.9	1899.2	1515.3	1259.3	939.4	735.5	600.0	503.5
Fe510 C50	4.	2488.1	1748.8	1421.7	1099.8	906.5	776.3	610.3	499.2	422.8	366.6
Fe510 C50	6.	801.5	691.0	634.4	561.2	505.8	462.0	397.0	344.8	305.0	273.6
Fe510 C50	8.	408.6	374.7	358.3	334.5	314.5	297.2	269.0	242.7	221.1	203.1
Fe510 C20	2.	2804.9	2236.1	1834.9	1410.2	1143.6	960.9	727.1	574.2	471.1	397.0
Fe510 C20	4.	1821.3	1320.1	1087.2	851.3	706.6	607.9	480.5	394.3	334.6	290.6
Fe510 C20	6.	614.5	537.6	497.1	443.7	402.5	369.5	319.8	279.0	247.7	222.8
Fe510 C20	8.	329.8	303.6	290.7	272.1	256.2	242.5	220.0	198.9	181.5	166.8
Fe360 C50	2.	3783.7	2945.2	2376.9	1795.2	1440.1	1201.1	900.2	706.8	577.6	485.4
Fe360 C50	4.	2430.5	1695.3	1374.0	1059.9	872.2	746.2	585.8	478.9	405.4	351.3
Fe360 C50	6.	1222.7	884.2	755.6	617.6	528.3	465.2	380.7	320.6	277.6	245.2
Fe360 C50	8.	446.6	393.8	369.9	337.3	311.1	289.7	256.2	227.3	204.5	185.9
Fe360 C20	2.	2456.8	2000.6	1667.0	1302.6	1067.7	903.8	690.4	548.5	451.9	381.9
Fe360 C20	4.	1727.8	1261.7	1042.4	818.8	680.8	586.4	464.1	381.2	323.7	281.2
Fe360 C20	6.	936.7	696.0	600.5	495.4	426.3	376.8	309.9	261.7	227.1	200.8
Fe360 C20	8.	351.9	315.1	297.9	274.0	254.5	238.2	212.4	189.5	171.2	156.2

DESIGNATION	> AF-HE 320 A + 4 D 25	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	2842.9	2209.5	1781.2	1343.9	1077.3	898.1	672.7	528.0	431.4	362.5
Fe510 C50	4.	1666.4	1212.7	1000.5	784.8	652.0	561.2	444.0	364.5	309.4	268.7
Fe510 C50	6.	681.0	563.6	507.6	438.9	389.3	351.4	297.1	255.2	224.1	199.9
Fe510 C50	8.	347.6	309.6	292.1	267.8	248.1	231.8	206.1	183.5	165.5	150.8
Fe510 C20	2.	1894.7	1536.4	1276.3	994.0	813.0	687.1	523.9	415.6	342.1	289.0
Fe510 C20	4.	1245.3	929.5	775.5	615.0	514.2	444.5	353.5	291.1	247.7	215.4
Fe510 C20	6.	511.2	433.5	394.8	346.0	309.6	281.4	240.1	207.5	183.0	163.7
Fe510 C20	8.	274.8	247.2	234.2	216.0	201.0	188.5	168.5	150.6	136.3	124.4
Fe360 C50	2.	2655.8	2081.2	1687.4	1280.6	1030.4	861.1	647.0	508.8	416.2	350.1
Fe360 C50	4.	1603.0	1172.4	969.3	761.9	633.8	546.0	432.3	355.1	301.6	262.0
Fe360 C50	6.	939.7	679.6	580.8	474.7	406.1	357.6	292.6	246.4	213.4	188.4
Fe360 C50	8.	427.0	354.5	325.0	287.4	259.3	237.3	204.9	178.8	159.0	143.3
Fe360 C20	2.	1686.3	1394.2	1175.0	929.8	768.5	654.3	503.7	402.1	332.4	281.6
Fe360 C20	4.	1155.0	882.8	744.7	597.2	502.7	436.5	349.0	288.4	245.9	214.2
Fe360 C20	6.	757.5	553.7	474.9	389.5	334.0	294.5	241.4	203.5	176.4	155.8
Fe360 C20	8.	326.2	279.7	259.6	233.2	212.7	196.3	171.4	150.8	134.8	122.0

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	1993.2	1543.0	1240.6	933.4	747.1	622.1	465.3	364.9	298.0	250.3
Fe510 C50	4.	1186.6	861.0	709.4	555.8	461.4	397.0	313.9	257.6	218.6	189.9
Fe510 C50	6.	517.0	421.3	376.9	323.4	285.3	256.6	215.8	184.8	161.9	144.2
Fe510 C50	8.	290.7	249.7	232.0	208.6	190.4	175.8	153.6	135.2	120.9	109.4
Fe510 C20	2.	1309.3	1060.2	879.8	684.4	559.3	472.5	360.0	285.5	235.0	198.4
Fe510 C20	4.	876.1	656.4	548.6	435.8	364.8	315.6	251.2	207.0	176.1	153.2
Fe510 C20	6.	389.2	326.3	295.6	257.3	229.3	207.7	176.4	152.0	133.7	119.5
Fe510 C20	8.	226.8	198.4	185.7	168.6	155.0	143.9	126.8	112.2	100.7	91.4
Fe360 C50	2.	1880.0	1465.7	1184.2	895.4	718.8	599.8	449.8	353.3	288.8	242.7
Fe360 C50	4.	1122.2	825.3	684.0	538.9	448.9	387.1	306.8	252.2	214.3	186.2
Fe360 C50	6.	711.7	508.3	432.6	352.1	300.5	264.2	215.8	181.5	157.0	138.6
Fe360 C50	8.	353.9	283.2	256.2	223.1	199.2	180.9	154.5	133.9	118.5	106.4
Fe360 C20	2.	1166.8	964.2	812.3	642.5	530.8	451.9	347.8	277.6	229.4	194.4
Fe360 C20	4.	818.7	627.4	530.0	425.5	358.5	311.4	249.2	206.0	175.7	153.1
Fe360 C20	6.	577.5	417.7	357.0	291.8	249.7	219.8	179.9	151.5	131.2	115.9
Fe360 C20	8.	280.7	231.1	211.3	186.2	167.6	153.1	131.8	114.9	102.0	91.8

DESIGNATION	> AF-HE 360 A + 8 D 20
SECTION	> AF-COLUMN
BUCKLING	> WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7435.4	5835.4	4736.0	3598.0	2896.8	2422.0	1820.9	1432.3	1172.1	985.9
Fe510 C50	4.	4447.1	3327.5	2779.5	2206.8	1846.5	1596.9	1270.6	1046.8	890.7	774.8
Fe510 C50	6.	1553.8	1378.6	1284.0	1156.8	1056.5	975.1	850.4	746.0	664.9	599.7
Fe510 C50	8.	858.8	796.4	765.3	719.8	680.7	646.6	589.9	535.4	490.1	451.8
Fe510 C20	2.	5398.5	4331.2	3570.3	2757.3	2243.1	1888.8	1433.0	1133.6	931.2	785.4
Fe510 C20	4.	2996.9	2375.6	2040.7	1667.3	1419.8	1242.6	1003.6	834.4	714.3	624.1
Fe510 C20	6.	1190.2	1073.2	1008.0	918.3	845.9	786.0	692.4	611.6	548.0	496.2
Fe510 C20	8.	694.4	646.7	622.8	587.6	557.1	530.3	485.5	441.8	405.3	374.3
Fe360 C50	2.	6485.0	5139.2	4199.4	3213.1	2598.5	2179.2	1644.7	1296.8	1062.9	895.1
Fe360 C50	4.	4529.7	3212.8	2621.7	2035.3	1680.9	1441.3	1134.8	929.1	787.3	682.9
Fe360 C50	6.	1861.9	1498.2	1333.2	1137.0	999.0	895.9	750.7	641.2	560.8	498.7
Fe360 C50	8.	813.4	736.2	699.5	647.7	604.7	568.3	510.0	457.1	414.5	379.1
Fe360 C20	2.	4495.2	3655.0	3042.2	2374.4	1944.7	1645.3	1255.9	997.3	821.4	694.1
Fe360 C20	4.	3010.9	2266.2	1898.2	1511.1	1266.5	1096.4	873.5	720.2	613.2	533.6
Fe360 C20	6.	1326.8	1114.5	1010.6	880.8	785.4	711.8	605.0	521.6	459.1	410.2
Fe360 C20	8.	636.3	582.9	556.9	519.6	488.1	461.0	416.9	375.9	342.3	314.2

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	5040.5	3883.1	3111.9	2333.6	1863.8	1549.9	1157.3	906.5	739.8	621.0
Fe510 C50	4.	3131.6	2186.2	1772.4	1367.6	1125.7	963.1	756.3	618.2	523.4	453.6
Fe510 C50	6.	1115.3	927.6	837.3	725.9	644.9	583.0	493.7	424.6	373.1	333.0
Fe510 C50	8.	522.1	475.1	452.6	420.5	393.7	370.8	333.9	300.0	272.6	249.7
Fe510 C20	2.	3523.4	2798.9	2290.9	1755.9	1421.6	1193.1	901.4	711.2	583.1	491.2
Fe510 C20	4.	2321.8	1669.2	1369.8	1069.1	885.6	760.9	600.5	492.4	417.6	362.5
Fe510 C20	6.	827.7	708.6	648.3	571.1	513.2	467.7	400.6	347.2	306.7	274.8
Fe510 C20	8.	424.4	388.0	370.4	345.2	323.9	305.7	276.1	248.7	226.3	207.6
Fe360 C50	2.	4615.5	3608.6	2921.2	2213.2	1778.9	1485.6	1115.3	876.5	716.9	602.7
Fe360 C50	4.	3060.0	2126.4	1720.7	1325.5	1089.9	932.0	731.3	597.5	505.7	438.2
Fe360 C50	6.	1534.4	1107.3	945.6	772.2	660.4	581.3	475.6	400.3	346.7	306.1
Fe360 C50	8.	772.8	605.1	543.4	469.3	416.6	376.8	320.2	276.5	244.1	218.8
Fe360 C20	2.	3081.1	2506.5	2087.1	1629.6	1335.0	1129.7	862.6	685.1	564.3	476.9
Fe360 C20	4.	2206.6	1602.2	1320.5	1034.8	859.3	739.4	584.6	479.9	407.3	353.7
Fe360 C20	6.	1210.1	889.9	764.9	628.8	539.8	476.4	391.1	329.8	286.0	252.7
Fe360 C20	8.	584.3	477.2	434.8	381.9	342.8	312.6	268.5	233.6	207.2	186.4

DESIGNATION	> AF-HE 360 A + 8 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	3645.9	2851.9	2309.4	1750.3	1407.2	1175.4	882.5	693.7	567.4	477.0
Fe510 C50	4.	2178.3	1588.3	1311.4	1029.5	855.7	736.8	583.1	478.8	406.5	353.1
Fe510 C50	6.	998.4	793.8	702.9	596.1	521.9	466.8	389.8	332.3	290.2	257.8
Fe510 C50	8.	468.5	413.3	388.2	354.0	326.6	304.1	269.0	238.6	214.7	195.3
Fe510 C20	2.	2513.0	2039.0	1694.5	1320.3	1080.2	913.2	696.4	552.6	455.0	384.3
Fe510 C20	4.	1631.2	1225.5	1025.6	815.8	683.4	591.4	471.0	388.2	330.5	287.5
Fe510 C20	6.	733.1	605.9	545.5	471.4	417.9	377.1	318.7	273.7	240.3	214.3
Fe510 C20	8.	377.2	335.5	316.3	289.8	268.4	250.6	222.6	198.1	178.7	162.8
Fe360 C50	2.	3380.6	2675.9	2184.8	1670.2	1350.0	1131.7	853.7	673.0	551.5	464.4
Fe360 C50	4.	2110.1	1551.6	1285.9	1013.1	843.9	727.6	576.8	474.1	402.8	350.1
Fe360 C50	6.	1196.3	881.9	758.7	624.2	536.1	473.3	388.7	327.9	284.4	251.3
Fe360 C50	8.	711.6	535.9	475.3	404.9	356.3	320.3	269.9	232.0	204.1	182.5
Fe360 C20	2.	2232.8	1852.2	1564.9	1241.9	1028.3	876.7	676.1	540.4	447.0	379.0
Fe360 C20	4.	1535.8	1179.8	997.7	802.0	676.1	587.7	470.5	389.1	331.9	289.2
Fe360 C20	6.	958.5	718.4	621.7	514.6	443.6	392.7	323.4	273.4	237.4	210.0
Fe360 C20	8.	581.4	445.6	397.5	340.6	300.9	271.2	229.4	197.5	174.0	155.8

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	2659.1	2075.7	1678.4	1270.2	1020.2	851.6	638.9	501.9	410.4	345.0
Fe510 C50	4.	1588.5	1167.5	967.4	762.0	634.7	547.2	433.7	356.5	302.9	263.2
Fe510 C50	6.	782.1	615.3	542.5	458.0	399.7	356.8	297.1	252.9	220.6	195.8
Fe510 C50	8.	383.5	332.9	310.5	280.7	257.2	238.2	209.1	184.6	165.4	150.0
Fe510 C20	2.	1826.7	1481.6	1230.9	958.8	784.3	662.9	505.5	401.1	330.2	278.9
Fe510 C20	4.	1218.3	916.5	767.4	610.8	511.9	443.1	353.0	291.0	247.7	215.6
Fe510 C20	6.	598.2	485.0	432.9	370.5	326.3	293.1	246.2	210.6	184.4	164.1
Fe510 C20	8.	311.0	273.3	256.3	233.2	214.9	199.8	176.4	156.3	140.5	127.7
Fe360 C50	2.	2477.1	1956.5	1595.0	1217.4	983.0	823.5	620.7	489.0	400.6	337.2
Fe360 C50	4.	1526.3	1136.4	947.1	750.3	627.0	541.8	430.6	354.5	301.5	262.2
Fe360 C50	6.	915.6	676.6	582.5	479.7	412.2	364.1	299.1	252.4	218.9	193.5
Fe360 C50	8.	559.2	422.1	374.6	319.4	281.2	252.8	213.2	183.3	161.2	144.2
Fe360 C20	2.	1624.8	1348.9	1140.3	905.5	750.1	639.7	493.5	394.5	326.4	276.8
Fe360 C20	4.	1135.1	878.1	745.1	601.1	507.8	442.0	354.5	293.5	250.5	218.5
Fe360 C20	6.	736.3	556.7	483.3	401.3	346.7	307.3	253.6	214.6	186.4	165.0
Fe360 C20	8.	468.6	358.4	319.4	273.5	241.4	217.5	183.9	158.3	139.5	124.8

DESIGNATION	> AF-HE 400 A + 8 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	8260.4	6450.4	5217.1	3949.2	3172.5	2648.5	1987.3	1561.4	1276.8	1073.3
Fe510 C50	4.	4730.5	3574.3	2999.2	2391.9	2006.9	1738.7	1386.4	1143.8	974.1	847.9
Fe510 C50	6.	1702.8	1514.6	1412.5	1274.7	1165.7	1077.0	940.7	826.0	736.8	664.9
Fe510 C50	8.	961.4	889.4	853.7	801.7	757.1	718.4	654.2	593.0	542.2	499.4
Fe510 C20	2.	5989.9	4779.1	3923.9	3017.6	2448.2	2057.7	1557.4	1230.2	1009.5	850.8
Fe510 C20	4.	3114.4	2496.8	2157.3	1773.6	1516.4	1330.7	1078.6	898.7	770.5	674.0
Fe510 C20	6.	1290.9	1163.0	1091.9	994.2	915.4	850.3	748.5	661.0	592.0	536.0
Fe510 C20	8.	764.9	710.2	682.9	642.9	608.4	578.3	528.2	479.7	439.4	405.3
Fe360 C50	2.	7225.5	5680.7	4616.2	3511.5	2829.4	2367.0	1780.7	1401.3	1147.1	965.1
Fe360 C50	4.	4942.1	3499.5	2853.7	2213.9	1827.8	1566.9	1233.3	1009.6	855.4	741.9
Fe360 C50	6.	1968.9	1608.5	1440.6	1237.5	1092.7	983.3	827.7	709.1	621.4	553.4
Fe360 C50	8.	886.5	807.0	768.8	714.4	668.9	630.2	567.5	510.0	463.4	424.6
Fe360 C20	2.	4991.4	4017.2	3318.9	2569.5	2093.5	1764.7	1340.8	1061.5	872.5	736.2
Fe360 C20	4.	3183.5	2410.5	2024.6	1616.3	1356.9	1176.0	938.2	774.2	659.5	574.1
Fe360 C20	6.	1353.3	1156.0	1056.6	929.6	834.5	760.1	650.5	563.3	497.4	445.5
Fe360 C20	8.	681.1	627.3	600.8	562.5	530.0	501.8	455.5	411.8	375.9	345.6

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	5689.2	4312.1	3418.7	2535.9	2012.2	1666.0	1237.2	965.9	786.5	659.2
Fe510 C50	4.	3349.2	2337.9	1895.3	1462.4	1203.7	1029.8	808.6	661.0	559.6	485.0
Fe510 C50	6.	1213.0	1003.3	903.5	781.0	692.6	625.1	528.4	453.9	398.5	355.4
Fe510 C50	8.	562.5	511.7	487.3	452.6	423.6	399.0	359.1	322.6	293.1	268.4
Fe510 C20	2.	3960.5	3084.8	2490.6	1881.9	1510.1	1259.7	944.3	741.5	606.1	509.4
Fe510 C20	4.	2430.1	1744.5	1430.8	1116.0	924.2	793.9	626.4	513.5	435.5	378.0
Fe510 C20	6.	882.4	749.9	683.7	599.8	537.2	488.6	417.2	360.8	318.2	284.8
Fe510 C20	8.	448.1	408.7	389.8	362.6	339.9	320.5	288.9	259.9	236.3	216.7
Fe360 C50	2.	5165.4	3983.1	3194.1	2396.8	1915.0	1592.9	1189.8	932.2	760.8	638.7
Fe360 C50	4.	3290.2	2279.7	1842.6	1417.9	1165.2	996.0	781.1	638.1	539.9	467.9
Fe360 C50	6.	1606.1	1168.7	1000.9	819.7	702.2	618.8	507.0	427.1	370.1	326.9
Fe360 C50	8.	786.4	629.1	569.1	495.5	442.3	401.6	343.0	297.3	263.0	236.2
Fe360 C20	2.	3421.2	2738.8	2254.1	1737.9	1412.2	1188.3	900.7	712.0	584.7	493.0
Fe360 C20	4.	2320.0	1676.8	1379.3	1078.8	894.8	769.4	607.9	498.7	423.1	367.4
Fe360 C20	6.	1240.6	918.8	791.7	652.5	561.0	495.7	407.4	343.9	298.3	263.7
Fe360 C20	8.	584.0	485.4	445.2	393.9	355.5	325.5	281.1	245.4	218.2	196.6

DESIGNATION	> AF-HE 400 A + 8 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	4181.2	3212.1	2569.3	1923.0	1534.1	1274.7	950.9	744.4	607.2	509.6
Fe510 C50	4.	2325.7	1701.8	1407.4	1106.5	920.5	793.1	628.0	516.0	438.2	380.7
Fe510 C50	6.	1075.6	854.3	756.1	641.0	561.0	501.7	418.9	357.0	311.7	276.9
Fe510 C50	8.	508.0	447.5	420.1	382.7	352.9	328.4	290.3	257.4	231.5	210.5
Fe510 C20	2.	2850.1	2268.1	1858.7	1426.6	1156.0	970.7	733.9	579.3	475.2	400.3
Fe510 C20	4.	1715.4	1287.4	1076.8	856.1	716.9	620.3	493.9	407.1	346.4	301.4
Fe510 C20	6.	788.6	646.1	579.4	498.4	440.5	396.7	334.2	286.5	251.2	223.8
Fe510 C20	8.	397.9	353.4	333.0	304.9	282.1	263.3	233.7	207.9	187.4	170.7
Fe360 C50	2.	3841.1	2994.0	2418.6	1828.5	1467.7	1224.6	918.3	721.2	589.5	495.5
Fe360 C50	4.	2262.1	1661.8	1376.7	1084.2	902.8	778.3	616.8	507.0	430.7	374.3
Fe360 C50	6.	1254.9	932.6	804.6	663.9	571.3	505.0	415.3	350.7	304.3	269.1
Fe360 C50	8.	738.9	564.9	503.4	431.0	380.4	342.8	289.7	249.5	219.7	196.6
Fe360 C20	2.	2506.8	2045.9	1707.6	1336.8	1097.0	929.4	710.7	565.0	465.7	393.8
Fe360 C20	4.	1621.8	1240.5	1047.0	839.9	707.2	614.1	491.2	405.9	346.1	301.5
Fe360 C20	6.	988.5	744.7	645.7	535.5	462.3	409.5	337.7	285.6	248.1	219.5
Fe360 C20	8.	581.7	454.5	407.9	351.9	312.2	282.3	239.8	207.0	182.7	163.8

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	3116.8	2377.9	1893.4	1410.6	1122.2	930.7	692.6	541.5	441.3	370.1
Fe510 C50	4.	1694.1	1249.6	1037.1	818.2	682.1	588.4	466.7	383.8	326.2	283.5
Fe510 C50	6.	840.7	662.0	583.8	493.0	430.4	384.3	320.1	272.4	237.6	210.9
Fe510 C50	8.	416.2	361.3	337.2	304.8	279.4	258.8	227.2	200.6	179.8	163.0
Fe510 C20	2.	2096.3	1664.2	1361.6	1043.2	844.3	708.5	535.1	422.1	346.1	291.5
Fe510 C20	4.	1271.3	957.9	802.7	639.3	536.0	464.1	369.8	305.0	259.7	226.0
Fe510 C20	6.	633.5	511.3	455.5	389.0	342.1	307.0	257.5	220.1	192.5	171.3
Fe510 C20	8.	332.6	290.5	271.7	246.4	226.4	210.1	185.0	163.6	146.8	133.3
Fe360 C50	2.	2861.7	2218.9	1786.1	1345.4	1077.5	897.7	671.8	527.0	430.5	361.6
Fe360 C50	4.	1637.3	1219.0	1015.9	804.8	672.5	581.1	461.8	380.2	323.4	281.2
Fe360 C50	6.	955.6	716.5	620.2	513.4	442.7	391.9	322.8	272.9	237.0	209.6
Fe360 C50	8.	580.3	446.7	398.9	342.3	302.6	273.0	231.1	199.1	175.5	157.1
Fe360 C20	2.	1847.0	1504.9	1254.5	980.8	804.2	680.9	520.3	413.4	340.6	287.9
Fe360 C20	4.	1198.3	923.1	781.8	629.3	531.0	461.8	370.0	306.1	261.2	227.7
Fe360 C20	6.	757.2	575.8	500.9	416.9	360.7	320.0	264.3	223.8	194.6	172.3
Fe360 C20	8.	479.5	370.9	331.8	285.2	252.5	227.9	193.1	166.5	146.8	131.5

DESIGNATION	> AF-HE 450 A + 12 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	9904.9	7821.8	6375.7	4865.6	3928.4	3290.8	2480.1	1953.8	1600.5	1347.2
Fe510 C50	4.	6263.4	4642.9	3861.8	3053.2	2548.4	2200.3	1747.1	1437.6	1222.2	1062.6
Fe510 C50	6.	2377.3	2061.5	1898.0	1685.0	1522.3	1393.4	1200.6	1044.5	925.4	830.8
Fe510 C50	8.	1245.8	1146.6	1097.9	1027.5	967.6	915.9	831.0	751.0	685.3	630.0
Fe510 C20	2.	7336.3	5910.0	4886.0	3785.5	3085.7	2602.0	1977.7	1566.2	1287.6	1086.6
Fe510 C20	4.	4346.7	3389.3	2887.4	2338.6	1980.7	1726.9	1388.2	1150.7	983.2	857.8
Fe510 C20	6.	1781.6	1576.5	1466.2	1318.5	1202.6	1108.8	965.4	846.0	753.4	679.1
Fe510 C20	8.	1024.3	944.5	905.2	848.2	799.6	757.5	688.2	622.6	568.5	523.0
Fe360 C50	2.	8642.6	6893.4	5658.5	4350.5	3529.0	2965.8	2244.4	1772.6	1454.6	1225.9
Fe360 C50	4.	6172.4	4416.6	3617.3	2817.9	2331.9	2002.0	1578.7	1293.7	1097.0	951.9
Fe360 C50	6.	2729.2	2174.2	1926.6	1635.5	1432.7	1282.1	1071.2	913.4	797.9	708.9
Fe360 C50	8.	1403.4	1203.1	1116.9	1003.2	915.1	844.5	737.6	648.7	579.9	524.8
Fe360 C20	2.	6153.3	5018.5	4186.5	3275.5	2687.0	2275.8	1739.8	1382.8	1139.6	963.5
Fe360 C20	4.	4264.0	3196.9	2672.8	2124.0	1778.2	1538.4	1224.5	1009.1	858.8	747.1
Fe360 C20	6.	2014.1	1652.1	1482.3	1276.0	1128.2	1016.3	856.6	734.5	644.0	573.8
Fe360 C20	8.	1081.4	946.5	886.2	804.6	739.9	687.0	605.4	535.8	481.1	436.8

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7012.3	5413.5	4344.6	3262.6	2608.2	2170.2	1621.6	1270.8	1037.4	871.0
Fe510 C50	4.	4380.8	3086.7	2511.9	1945.1	1604.1	1374.2	1080.7	884.3	749.0	649.5
Fe510 C50	6.	2184.1	1617.4	1393.7	1148.5	987.5	872.4	717.0	605.2	525.0	464.1
Fe510 C50	8.	1018.5	847.1	777.1	687.9	621.0	568.7	491.2	428.8	381.4	343.7
Fe510 C20	2.	5019.7	3978.9	3251.8	2488.5	2012.7	1688.1	1274.1	1004.7	823.6	693.5
Fe510 C20	4.	3268.9	2371.5	1953.8	1530.6	1270.7	1093.2	864.3	709.3	602.0	522.8
Fe510 C20	6.	1746.3	1304.3	1127.4	932.0	802.9	710.2	584.6	494.0	428.8	379.3
Fe510 C20	8.	803.4	679.6	627.6	560.0	508.4	467.4	406.2	356.0	317.5	286.7
Fe360 C50	2.	6378.0	5024.2	4088.3	3114.4	2511.7	2102.4	1582.9	1246.3	1020.5	858.7
Fe360 C50	4.	4253.6	3016.6	2461.5	1910.8	1578.1	1353.1	1065.3	872.2	739.1	641.1
Fe360 C50	6.	2215.4	1619.5	1389.1	1139.5	977.0	861.5	706.4	595.4	516.1	455.9
Fe360 C50	8.	1241.9	945.9	841.9	719.9	635.0	571.8	483.0	415.6	366.0	327.4
Fe360 C20	2.	4383.7	3575.7	2983.2	2334.3	1915.0	1622.1	1240.1	985.7	812.4	686.8
Fe360 C20	4.	3100.5	2294.7	1907.3	1506.9	1257.3	1085.2	861.4	708.7	602.4	523.7
Fe360 C20	6.	1741.1	1305.7	1130.2	935.7	806.8	714.2	588.3	497.3	431.9	382.1
Fe360 C20	8.	1027.8	793.0	708.7	608.7	538.4	485.8	411.4	354.7	312.6	279.9

DESIGNATION	> AF-HE 450 A + 12 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	5299.0	4175.9	3399.0	2590.0	2089.1	1749.0	1317.0	1037.0	849.2	714.6
Fe510 C50	4.	3098.7	2322.7	1941.8	1543.0	1291.7	1117.4	889.4	732.9	623.7	542.7
Fe510 C50	6.	1727.2	1312.7	1141.9	950.2	821.9	729.1	602.3	510.0	443.4	392.6
Fe510 C50	8.	995.9	787.7	709.8	615.3	547.6	496.2	422.6	365.6	323.0	289.8
Fe510 C20	2.	3766.6	3060.7	2546.3	1986.4	1626.3	1375.6	1049.8	833.4	686.3	579.9
Fe510 C20	4.	2336.3	1797.3	1521.0	1223.5	1031.9	897.2	718.6	594.4	507.1	442.0
Fe510 C20	6.	1395.2	1068.1	931.6	777.4	673.7	598.3	495.0	419.6	365.0	323.3
Fe510 C20	8.	801.1	642.6	581.8	507.1	453.0	411.6	351.7	305.0	269.9	242.4
Fe360 C50	2.	4869.2	3905.7	3219.0	2485.7	2021.8	1702.4	1291.5	1021.5	839.1	707.7
Fe360 C50	4.	3007.8	2283.6	1920.5	1535.1	1289.7	1118.4	892.8	737.0	628.0	546.8
Fe360 C50	6.	1711.3	1320.1	1154.8	966.7	839.3	746.4	618.6	524.9	456.9	404.9
Fe360 C50	8.	1050.1	826.0	742.9	642.6	571.1	517.0	439.7	380.1	335.6	301.0
Fe360 C20	2.	3339.8	2781.4	2357.0	1876.8	1557.6	1330.1	1028.0	822.7	681.2	577.9
Fe360 C20	4.	2216.8	1745.2	1493.9	1216.0	1033.2	902.7	727.6	604.2	516.8	451.3
Fe360 C20	6.	1362.9	1069.0	941.3	793.5	692.1	617.4	513.7	436.9	381.0	338.1
Fe360 C20	8.	866.5	689.1	622.1	540.4	481.6	436.8	372.5	322.5	285.2	255.9

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	4043.7	3180.8	2585.7	1967.6	1585.8	1326.8	998.4	785.8	643.3	541.2
Fe510 C50	4.	2285.4	1745.2	1471.7	1179.6	992.7	861.8	688.9	569.2	485.2	422.7
Fe510 C50	6.	1332.1	1026.5	897.6	751.0	651.9	579.6	480.3	407.4	354.6	314.3
Fe510 C50	8.	822.6	648.4	583.6	505.2	449.2	406.8	346.1	299.3	264.4	237.1
Fe510 C20	2.	2866.3	2328.8	1937.3	1511.0	1237.1	1046.3	798.4	633.9	522.0	441.0
Fe510 C20	4.	1743.5	1363.0	1162.6	942.9	799.2	697.2	560.8	465.1	397.5	346.9
Fe510 C20	6.	1083.9	840.2	736.4	617.7	537.0	478.0	396.6	336.8	293.3	260.0
Fe510 C20	8.	694.0	544.5	489.3	422.8	375.5	339.8	288.8	249.5	220.3	197.5
Fe360 C50	2.	3731.4	2989.6	2461.9	1899.3	1544.0	1299.5	985.3	779.1	639.9	539.6
Fe360 C50	4.	2213.5	1718.4	1460.7	1180.4	998.4	869.6	698.2	578.3	493.9	430.8
Fe360 C50	6.	1317.4	1037.7	915.3	773.0	674.9	602.6	502.0	427.2	372.7	330.8
Fe360 C50	8.	824.2	666.3	605.0	529.0	473.5	430.9	369.0	320.4	283.8	255.1
Fe360 C20	2.	2540.6	2120.3	1799.7	1435.7	1192.9	1019.6	789.0	631.9	523.5	444.3
Fe360 C20	4.	1658.1	1328.1	1147.0	942.6	805.6	706.8	572.7	477.1	409.0	357.7
Fe360 C20	6.	1055.6	845.6	751.0	639.1	560.8	502.5	420.4	358.9	313.7	278.8
Fe360 C20	8.	683.8	560.9	511.9	450.3	404.8	369.5	317.8	276.7	245.5	221.0

DESIGNATION > AF-HE 500 A + 12 D 20
SECTION > AF-COLUMN
BUCKLING > WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	10912.5	8591.6	6988.5	5321.6	4290.7	3590.9	2703.1	2127.9	1742.3	1466.0
Fe510 C50	4.	6730.4	5023.2	4191.1	3323.6	2779.2	2402.4	1910.3	1573.3	1338.4	1164.1
Fe510 C50	6.	2488.2	2186.5	2026.3	1814.0	1648.9	1516.4	1315.3	1149.6	1021.8	919.7
Fe510 C50	8.	1378.0	1270.1	1217.0	1140.0	1074.4	1017.7	924.3	835.9	763.2	702.0
Fe510 C20	2.	8074.4	6480.8	5343.8	4128.4	3359.1	2829.0	2146.7	1698.4	1395.2	1176.9
Fe510 C20	4.	4528.5	3577.5	3067.7	2501.8	2128.0	1860.8	1501.4	1247.5	1067.5	932.4
Fe510 C20	6.	1854.2	1660.5	1554.1	1409.0	1293.1	1198.0	1050.6	925.2	827.0	747.6
Fe510 C20	8.	1103.4	1020.0	978.8	918.7	867.2	822.6	748.7	678.3	620.1	570.9
Fe360 C50	2.	9674.9	7654.9	6248.1	4775.0	3858.7	3234.4	2439.5	1922.7	1575.6	1326.5
Fe360 C50	4.	6741.8	4817.2	3943.0	3069.9	2539.5	2179.9	1718.5	1408.1	1193.8	1035.8
Fe360 C50	6.	2886.8	2328.4	2073.9	1770.7	1557.0	1397.0	1171.3	1001.0	875.8	779.0
Fe360 C50	8.	1452.3	1271.8	1191.1	1081.8	995.0	924.2	814.6	721.0	647.6	588.0
Fe360 C20	2.	6731.9	5466.5	4545.7	3544.1	2900.7	2452.9	1871.3	1485.4	1223.0	1033.3
Fe360 C20	4.	4499.6	3394.9	2846.8	2268.9	1902.8	1648.1	1313.8	1083.6	922.7	803.1
Fe360 C20	6.	2070.4	1724.5	1557.8	1351.6	1201.5	1086.5	920.6	792.1	696.2	621.4
Fe360 C20	8.	1089.8	975.1	921.8	847.5	786.9	736.4	656.3	585.4	528.9	482.4

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7792.1	5941.4	4729.0	3521.7	2801.1	2322.8	1728.2	1350.9	1100.9	923.2
Fe510 C50	4.	4676.5	3284.8	2669.7	2064.8	1701.7	1457.2	1145.4	936.9	793.4	687.9
Fe510 C50	6.	2286.6	1701.8	1469.0	1212.7	1043.9	922.9	759.2	641.2	556.5	492.1
Fe510 C50	8.	996.7	852.9	791.1	709.9	647.1	596.9	520.9	457.9	409.2	370.2
Fe510 C20	2.	5516.9	4313.3	3491.6	2645.4	2126.3	1775.7	1333.1	1047.7	856.8	720.4
Fe510 C20	4.	3406.3	2463.8	2027.3	1586.1	1315.9	1131.6	894.1	733.6	622.5	540.4
Fe510 C20	6.	1748.2	1324.6	1150.9	956.6	826.8	733.1	605.2	512.2	445.2	394.1
Fe510 C20	8.	786.7	679.1	632.2	569.9	521.2	482.0	422.1	372.0	333.0	301.7
Fe360 C50	2.	7060.3	5492.9	4431.6	3345.9	2683.6	2237.9	1676.9	1316.4	1075.8	904.0
Fe360 C50	4.	4575.9	3215.6	2613.9	2022.0	1666.6	1427.1	1121.9	917.7	777.2	673.8
Fe360 C50	6.	2320.2	1698.2	1457.3	1195.9	1025.7	904.6	741.9	625.4	542.1	479.0
Fe360 C50	8.	1286.5	985.7	879.0	753.2	665.2	599.6	507.0	436.7	384.7	344.3
Fe360 C20	2.	4799.6	3860.1	3187.5	2466.4	2008.8	1692.9	1285.8	1017.8	836.5	705.7
Fe360 C20	4.	3244.5	2387.2	1978.9	1559.5	1299.2	1120.3	888.1	730.1	620.4	539.1
Fe360 C20	6.	1784.2	1340.5	1161.1	962.0	829.8	734.7	605.5	512.0	444.6	393.4
Fe360 C20	8.	1046.1	811.4	726.4	625.2	553.7	500.0	424.0	365.7	322.6	288.9

DESIGNATION	> AF-HE 500 A + 12 D 20	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	5941.2	4619.1	3724.8	2810.9	2253.8	1879.1	1407.7	1104.9	902.9	758.6
Fe510 C50	4.	3292.9	2468.6	2063.8	1640.0	1373.0	1187.8	945.4	779.1	663.0	576.8
Fe510 C50	6.	1801.7	1377.7	1201.2	1002.0	868.0	770.8	637.6	540.3	470.0	416.3
Fe510 C50	8.	977.3	796.4	725.1	636.2	570.8	520.2	446.6	388.3	344.3	309.7
Fe510 C20	2.	4166.1	3336.8	2747.2	2118.9	1722.3	1449.4	1098.8	868.8	713.5	601.6
Fe510 C20	4.	2408.5	1859.4	1576.2	1270.2	1072.5	933.1	748.0	619.1	528.4	460.6
Fe510 C20	6.	1417.3	1093.7	956.9	801.2	695.7	618.8	512.9	435.2	378.8	335.8
Fe510 C20	8.	776.0	638.4	583.3	513.9	462.3	422.3	363.5	316.6	281.2	253.1
Fe360 C50	2.	5455.2	4316.9	3523.9	2693.4	2176.7	1824.7	1376.3	1084.8	889.0	748.5
Fe360 C50	4.	3200.4	2423.1	2035.2	1624.7	1363.9	1182.1	943.1	778.2	662.9	577.1
Fe360 C50	6.	1785.2	1379.1	1207.2	1011.2	878.3	781.3	647.7	549.7	478.6	424.2
Fe360 C50	8.	1092.2	859.6	773.2	669.0	594.6	538.3	457.9	395.8	349.6	313.5
Fe360 C20	2.	3673.7	3021.0	2535.6	1997.4	1645.8	1398.3	1073.4	855.4	706.2	597.8
Fe360 C20	4.	2296.3	1805.5	1544.5	1256.4	1067.0	932.0	751.0	623.4	533.2	465.5
Fe360 C20	6.	1386.5	1090.6	961.5	811.6	708.3	632.3	526.5	448.0	390.8	346.8
Fe360 C20	8.	877.3	699.7	632.2	549.8	490.4	445.0	379.8	329.0	291.0	261.2

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	4604.5	3564.5	2865.9	2156.3	1725.7	1437.1	1074.8	842.9	688.3	578.1
Fe510 C50	4.	2410.1	1846.4	1559.5	1252.0	1054.6	916.1	733.0	605.9	516.7	450.2
Fe510 C50	6.	1370.5	1067.6	937.5	788.0	685.9	611.1	507.6	431.3	375.8	333.3
Fe510 C50	8.	838.9	669.8	605.5	526.8	470.0	426.6	364.2	315.5	279.1	250.6
Fe510 C20	2.	3216.2	2568.1	2109.8	1623.5	1317.7	1107.8	838.7	662.6	543.9	458.4
Fe510 C20	4.	1782.6	1399.9	1196.8	973.0	826.0	721.3	581.0	482.2	412.3	360.0
Fe510 C20	6.	1085.0	849.2	747.1	629.3	548.4	489.1	406.7	345.8	301.5	267.5
Fe510 C20	8.	693.5	549.4	495.3	429.6	382.5	346.7	295.4	255.6	225.9	202.7
Fe360 C50	2.	4231.3	3337.1	2717.7	2072.1	1672.0	1400.1	1054.6	830.6	680.2	572.5
Fe360 C50	4.	2350.9	1822.1	1547.7	1249.7	1056.4	919.9	738.2	611.3	522.0	455.2
Fe360 C50	6.	1358.7	1074.3	949.0	802.8	701.8	627.0	522.8	445.3	388.6	345.0
Fe360 C50	8.	847.6	687.4	624.8	547.1	490.2	446.3	382.6	332.4	294.6	264.8
Fe360 C20	2.	2838.1	2332.6	1957.0	1540.9	1269.3	1078.2	827.4	659.2	544.2	460.6
Fe360 C20	4.	1707.4	1368.8	1182.7	972.4	831.4	729.6	591.4	492.7	422.5	369.5
Fe360 C20	6.	1060.2	854.1	760.4	648.8	570.3	511.6	428.8	366.3	320.4	285.0
Fe360 C20	8.	683.7	562.8	514.3	453.2	407.9	372.6	320.8	279.5	248.2	223.4

DESIGNATION	> AF-HE 600 A + 12 D 20
SECTION	> AF-COLUMN
BUCKLING	> WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF :									
		0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	12778.2	9946.6	8027.4	6063.0	4863.9	4056.7	3040.4	2387.1	1950.9	1639.5
Fe510 C50	4.	7708.7	5712.8	4751.1	3755.9	3134.8	2706.5	2148.9	1768.1	1503.2	1306.9
Fe510 C50	6.	2838.6	2486.7	2301.0	2055.9	1866.1	1714.1	1484.5	1296.0	1151.0	1035.4
Fe510 C50	8.	1589.6	1459.8	1396.4	1304.9	1227.4	1160.7	1051.4	949.1	865.2	794.9
Fe510 C20	2.	9147.2	7270.7	5953.7	4565.6	3697.4	3103.8	2345.4	1850.8	1517.8	1278.6
Fe510 C20	4.	4868.4	3862.4	3319.2	2713.1	2311.1	2023.0	1634.3	1359.0	1163.5	1016.7
Fe510 C20	6.	2041.3	1822.3	1702.6	1540.3	1411.2	1305.7	1142.8	1005.0	897.4	810.6
Fe510 C20	8.	1224.2	1126.6	1078.7	1009.4	950.4	899.6	816.1	737.5	672.9	618.6
Fe360 C50	2.	11270.0	8827.8	7155.2	5428.3	4366.7	3648.8	2741.2	2155.3	1763.2	1482.7
Fe360 C50	4.	7739.1	5493.5	4484.3	3482.3	2876.5	2466.8	1942.4	1590.5	1347.8	1169.1
Fe360 C50	6.	3247.5	2630.9	2347.8	2008.7	1768.7	1588.6	1333.7	1140.8	998.6	888.6
Fe360 C50	8.	1648.3	1444.7	1353.4	1229.8	1131.5	1051.2	927.0	820.7	737.3	669.6
Fe360 C20	2.	7743.5	6197.1	5099.3	3930.7	3193.7	2687.0	2036.4	1609.8	1321.8	1114.5
Fe360 C20	4.	4920.3	3701.7	3099.9	2467.3	2067.6	1789.8	1425.8	1175.5	1000.7	870.8
Fe360 C20	6.	2228.7	1867.9	1692.1	1473.0	1312.4	1188.8	1009.6	869.9	765.4	683.7
Fe360 C20	8.	1173.8	1054.2	998.2	919.8	855.5	801.7	716.0	639.6	578.5	528.1

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF :									
		0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	9251.4	6907.9	5424.1	3985.3	3144.5	2593.7	1917.1	1492.6	1213.2	1015.4
Fe510 C50	4.	5268.6	3678.9	2982.9	2301.9	1894.8	1621.2	1273.1	1040.7	881.0	763.6
Fe510 C50	6.	2500.8	1875.7	1623.7	1344.4	1159.3	1026.2	845.4	714.7	620.6	549.0
Fe510 C50	8.	1220.3	1012.1	927.5	820.0	739.6	676.8	584.1	509.6	453.0	408.2
Fe510 C20	2.	6422.0	4898.3	3899.7	2904.8	2310.7	1916.3	1425.9	1114.7	908.4	761.8
Fe510 C20	4.	3646.9	2634.2	2166.2	1693.9	1404.8	1207.8	954.1	782.7	664.1	576.5
Fe510 C20	6.	1880.5	1425.3	1238.6	1029.6	890.0	789.1	651.5	551.5	479.3	424.3
Fe510 C20	8.	925.4	776.1	714.2	634.7	574.5	527.1	456.6	399.4	355.7	320.9
Fe360 C50	2.	8403.6	6406.9	5099.2	3797.1	3020.0	2504.2	1863.2	1456.4	1186.8	995.2
Fe360 C50	4.	5196.3	3613.3	2924.7	2253.6	1853.4	1584.9	1243.7	1016.3	860.2	745.4
Fe360 C50	6.	2547.8	1875.3	1612.4	1325.8	1138.4	1004.9	824.9	695.8	603.4	533.3
Fe360 C50	8.	1409.1	1089.5	974.3	837.5	741.2	669.0	566.9	488.8	430.9	385.9
Fe360 C20	2.	5583.7	4386.3	3562.3	2708.2	2181.3	1824.3	1372.0	1079.5	883.6	743.3
Fe360 C20	4.	3502.0	2567.3	2124.8	1671.9	1391.5	1199.2	950.0	780.7	663.1	576.1
Fe360 C20	6.	1866.0	1420.2	1236.1	1029.2	890.6	790.2	653.0	553.0	480.8	425.7
Fe360 C20	8.	1094.9	861.8	775.3	670.9	596.3	539.9	459.3	397.0	350.6	314.4

DESIGNATION > AF-HE 600 A + 12 D 20 SECTION > AF-COLUMN BUCKLING > WEAK AXIS	ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7161.7	5449.4	4331.5	3221.3	2560.0	2121.7	1577.6	1232.7	1004.2	841.9
Fe510 C50	4.	3655.9	2754.9	2308.8	1839.0	1541.8	1335.1	1063.9	877.4	747.0	650.1
Fe510 C50	6.	1921.6	1503.1	1322.2	1113.3	970.2	865.1	719.3	611.6	533.1	473.0
Fe510 C50	8.	1157.7	927.3	839.2	731.1	652.7	592.9	506.5	439.1	388.5	348.9
Fe510 C20	2.	4904.0	3831.1	3099.5	2347.0	1885.8	1574.5	1181.6	928.5	759.3	638.3
Fe510 C20	4.	2532.0	1969.5	1675.8	1355.6	1147.2	999.7	803.0	665.4	568.4	495.8
Fe510 C20	6.	1432.6	1133.6	1001.7	847.7	741.2	662.3	552.4	470.5	410.7	364.6
Fe510 C20	8.	896.6	719.7	651.7	568.2	507.6	461.3	394.3	341.9	302.6	271.8
Fe360 C50	2.	6580.4	5098.9	4102.4	3088.6	2472.9	2059.8	1541.2	1208.8	987.3	829.2
Fe360 C50	4.	3573.6	2706.7	2273.7	1815.4	1524.1	1321.0	1054.0	869.8	740.9	645.0
Fe360 C50	6.	1926.0	1508.1	1327.1	1118.0	974.5	869.1	722.9	614.7	535.9	475.5
Fe360 C50	8.	1168.6	938.1	849.6	740.8	661.8	601.4	514.1	445.8	394.6	354.4
Fe360 C20	2.	4319.5	3470.4	2863.6	2213.9	1802.3	1518.3	1152.7	912.2	749.5	632.3
Fe360 C20	4.	2418.0	1913.4	1642.1	1340.4	1140.8	997.9	805.6	669.5	573.0	500.6
Fe360 C20	6.	1409.5	1132.9	1007.6	858.8	754.4	676.3	566.5	483.8	423.1	376.2
Fe360 C20	8.	898.9	732.7	667.3	585.5	525.3	478.8	411.1	357.4	317.0	285.1

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	5730.5	4317.7	3410.0	2519.8	1994.9	1649.2	1222.3	953.3	775.6	649.7
Fe510 C50	4.	2669.1	2059.1	1745.0	1405.7	1186.6	1032.2	827.4	684.6	584.3	509.3
Fe510 C50	6.	1428.9	1144.9	1017.0	865.5	759.5	680.5	569.5	486.1	424.9	377.7
Fe510 C50	8.	878.5	721.2	658.5	579.5	521.1	475.7	409.3	356.4	316.3	284.7
Fe510 C20	2.	3867.7	3001.6	2417.6	1822.1	1459.9	1216.6	910.8	714.6	583.8	490.4
Fe510 C20	4.	1855.7	1474.5	1268.1	1037.4	884.1	774.2	625.7	520.5	445.7	389.5
Fe510 C20	6.	1057.1	858.3	766.7	656.7	578.6	520.0	436.9	373.8	327.3	291.3
Fe510 C20	8.	674.3	556.4	508.9	448.9	404.2	369.5	318.3	277.5	246.5	221.9
Fe360 C50	2.	5258.5	4040.3	3232.2	2419.4	1930.2	1604.0	1196.5	936.8	764.2	641.3
Fe360 C50	4.	2624.6	2037.7	1732.2	1399.9	1184.0	1031.3	828.0	685.9	585.8	510.9
Fe360 C50	6.	1434.6	1158.1	1031.8	881.3	775.1	695.6	583.4	498.6	436.3	388.1
Fe360 C50	8.	886.7	736.7	675.6	597.7	539.4	493.8	426.4	372.2	330.9	298.2
Fe360 C20	2.	3412.2	2730.5	2246.6	1731.6	1406.9	1183.6	897.0	709.1	582.2	490.9
Fe360 C20	4.	1785.0	1442.2	1251.2	1033.3	886.0	779.1	633.1	528.4	453.5	397.0
Fe360 C20	6.	1045.9	864.5	778.2	672.5	596.1	538.0	454.6	390.5	342.8	305.7
Fe360 C20	8.	676.3	572.7	529.1	472.3	429.0	394.6	343.0	300.7	268.2	242.3

DESIGNATION	> AF-HE 800 A + 12 D 25	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	17493.0	13575.0	10933.0	8239.9	6601.5	5501.1	4118.2	3231.1	2639.6	2217.4
Fe510 C50	4.	11255.9	8109.6	6661.5	5203.6	4313.0	3706.7	2926.6	2400.1	2036.0	1767.4
Fe510 C50	6.	4669.9	3873.6	3492.6	3023.7	2683.9	2424.4	2051.2	1763.1	1548.6	1381.5
Fe510 C50	8.	2476.1	2202.1	2075.9	1901.8	1760.9	1644.0	1460.4	1299.6	1171.9	1067.4
Fe510 C20	2.	12729.6	10037.4	8173.1	6230.4	5026.9	4209.1	3170.3	2496.6	2044.7	1720.7
Fe510 C20	4.	7291.3	5583.2	4714.4	3783.9	3186.9	2768.1	2214.5	1830.4	1560.9	1359.9
Fe510 C20	6.	3288.2	2785.6	2535.9	2220.7	1986.7	1805.1	1539.4	1330.1	1172.6	1048.9
Fe510 C20	8.	1837.4	1643.1	1552.7	1427.1	1324.7	1239.3	1104.1	984.7	889.4	811.1
Fe360 C50	2.	15511.6	12142.0	9836.9	7459.2	5998.6	5011.5	3763.8	2958.9	2420.4	2035.2
Fe360 C50	4.	10929.9	7726.3	6296.0	4881.3	4028.5	3452.6	2716.8	2223.6	1883.9	1633.8
Fe360 C50	6.	5003.2	3935.7	3469.6	2928.7	2556.2	2281.7	1900.0	1616.8	1410.3	1251.7
Fe360 C50	8.	2675.2	2253.1	2076.9	1849.2	1676.3	1539.6	1335.7	1169.4	1042.1	940.6
Fe360 C20	2.	10803.0	8620.8	7079.1	5444.8	4417.7	3713.3	2810.7	2220.2	1822.0	1535.7
Fe360 C20	4.	7182.4	5286.1	4382.6	3454.2	2877.8	2481.7	1967.5	1617.6	1374.4	1194.4
Fe360 C20	6.	3429.2	2772.2	2471.6	2112.5	1858.9	1668.8	1400.1	1197.1	1047.6	932.0
Fe360 C20	8.	1942.8	1660.9	1540.1	1381.2	1258.7	1160.7	1012.5	889.9	795.1	719.2

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	13076.7	9851.2	7779.4	5748.1	4550.4	3761.6	2787.9	2174.2	1769.0	1481.8
Fe510 C50	4.	7501.8	5413.5	4449.9	3478.3	2884.0	2479.2	1958.0	1606.1	1362.6	1182.9
Fe510 C50	6.	3728.7	2890.2	2533.0	2124.7	1847.1	1644.1	1364.1	1158.2	1008.7	894.3
Fe510 C50	8.	2155.2	1752.1	1593.9	1397.0	1252.5	1141.0	978.8	850.7	754.1	678.1
Fe510 C20	2.	9178.7	7051.1	5640.2	4221.4	3367.7	2798.3	2087.3	1634.1	1333.0	1118.7
Fe510 C20	4.	5185.9	3884.2	3246.0	2578.3	2158.0	1866.6	1485.5	1224.0	1041.5	906.1
Fe510 C20	6.	2764.7	2186.8	1932.1	1634.8	1429.2	1277.0	1064.9	907.0	791.6	702.9
Fe510 C20	8.	1650.3	1365.4	1250.1	1104.0	995.0	910.0	784.7	684.3	608.1	547.8
Fe360 C50	2.	11991.9	9258.2	7430.4	5580.1	4460.8	3711.8	2773.6	2173.7	1774.4	1489.8
Fe360 C50	4.	7357.2	5358.8	4422.6	3470.3	2883.8	2482.7	1964.2	1612.9	1369.3	1189.3
Fe360 C50	6.	3748.2	2908.1	2549.7	2139.6	1860.5	1656.3	1374.6	1167.2	1016.7	901.4
Fe360 C50	8.	2166.8	1766.4	1608.6	1411.5	1266.5	1154.5	991.2	861.9	764.3	687.4
Fe360 C20	2.	8078.2	6415.7	5250.5	4023.9	3257.5	2733.7	2065.1	1629.2	1335.9	1125.3
Fe360 C20	4.	4971.7	3810.5	3219.0	2584.8	2177.6	1891.8	1513.8	1251.4	1067.2	929.9
Fe360 C20	6.	2719.8	2194.2	1954.6	1669.0	1467.7	1316.9	1104.3	943.8	825.7	734.4
Fe360 C20	8.	1645.5	1385.4	1277.0	1136.8	1030.4	946.4	820.9	718.7	640.4	578.0

DESIGNATION	> AF-HE 800 A + 12 D 25	ARBED RECHERCHES
SECTION	> AF-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	10432.7	8010.7	6405.7	4792.8	3822.8	3176.1	2368.7	1854.2	1512.5	1269.2
Fe510 C50	4.	5224.5	4066.1	3460.7	2800.3	2370.3	2065.8	1659.7	1375.4	1174.9	1024.9
Fe510 C50	6.	2751.5	2260.5	2029.4	1748.3	1546.6	1393.6	1175.2	1008.0	884.1	787.8
Fe510 C50	8.	1685.5	1435.7	1329.3	1190.0	1083.0	997.7	869.1	763.1	681.3	615.9
Fe510 C20	2.	7271.6	5698.0	4619.7	3505.7	2820.6	2357.2	1771.1	1392.6	1139.4	958.2
Fe510 C20	4.	3584.6	2882.5	2494.5	2054.4	1758.4	1544.3	1253.0	1044.6	896.0	784.0
Fe510 C20	6.	1979.9	1661.1	1505.4	1311.2	1168.7	1058.9	899.6	775.3	682.3	609.5
Fe510 C20	8.	1251.2	1080.3	1005.7	906.6	829.2	766.8	671.6	591.9	529.9	480.0
Fe360 C50	2.	9629.2	7537.9	6107.1	4631.2	3724.4	3111.6	2337.0	1837.2	1502.9	1263.7
Fe360 C50	4.	5120.5	4022.1	3439.0	2796.1	2373.8	2073.1	1669.9	1386.0	1185.2	1034.7
Fe360 C50	6.	2766.3	2285.7	2057.3	1777.5	1575.5	1421.8	1201.3	1031.7	905.6	807.5
Fe360 C50	8.	1700.8	1456.6	1351.6	1213.3	1106.3	1020.6	891.0	783.4	700.2	633.5
Fe360 C20	2.	6447.1	5194.5	4295.0	3328.0	2713.0	2287.8	1739.1	1377.3	1132.3	955.6
Fe360 C20	4.	3441.7	2796.9	2434.0	2016.9	1733.1	1526.3	1242.8	1038.5	892.1	781.4
Fe360 C20	6.	1963.9	1653.9	1501.5	1310.5	1169.7	1061.0	902.7	778.7	685.8	612.9
Fe360 C20	8.	1270.3	1096.2	1020.3	919.5	840.9	777.4	680.8	599.9	537.0	486.4

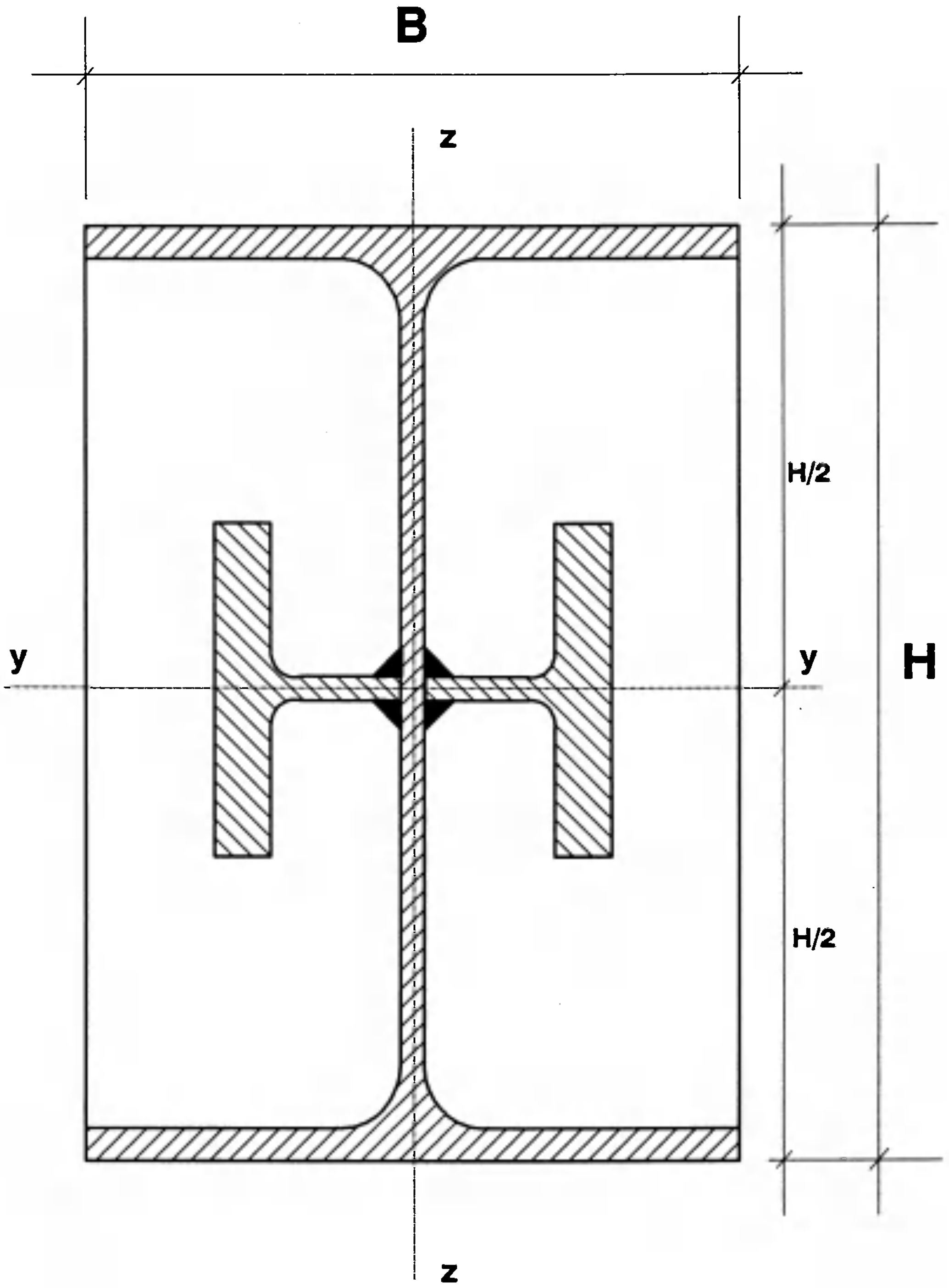
FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	8491.9	6486.8	5169.3	3854.3	3067.8	2545.2	1894.9	1481.7	1207.8	1013.0
Fe510 C50	4.	3854.0	3081.3	2658.5	2182.4	1864.1	1634.7	1323.8	1102.4	944.9	826.2
Fe510 C50	6.	2004.9	1697.4	1544.8	1352.3	1209.5	1098.7	936.8	809.2	713.3	638.0
Fe510 C50	8.	1235.5	1075.8	1005.1	910.0	835.1	774.2	680.7	601.3	539.4	489.3
Fe510 C20	2.	5813.1	4543.5	3677.2	2785.4	2238.5	1869.3	1403.1	1102.7	901.8	758.1
Fe510 C20	4.	2624.2	2151.6	1881.5	1567.4	1351.6	1193.2	974.8	816.2	702.1	615.6
Fe510 C20	6.	1415.0	1212.7	1110.2	978.7	879.8	802.2	687.5	595.9	526.6	471.9
Fe510 C20	8.	886.2	780.6	732.8	667.7	615.6	572.9	506.4	449.1	403.9	367.2
Fe360 C50	2.	7880.0	6131.4	4947.0	3735.4	2996.1	2498.6	1872.3	1469.9	1201.3	1009.4
Fe360 C50	4.	3795.1	3042.4	2628.6	2161.1	1847.6	1621.4	1314.2	1095.0	938.8	821.2
Fe360 C50	6.	2030.8	1709.3	1551.4	1353.6	1208.0	1095.5	931.8	803.7	707.7	632.5
Fe360 C50	8.	1267.8	1098.5	1024.2	924.9	847.2	784.2	688.0	606.9	543.8	492.9
Fe360 C20	2.	5187.0	4162.9	3432.3	2651.4	2157.3	1816.7	1378.6	1090.6	895.9	755.7
Fe360 C20	4.	2548.6	2104.1	1847.0	1545.2	1336.2	1182.0	968.1	812.0	699.3	613.7
Fe360 C20	6.	1439.9	1229.8	1124.0	988.9	887.6	808.5	691.8	599.1	529.0	473.8
Fe360 C20	8.	920.5	806.7	755.7	686.7	631.8	586.9	517.5	458.2	411.6	373.8

TYPICAL COLUMN CROSS SECTION TYPE AFC.

FOR BENDING ABOUT MAJOR AXIS ≡ STRONG AXIS yy

OR MINOR AXIS ≡ WEAK AXIS zz



- A 36 -

DESIGNATION SECTION BUCKLING	> AFC-HE 500 A + 2 1/2 HE 140 M > AFC-COLUMN > STRONG AXIS	ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	12590.4	11376.9	8614.6	6612.9	4519.6	3435.5	2528.5	2001.4	1235.3	660.9
Fe510 C50	4.	11211.0	9862.7	7394.7	5682.4	3937.0	3041.0	2288.3	1846.4	1173.5	646.0
Fe510 C50	6.	8627.4	7535.2	5796.1	4563.0	3272.7	2591.4	2004.5	1651.6	1080.4	608.2
Fe510 C50	8.	5398.2	4867.8	4035.8	3366.2	2581.8	2127.6	1711.0	1447.7	979.9	563.7
Fe510 C20	2.	9537.7	8786.9	6962.8	5530.8	3922.3	3040.6	2275.4	1818.9	1137.7	614.9
Fe510 C20	4.	8238.0	7426.5	5825.9	4620.6	3305.5	2594.9	1978.8	1608.9	1033.1	573.0
Fe510 C20	6.	5945.0	5385.2	4392.1	3604.0	2696.9	2182.2	1718.5	1430.7	949.0	539.7
Fe510 C20	8.	4014.0	3702.7	3179.3	2725.6	2155.7	1806.5	1474.0	1258.1	861.8	500.3
Fe360 C50	2.	11052.9	9824.5	7172.9	5367.6	3574.5	2681.8	1952.5	1536.0	940.1	499.9
Fe360 C50	4.	9847.4	8471.3	6111.5	4581.2	3100.0	2367.5	1765.3	1417.1	894.6	490.1
Fe360 C50	6.	7741.3	6564.6	4838.4	3707.2	2592.0	2027.4	1553.1	1272.7	826.6	462.9
Fe360 C50	8.	5272.5	4553.7	3556.9	2845.8	2092.3	1687.7	1333.5	1116.9	745.8	424.8
Fe360 C20	2.	8028.0	7289.6	5581.6	4319.7	2977.7	2273.5	1679.5	1332.3	824.7	442.2
Fe360 C20	4.	6913.1	6119.2	4639.0	3591.5	2506.7	1943.3	1466.6	1185.4	755.1	416.3
Fe360 C20	6.	5161.7	4561.9	3573.6	2848.3	2067.9	1647.3	1280.5	1058.1	694.7	392.1
Fe360 C20	8.	3441.1	3105.3	2577.4	2151.6	1651.7	1361.8	1095.5	927.2	627.8	361.2

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	9533.7	8250.3	5699.6	4114.9	2648.1	1954.1	1403.9	1096.2	664.3	350.7
Fe510 C50	4.	8071.4	6738.3	4634.8	3377.0	2227.6	1681.3	1242.2	992.1	622.2	339.2
Fe510 C50	6.	5411.5	4561.8	3335.1	2542.9	1770.0	1381.7	1056.7	865.2	561.3	314.1
Fe510 C50	8.	3270.5	2857.6	2266.4	1831.6	1359.9	1102.3	874.3	733.9	491.5	280.5
Fe510 C20	2.	7086.5	6242.9	4472.4	3304.6	2173.6	1620.9	1174.3	921.2	561.8	297.9
Fe510 C20	4.	5713.5	4919.4	3554.1	2666.5	1805.9	1379.7	1029.1	826.2	521.7	285.8
Fe510 C20	6.	3712.6	3244.6	2498.1	1967.9	1412.3	1118.6	865.4	713.2	466.6	262.7
Fe510 C20	8.	2336.0	2093.8	1720.6	1425.8	1085.9	891.6	714.8	603.7	407.6	234.1
Fe360 C50	2.	8680.7	7367.0	4901.7	3459.8	2181.6	1594.7	1137.3	884.3	533.1	280.4
Fe360 C50	4.	7372.7	5991.1	3961.2	2824.0	1828.7	1368.8	1004.9	799.8	499.4	271.4
Fe360 C50	6.	5089.0	4144.1	2897.5	2153.5	1466.0	1132.8	859.6	700.8	452.1	252.0
Fe360 C50	8.	3057.2	2595.1	1983.5	1565.3	1136.0	910.7	716.0	598.1	397.9	226.0
Fe360 C20	2.	6218.6	5377.8	3710.2	2676.4	1721.0	1269.5	911.8	711.8	431.3	227.7
Fe360 C20	4.	5015.3	4218.2	2934.8	2152.5	1428.1	1080.7	800.1	639.7	401.7	219.3
Fe360 C20	6.	3286.0	2800.7	2079.0	1599.9	1123.0	880.1	675.2	553.7	360.0	201.8
Fe360 C20	8.	2065.4	1810.0	1441.1	1167.8	869.4	705.6	560.2	470.5	315.4	180.1

DESIGNATION	> AFC-HE 500 A + 2 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	7914.4	6660.2	4362.8	3051.9	1909.3	1390.7	989.0	767.9	462.0	242.6
Fe510 C50	4.	6858.3	5479.5	3539.2	2492.6	1598.1	1191.0	871.5	692.4	431.3	234.0
Fe510 C50	6.	4483.8	3632.0	2523.0	1868.6	1268.3	978.8	742.0	604.6	389.8	217.1
Fe510 C50	8.	2690.6	2278.5	1736.5	1367.9	991.1	794.0	623.8	520.9	346.4	196.7
Fe510 C20	2.	5924.8	5070.1	3426.8	2441.3	1552.2	1138.9	814.6	634.5	383.3	201.9
Fe510 C20	4.	5042.4	4131.8	2764.5	1983.5	1291.3	968.9	712.6	567.7	354.9	193.0
Fe510 C20	6.	3101.4	2611.4	1906.3	1452.2	1010.0	788.1	602.6	493.3	319.9	179.0
Fe510 C20	8.	1916.0	1668.8	1317.8	1062.0	786.3	636.4	504.2	423.0	283.0	161.4
Fe360 C50	2.	7314.5	6037.8	3821.7	2623.2	1614.8	1167.7	825.8	639.2	383.1	200.6
Fe360 C50	4.	6326.9	4925.3	3075.5	2129.9	1347.4	998.5	727.5	576.7	358.2	193.9
Fe360 C50	6.	4152.9	3276.2	2206.8	1608.2	1077.1	826.4	623.7	507.0	325.9	181.1
Fe360 C50	8.	2486.4	2059.5	1529.5	1186.3	847.6	674.6	527.4	439.1	291.0	164.8
Fe360 C20	2.	5308.0	4453.5	2901.5	2023.5	1262.6	918.5	652.6	506.4	304.5	159.8
Fe360 C20	4.	4498.7	3592.9	2319.5	1633.1	1046.8	780.1	570.8	453.5	282.5	153.3
Fe360 C20	6.	2742.3	2258.9	1602.1	1200.2	822.6	637.6	485.0	395.9	255.8	142.7
Fe360 C20	8.	1695.9	1449.4	1117.2	886.3	646.4	519.4	409.1	342.1	227.9	129.6

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	6520.4	5397.9	3433.9	2363.4	1458.2	1055.5	747.1	578.5	346.9	181.8
Fe510 C50	4.	5394.4	4260.6	2710.3	1894.2	1206.9	897.1	655.1	519.9	323.4	175.3
Fe510 C50	6.	3403.1	2753.3	1909.8	1413.3	958.6	739.6	560.6	456.7	294.4	164.0
Fe510 C50	8.	2086.5	1758.4	1332.3	1045.8	755.3	604.1	474.1	395.6	262.8	149.2
Fe510 C20	2.	4955.3	4161.3	2715.6	1895.6	1183.7	861.4	612.2	475.2	285.8	150.0
Fe510 C20	4.	4114.3	3304.9	2150.2	1520.1	977.5	729.5	534.3	424.7	264.8	143.7
Fe510 C20	6.	2544.5	2102.8	1497.6	1124.6	772.3	599.2	456.1	372.4	240.8	134.4
Fe510 C20	8.	1588.2	1360.3	1051.3	835.4	610.3	490.7	386.8	323.5	215.6	122.6
Fe360 C50	2.	6072.4	4929.5	3033.4	2051.4	1247.4	897.1	631.9	488.1	291.7	152.5
Fe360 C50	4.	4999.6	3855.6	2379.5	1638.7	1032.1	763.5	555.5	440.0	273.0	147.7
Fe360 C50	6.	3101.5	2462.7	1671.1	1222.4	821.2	630.9	476.7	387.7	249.3	138.7
Fe360 C50	8.	1895.8	1571.6	1168.3	906.6	648.1	516.0	403.4	336.0	222.6	126.1
Fe360 C20	2.	4498.0	3696.2	2321.5	1586.9	973.5	702.9	496.5	384.1	230.0	120.4
Fe360 C20	4.	3707.7	2900.9	1823.0	1266.4	803.1	595.7	434.4	344.5	214.1	115.9
Fe360 C20	6.	2249.3	1821.7	1265.2	937.0	635.9	490.7	372.0	303.1	195.4	108.8
Fe360 C20	8.	1397.2	1176.7	890.9	698.9	504.6	403.5	316.6	264.2	175.5	99.6

DESIGNATION > AFC-HE 550 A + 2 1/2 HE 140 M SECTION > AFC-COLUMN BUCKLING > STRONG AXIS	ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	13786.1	12582.9	9751.0	7614.3	5299.2	4066.5	3016.9	2399.2	1484.2	790.6
Fe510 C50	4.	12649.4	11244.6	8591.4	6687.2	4692.5	3647.6	2759.0	2232.7	1418.8	775.8
Fe510 C50	6.	10390.3	9091.2	7012.1	5530.3	3973.5	3148.9	2437.5	2009.2	1309.7	730.1
Fe510 C50	8.	7421.2	6567.4	5299.6	4334.5	3256.9	2655.6	2116.6	1781.7	1192.7	675.4
Fe510 C20	2.	10329.5	9602.5	7779.9	6290.6	4552.4	3569.0	2697.3	2168.9	1362.3	734.2
Fe510 C20	4.	9312.6	8455.9	6727.2	5391.1	3899.5	3078.9	2359.4	1923.8	1235.1	680.5
Fe510 C20	6.	7289.7	6595.1	5367.8	4397.6	3285.3	2655.8	2089.9	1739.1	1148.2	646.2
Fe510 C20	8.	5051.3	4637.3	3951.6	3366.7	2643.8	2206.7	1794.2	1528.1	1039.4	595.7
Fe360 C50	2.	12030.0	10816.0	8097.7	6166.0	4179.0	3163.0	2319.6	1832.3	1123.3	594.3
Fe360 C50	4.	11090.4	9646.7	7090.8	5378.5	3680.1	2825.4	2115.6	1702.3	1073.6	583.8
Fe360 C50	6.	9234.3	7861.3	5825.9	4478.7	3140.9	2460.3	1886.8	1547.2	1001.6	555.6
Fe360 C50	8.	6949.8	5911.9	4530.4	3580.9	2602.8	2088.1	1642.6	1372.4	909.7	511.5
Fe360 C20	2.	8639.6	7923.6	6210.8	4892.1	3437.0	2650.9	1975.1	1574.7	977.6	522.1
Fe360 C20	4.	7766.8	6939.4	5352.2	4193.5	2962.4	2310.5	1752.5	1420.4	904.6	495.4
Fe360 C20	6.	6188.8	5477.9	4301.5	3434.1	2497.4	1991.1	1548.8	1280.2	837.6	468.2
Fe360 C20	8.	4464.3	3987.0	3259.2	2690.4	2040.8	1672.2	1338.2	1129.1	758.2	430.4

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	10499.4	9213.7	6547.6	4812.5	3149.5	2342.8	1694.0	1327.4	805.0	422.6
Fe510 C50	4.	9349.1	7889.2	5517.3	4058.7	2700.0	2045.7	1515.9	1212.7	759.1	410.5
Fe510 C50	6.	7010.5	5838.6	4200.3	3172.3	2189.6	1702.6	1298.2	1061.1	684.1	378.4
Fe510 C50	8.	4471.5	3833.4	2966.2	2358.8	1724.3	1387.1	1093.5	914.7	607.3	341.8
Fe510 C20	2.	7691.1	6869.4	5068.2	3819.9	2562.1	1929.1	1408.6	1109.9	678.2	357.9
Fe510 C20	4.	6629.5	5749.9	4205.8	3180.1	2169.4	1663.2	1244.0	1000.3	630.3	342.6
Fe510 C20	6.	4737.4	4109.6	3129.0	2446.9	1743.7	1376.3	1061.9	873.7	568.2	316.2
Fe510 C20	8.	3094.8	2742.5	2217.3	1816.0	1366.4	1114.9	889.1	748.7	501.4	284.0
Fe360 C50	2.	9526.6	8209.3	5624.2	4039.7	2587.4	1905.1	1366.3	1065.8	642.6	335.8
Fe360 C50	4.	8497.4	6984.4	4694.1	3376.2	2202.5	1654.1	1217.4	970.2	604.4	325.7
Fe360 C50	6.	6431.1	5190.2	3589.6	2652.3	1796.6	1385.3	1049.5	854.8	548.6	302.4
Fe360 C50	8.	4186.5	3464.9	2570.9	1993.0	1423.4	1132.6	885.3	737.1	486.3	272.5
Fe360 C20	2.	6710.7	5889.5	4186.1	3077.2	2014.1	1498.3	1083.4	849.0	514.9	270.3
Fe360 C20	4.	5768.0	4891.2	3447.2	2547.5	1701.7	1291.7	958.6	767.5	480.9	260.3
Fe360 C20	6.	4171.9	3522.1	2580.4	1969.9	1372.7	1072.1	820.3	671.7	434.1	240.5
Fe360 C20	8.	2732.8	2359.3	1842.0	1473.2	1082.8	873.3	689.9	577.8	384.2	216.5

DESIGNATION > AFC-HE 550 A + 2 1/2 HE 140 M SECTION > AFC-COLUMN BUCKLING > STRONG AXIS	ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	8813.1	7544.7	5103.3	3637.4	2313.6	1697.9	1214.6	946.1	569.3	297.2
Fe510 C50	4.	7896.0	6425.5	4256.8	3038.0	1969.0	1474.4	1082.8	861.9	536.1	288.6
Fe510 C50	6.	5859.3	4696.1	3221.3	2369.7	1599.4	1231.2	931.6	758.3	486.3	267.9
Fe510 C50	8.	3664.6	3049.8	2277.2	1771.8	1269.6	1011.8	791.8	659.6	435.6	244.2
Fe510 C20	2.	6482.5	5640.2	3938.6	2862.7	1853.8	1372.0	988.0	772.4	467.1	244.6
Fe510 C20	4.	5827.0	4837.8	3300.1	2393.2	1572.2	1184.5	873.9	697.4	435.1	234.8
Fe510 C20	6.	4002.3	3341.4	2411.5	1824.7	1261.5	981.7	748.9	612.4	395.0	218.5
Fe510 C20	8.	2544.8	2189.6	1702.0	1357.5	995.1	801.5	632.6	529.5	351.8	198.1
Fe360 C50	2.	8097.6	6810.3	4456.2	3115.3	1948.0	1418.5	1008.6	783.0	469.2	244.1
Fe360 C50	4.	7275.5	5767.4	3686.5	2582.6	1648.7	1226.5	896.2	711.5	441.0	236.9
Fe360 C50	6.	5415.4	4218.1	2801.5	2027.2	1350.0	1033.2	778.4	632.1	404.1	222.2
Fe360 C50	8.	3365.4	2734.6	1988.4	1523.8	1077.6	853.6	664.9	552.5	363.7	203.4
Fe360 C20	2.	5775.8	4932.0	3319.9	2359.4	1496.8	1097.2	784.2	610.5	367.1	191.5
Fe360 C20	4.	5171.9	4184.9	2750.5	1954.7	1262.4	943.9	692.4	550.8	342.3	184.2
Fe360 C20	6.	3516.8	2865.2	2004.5	1490.3	1014.8	784.3	595.2	485.3	311.8	172.0
Fe360 C20	8.	2245.2	1890.0	1430.1	1121.6	809.4	647.2	507.8	423.6	280.3	157.4

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	7365.9	6207.7	4077.3	2856.5	1789.5	1304.2	927.9	720.6	432.0	224.9
Fe510 C50	4.	6358.0	5102.3	3315.4	2342.2	1505.4	1123.2	822.5	653.8	405.8	218.2
Fe510 C50	6.	4405.9	3540.7	2436.4	1795.4	1213.4	934.7	707.6	576.1	369.5	203.6
Fe510 C50	8.	2790.7	2324.2	1736.9	1352.1	969.3	772.6	604.7	503.8	332.7	186.6
Fe510 C20	2.	5506.0	4706.2	3173.8	2258.1	1434.0	1051.6	751.9	585.5	352.2	183.8
Fe510 C20	4.	4806.3	3915.4	2597.9	1855.5	1203.4	901.4	662.1	527.2	327.9	176.6
Fe510 C20	6.	3239.9	2666.1	1888.6	1413.9	968.4	750.4	570.7	465.8	299.7	165.5
Fe510 C20	8.	2084.0	1769.3	1352.7	1067.6	774.9	621.3	488.5	408.0	270.4	152.0
Fe360 C50	2.	6817.8	5643.1	3588.7	2469.5	1523.4	1102.6	780.4	604.3	360.9	187.4
Fe360 C50	4.	5865.5	4595.5	2892.9	2011.4	1276.4	947.1	690.7	547.8	339.1	181.9
Fe360 C50	6.	4034.6	3167.3	2121.7	1541.8	1030.3	789.7	595.6	484.0	309.6	170.3
Fe360 C50	8.	2531.4	2066.4	1510.0	1160.4	822.5	652.3	508.5	422.7	278.4	155.8
Fe360 C20	2.	4956.1	4149.4	2693.0	1874.0	1167.1	848.3	602.4	467.3	279.7	145.4
Fe360 C20	4.	4308.8	3417.5	2186.0	1532.0	978.3	727.9	531.9	422.3	261.8	140.6
Fe360 C20	6.	2856.2	2295.2	1579.3	1163.7	786.5	605.8	458.6	373.4	239.5	132.0
Fe360 C20	8.	1823.1	1516.3	1131.4	879.9	630.3	502.2	392.9	327.3	216.1	121.2

DESIGNATION > AFC-HE 600 A + 2 1/2 HE 140 M
SECTION > AFC-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF :									
		0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	14932.7	13741.5	10858.7	8607.0	6089.1	4714.1	3523.8	2814.8	1746.5	927.8
Fe510 C50	4.	14032.3	12592.4	9792.5	7717.6	5484.7	4291.0	3262.9	2648.6	1684.7	916.9
Fe510 C50	6.	12133.8	10669.3	8291.8	6573.1	4746.4	3770.8	2924.7	2413.6	1570.5	869.5
Fe510 C50	8.	9487.1	8306.7	6606.3	5349.1	3978.9	3228.0	2562.2	2151.7	1431.1	801.7
Fe510 C20	2.	11132.5	10396.6	8521.5	6956.4	5091.1	4016.9	3053.1	2463.5	1550.0	832.4
Fe510 C20	4.	10314.4	9439.3	7628.5	6186.9	4533.9	3605.0	2779.0	2273.9	1462.2	802.3
Fe510 C20	6.	8561.2	7753.8	6322.4	5186.8	3880.6	3139.6	2472.2	2058.1	1355.1	756.8
Fe510 C20	8.	6378.3	5812.9	4897.1	4134.8	3214.0	2667.8	2158.5	1833.0	1237.7	701.2
Fe360 C50	2.	13035.3	11836.2	9062.6	7013.6	4834.5	3691.2	2726.8	2163.1	1329.4	701.1
Fe360 C50	4.	12299.3	10819.3	8110.9	6232.2	4317.6	3334.9	2509.4	2024.7	1277.5	691.2
Fe360 C50	6.	10658.0	9130.0	6825.6	5275.9	3718.5	2919.7	2243.3	1841.4	1189.9	655.4
Fe360 C50	8.	8553.4	7246.8	5526.3	4354.7	3156.4	2528.8	1987.2	1659.4	1095.5	610.4
Fe360 C20	2.	9222.9	8532.0	6829.1	5468.0	3912.7	3048.2	2290.9	1836.0	1144.3	610.0
Fe360 C20	4.	8544.4	7706.3	6050.8	4802.1	3437.6	2699.6	2059.2	1674.6	1067.7	582.2
Fe360 C20	6.	7174.8	6373.7	5033.8	4035.0	2946.3	2353.8	1834.0	1517.5	990.9	550.0
Fe360 C20	8.	5536.4	4915.0	3983.8	3268.5	2463.8	2012.2	1606.0	1352.9	903.6	507.8

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF :									
		0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	11483.6	10206.4	7450.5	5574.6	3712.0	2784.7	2027.4	1594.8	969.1	506.9
Fe510 C50	4.	10566.2	9027.1	6438.9	4793.0	3222.6	2453.6	1825.2	1463.3	915.5	492.3
Fe510 C50	6.	8522.9	7106.0	5119.4	3869.7	2672.9	2079.1	1585.8	1296.4	833.2	457.2
Fe510 C50	8.	5915.3	4986.5	3779.7	2967.4	2143.6	1714.7	1345.8	1123.0	740.7	412.4
Fe510 C20	2.	8323.5	7521.7	5696.4	4373.3	2989.3	2272.4	1672.5	1324.0	811.3	427.0
Fe510 C20	4.	7499.7	6571.3	4892.0	3741.5	2580.4	1988.7	1493.8	1204.0	758.7	410.1
Fe510 C20	6.	5798.3	5024.2	3819.0	2983.2	2123.7	1675.4	1292.2	1062.9	688.7	380.1
Fe510 C20	8.	4019.4	3521.2	2802.6	2270.4	1689.7	1371.2	1088.6	914.3	608.2	340.8
Fe360 C50	2.	10386.1	9076.0	6394.2	4673.6	3042.5	2257.4	1628.9	1275.0	769.6	400.6
Fe360 C50	4.	9556.3	7973.3	5479.5	3990.4	2631.1	1985.4	1466.7	1171.3	729.1	390.7
Fe360 C50	6.	7750.6	6267.4	4344.9	3214.4	2179.6	1681.4	1274.3	1038.1	664.2	363.3
Fe360 C50	8.	5542.9	4498.4	3266.6	2501.5	1767.8	1400.0	1090.3	905.9	594.2	329.6
Fe360 C20	2.	7214.8	6415.4	4687.8	3509.8	2338.7	1755.1	1278.1	1005.5	611.2	319.7
Fe360 C20	4.	6482.2	5557.7	3987.3	2978.6	2009.2	1532.1	1141.1	915.4	573.2	308.4
Fe360 C20	6.	5084.8	4283.4	3128.6	2384.1	1658.7	1294.5	989.8	810.4	521.8	286.7
Fe360 C20	8.	3524.0	3003.2	2306.6	1825.7	1328.7	1066.6	839.5	701.6	463.7	258.6

DESIGNATION	> AFC-HE 600 A + 2 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	9711.5	8441.1	5882.7	4270.3	2762.0	2043.0	1470.6	1149.4	692.6	360.0
Fe510 C50	4.	8904.3	7373.5	5010.2	3625.4	2377.3	1789.4	1319.4	1052.5	654.3	350.3
Fe510 C50	6.	7217.7	5786.0	3969.8	2920.7	1971.5	1517.8	1148.5	934.8	597.5	326.6
Fe510 C50	8.	4841.9	3967.4	2911.2	2242.4	1592.7	1264.1	986.2	820.2	538.6	299.0
Fe510 C20	2.	7062.4	6233.0	4482.4	3320.3	2189.3	1634.5	1185.3	930.3	563.7	294.2
Fe510 C20	4.	6529.0	5509.1	3852.2	2833.6	1884.9	1428.1	1058.2	846.6	528.2	283.4
Fe510 C20	6.	5020.8	4168.3	2986.3	2250.0	1549.8	1203.9	917.3	749.5	481.4	264.0
Fe510 C20	8.	3320.1	2821.4	2159.4	1705.5	1238.8	993.5	781.3	652.7	431.1	240.3
Fe360 C50	2.	8867.4	7583.1	5118.8	3644.0	2315.2	1698.3	1214.4	945.7	567.2	293.8
Fe360 C50	4.	8172.6	6604.0	4332.3	3075.8	1984.9	1483.6	1087.9	865.4	536.0	286.1
Fe360 C50	6.	6612.8	5153.2	3424.2	2478.3	1650.8	1263.6	952.0	773.1	492.7	268.7
Fe360 C50	8.	4460.7	3550.1	2526.2	1913.4	1339.8	1056.7	820.4	680.5	445.4	246.6
Fe360 C20	2.	6230.1	5405.5	3753.7	2718.7	1754.8	1296.7	932.7	728.7	438.8	228.0
Fe360 C20	4.	5760.1	4741.6	3193.8	2299.9	1501.9	1128.4	830.8	662.3	411.3	220.0
Fe360 C20	6.	4392.8	3552.4	2462.8	1822.0	1235.5	953.1	722.3	588.4	376.5	205.9
Fe360 C20	8.	2919.9	2420.2	1798.8	1395.8	997.8	794.3	621.0	517.1	340.2	189.0

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	8191.5	7021.0	4760.2	3397.5	2163.7	1588.9	1137.1	886.0	531.6	275.5
Fe510 C50	4.	7305.6	5965.1	3970.9	2841.2	1845.4	1383.2	1016.6	809.5	502.1	268.3
Fe510 C50	6.	5565.0	4460.8	3060.3	2251.4	1519.6	1169.9	885.2	720.6	460.6	251.7
Fe510 C50	8.	3667.6	3022.1	2231.2	1724.7	1228.7	976.6	762.7	634.7	417.1	231.7
Fe510 C20	2.	6054.2	5259.3	3661.2	2655.8	1716.7	1269.4	913.5	713.9	430.1	223.5
Fe510 C20	4.	5454.9	4520.0	3074.3	2225.7	1460.2	1099.3	810.7	646.8	402.1	215.3
Fe510 C20	6.	4046.6	3322.1	2346.2	1753.5	1199.4	928.8	705.9	576.0	369.3	202.3
Fe510 C20	8.	2691.3	2265.7	1714.6	1344.8	970.6	776.0	608.9	508.0	335.0	186.5
Fe360 C50	2.	7545.9	6358.0	4174.3	2923.9	1831.3	1334.5	949.5	737.3	440.6	227.6
Fe360 C50	4.	6701.0	5346.1	3446.4	2424.9	1553.4	1157.3	846.6	672.6	415.9	221.7
Fe360 C50	6.	5095.2	3979.4	2650.6	1920.8	1280.6	980.6	739.1	600.3	382.6	208.7
Fe360 C50	8.	3334.3	2683.3	1931.4	1471.9	1035.9	818.9	636.8	528.7	346.5	192.0
Fe360 C20	2.	5396.3	4598.8	3083.9	2186.8	1384.5	1013.9	724.1	563.5	337.6	174.8
Fe360 C20	4.	4863.6	3926.0	2571.7	1824.5	1176.6	879.2	644.6	512.7	317.5	169.5
Fe360 C20	6.	3565.1	2848.5	1946.9	1429.5	963.3	741.1	560.4	456.1	291.4	159.2
Fe360 C20	8.	2352.3	1934.2	1424.7	1099.8	782.6	621.7	485.3	403.8	265.3	147.3

DESIGNATION > AFC-HE 650 A + 2 1/2 HE 140 M SECTION > AFC-COLUMN BUCKLING > STRONG AXIS	ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	16124.3	14960.6	12063.0	9715.8	6999.5	5473.5	4127.4	3314.3	2066.0	1097.0
Fe510 C50	4.	15348.7	13903.4	11009.3	8791.8	6335.4	4992.4	3819.3	3111.1	1983.1	1076.3
Fe510 C50	6.	13711.5	12148.3	9554.0	7635.6	5558.8	4434.2	3450.8	2853.1	1856.4	1022.9
Fe510 C50	8.	11322.4	9911.6	7880.4	6379.6	4744.6	3848.8	3054.8	2565.2	1701.5	946.6
Fe510 C20	2.	11922.8	11234.9	9424.5	7846.8	5882.1	4706.6	3623.2	2946.5	1870.0	1007.0
Fe510 C20	4.	11269.4	10394.2	8536.4	7011.2	5211.6	4176.2	3241.2	2662.8	1717.4	940.4
Fe510 C20	6.	9772.0	8891.6	7308.1	6031.9	4542.7	3688.2	2913.0	2429.3	1599.2	888.9
Fe510 C20	8.	7732.8	7021.2	5881.5	4944.3	3824.6	3166.2	2556.1	2167.7	1457.1	818.7
Fe360 C50	2.	14103.8	12917.3	10092.2	7929.6	5555.8	4278.8	3184.1	2536.7	1564.2	823.6
Fe360 C50	4.	13421.5	11930.2	9113.9	7093.3	4977.0	3868.6	2926.0	2367.8	1495.9	806.6
Fe360 C50	6.	12029.7	10406.1	7890.3	6153.7	4373.9	3448.2	2657.9	2185.6	1411.9	773.9
Fe360 C50	8.	10073.7	8555.7	6543.9	5166.1	3750.9	3007.5	2364.9	1975.5	1301.3	720.3
Fe360 C20	2.	9875.7	9201.9	7499.0	6092.5	4433.8	3487.0	2642.8	2128.6	1332.6	709.9
Fe360 C20	4.	9289.9	8456.0	6760.1	5437.3	3948.5	3124.2	2398.4	1957.6	1251.3	680.6
Fe360 C20	6.	8101.5	7244.1	5781.9	4669.5	3435.9	2755.8	2154.2	1785.7	1165.9	644.1
Fe360 C20	8.	6568.9	5829.1	4722.0	3872.6	2917.9	2382.5	1901.2	1601.4	1066.6	595.2

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	12473.9	11212.1	8389.1	6385.2	4325.6	3273.2	2400.0	1895.6	1155.3	603.0
Fe510 C50	4.	11679.5	10112.0	7374.1	5565.1	3789.6	2902.8	2169.6	1744.0	1092.1	585.0
Fe510 C50	6.	9955.3	8359.1	6078.9	4620.3	3207.0	2500.1	1910.1	1563.0	1003.2	547.3
Fe510 C50	8.	7597.8	6318.1	4713.2	3665.2	2625.0	2091.5	1636.4	1363.2	894.7	494.0
Fe510 C20	2.	8959.7	8177.9	6337.8	4949.3	3444.6	2643.4	1961.2	1559.7	959.3	504.2
Fe510 C20	4.	8308.4	7360.7	5588.9	4331.6	3026.6	2347.6	1772.5	1433.0	904.1	487.0
Fe510 C20	6.	6829.2	5933.5	4528.2	3546.5	2530.9	1999.1	1543.3	1270.2	821.5	450.6
Fe510 C20	8.	5029.1	4375.7	3450.8	2778.4	2055.3	1662.8	1317.0	1104.6	731.5	406.4
Fe360 C50	2.	11253.3	9950.9	7185.3	5337.0	3528.3	2637.6	1914.7	1503.7	909.5	472.1
Fe360 C50	4.	10521.3	8910.7	6267.5	4626.3	3086.9	2342.1	1737.4	1390.7	866.1	462.1
Fe360 C50	6.	9017.7	7347.7	5141.1	3822.6	2603.1	2011.8	1526.8	1244.8	795.2	432.4
Fe360 C50	8.	6981.7	5597.7	4013.5	3052.3	2144.4	1693.8	1316.5	1092.7	713.8	392.8
Fe360 C20	2.	7717.0	6941.0	5201.0	3962.8	2687.4	2034.7	1492.6	1179.2	718.9	375.3
Fe360 C20	4.	7141.5	6199.9	4542.3	3438.1	2347.7	1800.7	1347.3	1083.7	679.1	364.0
Fe360 C20	6.	5890.1	4994.6	3681.1	2820.3	1971.8	1542.4	1181.5	968.2	622.6	340.1
Fe360 C20	8.	4406.0	3722.5	2829.2	2224.8	1609.5	1288.4	1011.7	844.5	555.8	307.4

DESIGNATION	> AFC-HE 650 A + 2 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	10580.8	9323.7	6683.2	4940.0	3250.5	2424.3	1756.6	1378.1	832.3	431.6
Fe510 C50	4.	9910.4	8341.5	5810.3	4264.3	2830.9	2142.9	1586.7	1268.8	789.2	420.7
Fe510 C50	6.	8454.8	6843.9	4750.4	3516.7	2386.0	1841.1	1395.5	1137.0	725.7	394.3
Fe510 C50	8.	6252.5	5046.8	3643.8	2781.6	1960.5	1550.8	1206.6	1002.0	655.1	360.6
Fe510 C20	2.	7636.3	6826.2	5045.7	3807.8	2557.3	1926.7	1407.6	1109.5	674.3	351.2
Fe510 C20	4.	7180.6	6157.8	4419.5	3302.2	2227.9	1699.1	1265.5	1015.3	634.1	339.1
Fe510 C20	6.	5984.2	4983.1	3584.0	2706.5	1867.9	1452.3	1107.4	905.1	580.1	316.2
Fe510 C20	8.	4224.7	3552.8	2685.3	2104.6	1517.9	1213.3	951.7	793.9	522.0	288.6
Fe360 C50	2.	9630.9	8353.6	5797.5	4197.5	2708.3	2001.0	1439.0	1124.2	675.2	348.7
Fe360 C50	4.	9011.9	7422.2	5003.1	3604.3	2354.5	1769.3	1302.8	1038.6	643.4	342.0
Fe360 C50	6.	7734.6	6079.4	4078.1	2965.7	1982.9	1520.3	1146.8	931.9	592.8	321.4
Fe360 C50	8.	5748.6	4493.4	3141.3	2357.5	1638.3	1287.9	997.3	826.2	538.4	295.7
Fe360 C20	2.	6687.8	5884.0	4203.8	3100.6	2036.0	1516.9	1098.2	861.2	519.8	269.4
Fe360 C20	4.	6291.6	5273.0	3648.7	2667.6	1765.0	1333.9	986.6	788.4	489.9	261.0
Fe360 C20	6.	5230.8	4236.8	2943.0	2179.6	1479.3	1141.6	865.5	705.2	450.1	244.6
Fe360 C20	8.	3695.7	3023.9	2215.3	1704.9	1210.0	960.0	748.7	622.6	407.7	224.7

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	9019.9	7846.1	5476.7	3979.5	2576.3	1906.5	1372.8	1073.2	645.2	333.4
Fe510 C50	4.	8190.4	6805.5	4647.9	3372.9	2217.2	1670.8	1232.9	984.0	610.5	324.9
Fe510 C50	6.	6710.5	5400.3	3722.2	2745.2	1856.7	1430.7	1083.3	882.1	562.6	305.5
Fe510 C50	8.	4688.2	3825.5	2794.4	2146.9	1521.5	1206.5	940.5	781.8	511.8	282.0
Fe510 C20	2.	6586.3	5805.8	4164.6	3079.8	2027.4	1512.4	1096.1	860.0	519.5	269.4
Fe510 C20	4.	6065.7	5115.6	3574.4	2628.1	1747.5	1323.7	980.8	784.5	488.2	260.3
Fe510 C20	6.	4883.5	4020.3	2849.4	2133.8	1461.9	1132.9	861.6	703.3	449.9	244.9
Fe510 C20	8.	3406.9	2847.5	2136.7	1667.4	1197.9	955.8	748.6	624.0	409.9	226.4
Fe360 C50	2.	8264.5	7071.8	4779.3	3404.6	2164.5	1588.2	1135.9	884.7	529.3	272.6
Fe360 C50	4.	7502.4	6097.7	4032.7	2875.4	1862.2	1394.0	1023.5	814.6	503.6	267.3
Fe360 C50	6.	6134.4	4807.5	3214.4	2333.8	1558.3	1194.1	900.4	731.5	465.2	252.1
Fe360 C50	8.	4276.8	3395.2	2409.9	1822.9	1275.0	1005.1	780.0	646.9	422.2	232.1
Fe360 C20	2.	5832.9	5049.4	3490.6	2521.1	1623.1	1197.9	860.8	672.1	403.5	208.3
Fe360 C20	4.	5352.1	4403.7	2964.1	2133.7	1392.9	1046.4	770.3	614.0	380.3	202.1
Fe360 C20	6.	4302.2	3438.5	2350.9	1726.5	1163.6	895.2	677.1	551.0	351.1	190.6
Fe360 C20	8.	2980.1	2421.7	1761.0	1349.6	954.4	756.1	588.9	489.4	320.2	176.4

DESIGNATION	> AFC-HE 700 A + 2 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	17428.1	16269.2	13320.7	10864.5	7942.9	6263.3	4757.9	3837.8	2402.3	1275.4
Fe510 C50	4.	16701.0	15260.2	12293.9	9946.4	7269.4	5771.7	4443.7	3633.4	2323.0	1259.1
Fe510 C50	6.	15346.7	13704.4	10914.6	8801.0	6465.7	5181.5	4047.7	3354.0	2184.0	1199.4
Fe510 C50	8.	13201.4	11591.5	9253.8	7512.3	5602.4	4550.9	3616.1	3038.5	2012.7	1113.9
Fe510 C20	2.	12810.3	12114.6	10259.5	8613.5	6524.8	5253.9	4068.1	3320.4	2114.0	1137.5
Fe510 C20	4.	12265.0	11393.6	9499.3	7898.2	5954.7	4809.9	3759.4	3101.7	2008.0	1098.9
Fe510 C20	6.	11006.1	10071.9	8361.3	6954.8	5282.9	4309.1	3417.1	2856.4	1882.4	1043.1
Fe510 C20	8.	9144.6	8307.9	6965.6	5859.6	4536.0	3756.7	3033.8	2573.3	1726.5	964.6
Fe360 C50	2.	15131.2	13965.5	11115.5	8860.5	6308.3	4900.7	3674.3	2940.4	1820.3	958.2
Fe360 C50	4.	14551.4	13081.1	10206.5	8063.2	5744.6	4500.1	3425.6	2782.3	1762.8	949.0
Fe360 C50	6.	13334.8	11664.2	8992.6	7090.3	5092.8	4035.4	3123.3	2574.4	1664.5	909.3
Fe360 C50	8.	11598.2	9909.0	7634.4	6054.6	4414.6	3546.9	2793.5	2335.5	1536.9	846.5
Fe360 C20	2.	10560.3	9905.1	8209.6	6764.8	5007.0	3976.4	3040.2	2461.9	1549.7	826.4
Fe360 C20	4.	10049.3	9229.8	7514.0	6128.9	4520.0	3606.4	2788.5	2285.7	1466.4	796.9
Fe360 C20	6.	9061.4	8156.8	6582.6	5359.0	3976.6	3203.3	2513.2	2087.7	1364.1	751.0
Fe360 C20	8.	7651.5	6806.4	5532.6	4548.5	3435.8	2809.0	2243.9	1891.3	1258.0	698.3

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	13571.9	12320.7	9428.7	7294.1	5025.8	3836.5	2833.6	2247.6	1374.7	717.0
Fe510 C50	4.	12868.0	11290.2	8424.9	6453.7	4457.6	3438.0	2583.9	2083.4	1307.2	698.6
Fe510 C50	6.	11398.3	9667.7	7127.7	5462.2	3819.6	2987.9	2289.0	1875.9	1203.7	654.0
Fe510 C50	8.	9216.9	7666.3	5720.6	4449.3	3187.1	2539.4	1987.0	1655.3	1084.1	595.1
Fe510 C20	2.	9716.4	8949.2	7087.1	5626.9	3988.3	3090.8	2312.5	1848.2	1142.2	600.4
Fe510 C20	4.	9162.9	8206.4	6357.8	4997.3	3541.7	2766.9	2101.5	1704.7	1078.2	579.7
Fe510 C20	6.	7871.4	6889.8	5317.1	4195.1	3015.3	2390.0	1850.3	1525.3	986.4	539.0
Fe510 C20	8.	6152.2	5344.5	4206.2	3382.0	2498.5	2020.1	1599.1	1340.8	885.6	489.1
Fe360 C50	2.	12147.7	10872.4	8058.4	6092.9	4099.8	3091.8	2260.6	1782.6	1081.7	560.9
Fe360 C50	4.	11513.9	9903.2	7142.5	5353.1	3621.7	2765.7	2062.1	1655.3	1032.5	549.5
Fe360 C50	6.	10238.8	8455.1	6016.1	4515.2	3099.5	2404.1	1829.6	1493.9	954.1	516.6
Fe360 C50	8.	8362.9	6723.3	4834.2	3682.0	2590.1	2047.0	1591.7	1321.4	861.6	471.4
Fe360 C20	2.	8298.5	7545.6	5795.9	4496.1	3107.0	2375.4	1756.7	1394.4	853.7	445.6
Fe360 C20	4.	7818.7	6876.8	5153.8	3959.3	2742.4	2118.0	1593.6	1285.7	807.4	431.8
Fe360 C20	6.	6733.0	5757.0	4292.7	3312.6	2331.2	1829.1	1404.6	1152.6	740.9	403.0
Fe360 C20	8.	5336.2	4500.2	3412.7	2680.1	1936.6	1549.3	1216.1	1014.8	666.2	366.3

DESIGNATION > AFC-HE 700 A + 2 1/2 HE 140 M
SECTION > AFC-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	11556.3	10308.0	7583.5	5704.4	3818.6	2872.3	2095.6	1650.5	999.9	517.9
Fe510 C50	4.	10935.9	9362.5	6701.0	4998.5	3367.1	2566.0	1910.2	1531.9	954.4	507.5
Fe510 C50	6.	9634.4	7923.3	5608.3	4196.8	2873.6	2226.3	1692.8	1381.5	881.8	477.3
Fe510 C50	8.	7690.5	6196.5	4465.7	3405.6	2398.3	1896.3	1475.0	1224.7	798.8	437.1
Fe510 C20	2.	8314.1	7518.3	5702.4	4382.8	2999.2	2281.3	1679.9	1330.2	811.6	422.6
Fe510 C20	4.	7921.2	6898.4	5081.3	3859.4	2644.1	2031.2	1521.7	1224.8	766.6	409.0
Fe510 C20	6.	6909.0	5817.1	4245.8	3234.1	2249.2	1755.0	1341.8	1098.4	703.8	382.0
Fe510 C20	8.	5271.0	4412.2	3316.8	2591.0	1863.2	1487.3	1165.4	971.6	637.0	349.9
Fe360 C50	2.	10450.9	9189.8	6558.2	4833.5	3171.6	2362.2	1709.7	1340.5	807.3	416.2
Fe360 C50	4.	9883.8	8288.3	5740.0	4198.6	2779.1	2100.8	1554.0	1241.9	770.2	408.2
Fe360 C50	6.	8811.4	7031.5	4798.9	3520.9	2371.1	1823.6	1378.9	1121.9	713.3	385.0
Fe360 C50	8.	7020.5	5477.7	3822.8	2866.4	1990.5	1564.3	1211.1	1003.1	652.2	356.1
Fe360 C20	2.	7207.7	6424.0	4717.8	3544.5	2369.9	1781.5	1299.1	1022.9	619.5	320.7
Fe360 C20	4.	6853.3	5848.0	4163.1	3095.2	2078.8	1582.0	1176.4	942.9	587.0	311.9
Fe360 C20	6.	6030.1	4937.0	3474.9	2592.2	1770.1	1369.8	1040.6	848.8	541.4	292.9
Fe360 C20	8.	4580.8	3725.9	2712.1	2079.7	1471.4	1165.8	908.3	754.8	492.9	269.9

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	9920.5	8747.1	6277.7	4644.1	3058.2	2281.8	1653.8	1297.7	782.3	403.7
Fe510 C50	4.	9172.1	7752.9	5436.4	4005.5	2668.3	2023.0	1499.8	1200.2	745.5	395.6
Fe510 C50	6.	7842.3	6392.1	4474.3	3327.5	2266.4	1751.7	1329.5	1084.0	691.0	373.7
Fe510 C50	8.	5883.4	4781.6	3477.7	2665.5	1885.1	1493.4	1163.3	966.7	631.1	345.6
Fe510 C20	2.	7214.5	6444.0	4755.0	3584.1	2404.2	1810.3	1321.9	1041.6	631.5	327.2
Fe510 C20	4.	6744.5	5786.0	4155.1	3105.9	2096.2	1598.9	1191.0	955.6	595.6	316.8
Fe510 C20	6.	5757.9	4782.1	3427.9	2583.6	1780.0	1382.9	1053.8	861.1	550.4	298.2
Fe510 C20	8.	4251.0	3542.5	2649.2	2063.1	1479.5	1179.5	923.3	769.3	504.0	276.7
Fe360 C50	2.	9015.4	7831.7	5451.8	3954.7	2556.2	1890.2	1360.3	1063.1	637.5	327.7
Fe360 C50	4.	8335.8	6901.3	4687.9	3391.6	2223.7	1673.7	1233.9	984.4	609.0	322.3
Fe360 C50	6.	7149.2	5669.5	3841.5	2807.9	1885.2	1448.0	1093.7	889.4	565.1	304.9
Fe360 C50	8.	5359.6	4224.0	2976.7	2243.2	1564.1	1231.4	954.6	791.3	514.9	281.3
Fe360 C20	2.	6322.5	5554.9	3957.2	2913.2	1909.4	1421.4	1028.4	806.1	485.3	250.2
Fe360 C20	4.	5887.9	4938.6	3421.4	2503.2	1657.2	1252.8	926.8	740.7	459.4	243.5
Fe360 C20	6.	5036.1	4064.2	2810.7	2076.7	1406.7	1084.6	821.7	669.3	426.1	230.2
Fe360 C20	8.	3714.4	3000.1	2167.6	1655.4	1167.1	923.3	718.5	596.7	389.3	213.1

DESIGNATION	> AFC – HE 500 A + 2 * 1/2 HE 140 M
SECTION	> AFC-COLUMN
BUCKLING	> WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	11483.9	8967.0	7252.3	5489.7	4409.9	3681.5	2762.3	2170.3	1774.7	1491.8
Fe510 C50	4.	7438.4	5343.1	4383.4	3420.0	2832.6	2433.4	1920.2	1574.2	1335.2	1158.8
Fe510 C50	6.	3089.5	2529.1	2267.1	1949.6	1722.6	1550.9	1306.3	1119.7	981.5	874.3
Fe510 C50	8.	1385.9	1268.8	1211.9	1130.2	1061.3	1002.3	906.0	816.5	743.4	682.3
Fe510 C20	2.	8749.4	6939.9	5674.4	4344.6	3515.0	2948.7	2226.3	1755.8	1439.4	1212.2
Fe510 C20	4.	5293.3	3972.6	3323.0	2641.9	2212.4	1914.3	1524.1	1256.2	1069.1	930.2
Fe510 C20	6.	2091.4	1806.0	1659.3	1469.4	1325.1	1211.2	1041.5	904.9	800.9	718.6
Fe510 C20	8.	1089.0	1004.2	962.5	901.9	850.3	805.6	731.9	662.2	604.7	556.3
Fe360 C50	2.	10180.6	7985.7	6479.0	4920.3	3960.5	3310.9	2488.6	1957.4	1601.7	1347.1
Fe360 C50	4.	7173.9	5016.6	4069.8	3142.4	2587.4	2214.2	1739.2	1422.0	1203.9	1043.6
Fe360 C50	6.	3436.6	2591.0	2247.1	1864.1	1609.4	1425.7	1175.8	994.6	864.1	764.7
Fe360 C50	8.	1824.2	1476.5	1341.1	1173.3	1050.6	956.3	819.3	711.5	630.4	566.5
Fe360 C20	2.	7423.5	5932.4	4876.4	3754.7	3048.6	2563.7	1941.7	1534.4	1259.5	1061.7
Fe360 C20	4.	5088.1	3680.7	3028.7	2369.8	1966.1	1690.8	1335.9	1096.1	930.1	807.5
Fe360 C20	6.	2504.9	1954.3	1717.2	1444.3	1257.8	1120.9	931.5	791.6	689.9	611.9
Fe360 C20	8.	1373.8	1138.5	1043.0	921.8	831.2	760.5	656.1	572.4	508.8	458.4

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	8653.4	6504.7	5129.4	3784.7	2993.6	2473.3	1831.8	1428.0	1161.5	972.8
Fe510 C50	4.	5698.0	3761.6	2984.7	2259.2	1839.8	1563.6	1217.9	991.0	836.4	723.4
Fe510 C50	6.	2828.2	1956.4	1647.9	1327.9	1126.7	986.8	802.2	672.7	581.1	512.2
Fe510 C50	8.	1320.0	1033.3	927.8	801.2	711.1	643.2	546.5	472.0	416.6	373.4
Fe510 C20	2.	6492.8	4956.1	3947.6	2942.0	2341.0	1941.8	1445.3	1130.0	921.0	772.4
Fe510 C20	4.	4352.8	2922.5	2333.5	1776.0	1450.7	1235.2	964.3	785.7	663.7	574.3
Fe510 C20	6.	2090.0	1506.4	1285.9	1049.7	897.5	789.9	646.1	543.8	470.9	415.7
Fe510 C20	8.	978.5	797.2	725.8	636.8	571.3	520.7	446.9	388.6	344.6	309.9
Fe360 C50	2.	7914.6	6076.1	4858.2	3634.5	2898.8	2408.2	1796.0	1405.8	1146.7	962.2
Fe360 C50	4.	5528.2	3698.9	2949.6	2242.4	1830.5	1558.0	1215.7	990.3	836.3	723.7
Fe360 C50	6.	2901.6	1990.2	1671.9	1344.0	1138.7	996.3	809.0	678.0	585.4	515.8
Fe360 C50	8.	1614.5	1171.8	1028.1	865.8	756.3	676.6	566.6	485.1	425.6	379.8
Fe360 C20	2.	5726.9	4497.4	3651.7	2775.5	2235.2	1869.2	1405.6	1105.9	905.1	761.3
Fe360 C20	4.	4153.1	2865.1	2311.8	1776.2	1458.4	1245.8	976.5	797.4	674.5	584.4
Fe360 C20	6.	2288.5	1606.4	1359.3	1100.3	936.0	821.1	668.9	561.6	485.5	428.2
Fe360 C20	8.	1313.7	964.9	849.4	717.9	628.5	563.1	472.5	405.0	355.6	317.5

DESIGNATION	> AFC - HE 500 A + 2 * 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7032.7	5422.9	4348.7	3263.1	2607.2	2168.7	1619.8	1269.1	1035.8	869.6
Fe510 C50	4.	4689.8	3230.6	2605.2	2000.5	1642.1	1402.5	1099.0	897.4	759.0	657.5
Fe510 C50	6.	2548.0	1780.6	1504.5	1216.1	1033.7	906.4	737.9	619.3	535.3	471.9
Fe510 C50	8.	1318.2	1004.2	893.8	764.4	674.2	607.2	512.9	441.4	388.6	347.7
Fe510 C20	2.	5319.3	4181.1	3397.0	2583.6	2081.6	1741.2	1309.8	1030.7	843.7	709.8
Fe510 C20	4.	3705.3	2586.5	2096.9	1618.0	1331.7	1139.4	894.7	731.4	619.2	536.7
Fe510 C20	6.	2082.4	1458.6	1233.4	997.7	848.4	744.0	605.9	508.7	439.7	387.7
Fe510 C20	8.	976.9	778.0	702.7	610.8	544.5	494.0	421.5	365.0	322.8	289.7
Fe360 C50	2.	6523.8	5138.6	4181.1	3184.8	2568.4	2149.8	1618.5	1274.3	1043.4	878.0
Fe360 C50	4.	4539.6	3213.7	2620.3	2032.7	1678.1	1438.5	1132.2	926.8	785.3	681.1
Fe360 C50	6.	2547.1	1829.3	1559.6	1271.7	1086.5	955.8	781.4	657.4	569.1	502.4
Fe360 C50	8.	1480.2	1111.4	984.8	838.1	737.0	662.3	557.8	479.3	421.5	376.8
Fe360 C20	2.	4771.2	3859.7	3200.6	2487.9	2032.2	1716.2	1306.9	1036.2	852.6	719.9
Fe360 C20	4.	3528.5	2556.6	2105.2	1648.3	1368.0	1176.7	930.1	763.2	647.7	562.4
Fe360 C20	6.	2070.0	1504.1	1287.4	1053.9	902.5	795.2	651.3	548.6	475.3	419.8
Fe360 C20	8.	1257.2	937.9	829.4	704.4	618.6	555.4	467.3	401.1	352.6	315.1

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	5782.1	4517.1	3654.5	2767.3	2223.5	1856.5	1393.2	1094.8	895.3	752.6
Fe510 C50	4.	3904.1	2756.5	2245.1	1739.8	1435.5	1230.1	967.7	792.0	670.9	581.8
Fe510 C50	6.	2191.9	1567.3	1334.3	1086.4	927.4	815.4	666.1	560.3	484.9	427.9
Fe510 C50	8.	1260.1	942.4	834.1	709.0	622.9	559.4	470.9	404.4	355.5	317.8
Fe510 C20	2.	4433.8	3534.7	2900.5	2229.2	1807.8	1519.0	1149.3	907.6	744.7	627.6
Fe510 C20	4.	3193.8	2265.9	1849.2	1435.7	1185.8	1016.8	800.6	655.5	555.5	481.8
Fe510 C20	6.	1860.9	1321.5	1122.4	911.8	777.3	682.9	557.2	468.4	405.2	357.5
Fe510 C20	8.	975.4	758.0	679.0	584.8	518.1	468.1	397.0	342.6	302.2	270.7
Fe360 C50	2.	5381.6	4288.2	3517.6	2702.5	2191.2	1840.9	1392.6	1099.6	902.1	760.2
Fe360 C50	4.	3775.0	2740.9	2258.9	1770.2	1469.9	1264.8	1000.0	820.8	696.7	605.0
Fe360 C50	6.	2177.7	1613.3	1390.3	1145.9	985.3	870.5	715.5	604.0	524.0	463.2
Fe360 C50	8.	1288.9	1001.2	896.7	772.1	684.0	617.9	524.0	452.1	398.8	357.2
Fe360 C20	2.	4020.4	3289.9	2751.2	2158.4	1773.7	1504.2	1151.8	916.4	755.8	639.3
Fe360 C20	4.	3040.8	2246.5	1865.7	1472.9	1228.3	1059.9	841.0	691.7	587.9	511.0
Fe360 C20	6.	1836.1	1366.2	1179.2	973.4	837.8	740.7	609.3	514.6	446.6	394.9
Fe360 C20	8.	1130.0	869.7	776.6	666.5	589.2	531.5	449.9	387.7	341.6	305.9

DESIGNATION	> AFC – HE 550 A + 2 * 1/2 HE 140 M
SECTION	> AFC-COLUMN
BUCKLING	> WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	12410.6	9638.6	7766.8	5856.9	4693.9	3912.4	2929.7	2299.0	1878.4	1578.1
Fe510 C50	4.	7911.7	5678.2	4656.5	3631.8	3007.5	2583.2	2038.1	1670.8	1416.9	1229.7
Fe510 C50	6.	3242.7	2663.6	2391.3	2059.9	1822.1	1641.9	1384.5	1187.5	1041.5	928.1
Fe510 C50	8.	1510.2	1374.1	1308.7	1215.7	1138.0	1071.8	964.9	867.0	787.5	721.4
Fe510 C20	2.	9242.0	7307.0	5961.0	4553.1	3678.1	3082.3	2324.1	1831.4	1500.6	1263.3
Fe510 C20	4.	5486.0	4132.5	3462.6	2757.6	2311.7	2001.6	1595.0	1315.2	1119.8	974.5
Fe510 C20	6.	2226.4	1911.0	1750.7	1544.7	1389.4	1267.5	1086.9	942.6	833.2	746.8
Fe510 C20	8.	1173.8	1073.8	1025.4	955.8	897.2	847.1	765.3	689.5	627.6	575.9
Fe360 C50	2.	10919.7	8548.6	6926.2	5252.5	4224.2	3529.2	2650.7	2083.8	1704.6	1433.4
Fe360 C50	4.	7648.5	5328.1	4315.9	3327.7	2737.8	2341.7	1838.2	1502.4	1271.7	1102.1
Fe360 C50	6.	3629.5	2746.8	2385.6	1982.0	1712.6	1518.2	1253.0	1060.4	921.5	815.7
Fe360 C50	8.	1902.6	1549.4	1410.4	1237.0	1109.6	1011.2	867.9	754.5	669.0	601.6
Fe360 C20	2.	7896.4	6283.2	5148.9	3951.6	3201.8	2688.7	2032.6	1604.4	1316.0	1108.7
Fe360 C20	4.	5335.5	3857.3	3173.1	2482.1	2059.0	1770.5	1398.7	1147.6	973.7	845.4
Fe360 C20	6.	2539.4	1998.7	1762.4	1488.0	1299.0	1159.6	965.7	821.9	716.9	636.3
Fe360 C20	8.	1424.7	1182.9	1084.5	959.3	865.5	792.2	683.9	596.9	530.7	478.2

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	9426.4	7017.6	5499.7	4033.4	3178.9	2620.3	1935.0	1505.8	1223.4	1023.7
Fe510 C50	4.	6089.7	4000.8	3168.9	2394.9	1948.8	1655.3	1288.6	1048.2	884.4	764.8
Fe510 C50	6.	2945.5	2056.8	1737.6	1404.2	1193.4	1046.3	851.7	714.8	617.8	544.7
Fe510 C50	8.	1394.7	1096.5	986.0	852.8	757.7	685.9	583.3	504.2	445.2	399.2
Fe510 C20	2.	6967.2	5262.1	4162.3	3080.5	2441.1	2019.2	1497.8	1168.6	951.1	796.9
Fe510 C20	4.	4556.9	3048.1	2430.3	1847.4	1508.0	1283.4	1001.5	815.7	688.9	596.1
Fe510 C20	6.	2219.7	1586.2	1350.1	1099.0	938.1	824.7	673.6	566.5	490.3	432.7
Fe510 C20	8.	995.7	820.0	749.5	660.6	594.5	543.1	467.7	407.5	361.9	325.8
Fe360 C50	2.	8568.9	6535.5	5202.8	3875.2	3082.5	2556.4	1902.2	1487.0	1211.8	1016.2
Fe360 C50	4.	5916.3	3939.0	3135.2	2379.6	1940.8	1650.9	1287.4	1048.2	885.1	765.7
Fe360 C50	6.	3027.7	2105.8	1776.7	1434.1	1218.0	1067.3	868.3	728.5	629.5	554.9
Fe360 C50	8.	1682.5	1242.7	1095.8	927.8	813.1	729.0	612.3	525.1	461.3	412.0
Fe360 C20	2.	6125.2	4769.0	3849.4	2907.9	2333.0	1946.0	1458.6	1145.2	936.0	786.6
Fe360 C20	4.	4359.4	3001.4	2419.9	1857.9	1524.9	1302.3	1020.4	833.1	704.7	610.4
Fe360 C20	6.	2357.3	1669.3	1416.6	1149.8	979.7	860.3	701.8	589.7	510.0	450.0
Fe360 C20	8.	1350.3	1003.0	885.9	751.4	659.3	591.6	497.3	426.8	375.0	335.1

DESIGNATION	> AFC - HE 550 A + 2 * 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7734.1	5901.1	4699.0	3500.9	2785.2	2310.0	1719.1	1344.0	1095.3	918.6
Fe510 C50	4.	5021.0	3452.8	2782.5	2135.3	1752.2	1496.2	1172.1	956.9	809.3	701.0
Fe510 C50	6.	2691.3	1896.6	1606.9	1302.3	1108.6	973.0	793.1	666.1	576.0	508.0
Fe510 C50	8.	1393.4	1072.2	957.4	821.6	726.3	655.0	554.4	477.8	421.0	376.9
Fe510 C20	2.	5759.3	4473.9	3605.6	2719.3	2179.6	1816.8	1360.6	1067.7	872.4	732.9
Fe510 C20	4.	3886.0	2706.1	2191.7	1689.7	1390.0	1188.9	933.2	762.7	645.6	559.5
Fe510 C20	6.	2153.5	1521.2	1289.9	1046.2	891.0	782.2	637.8	535.8	463.4	408.7
Fe510 C20	8.	995.0	806.9	733.4	642.1	575.3	523.8	449.0	390.1	345.7	310.8
Fe360 C50	2.	7137.6	5564.5	4495.5	3399.1	2728.6	2276.9	1707.4	1341.0	1096.2	921.4
Fe360 C50	4.	4889.9	3435.7	2792.7	2160.2	1780.4	1524.6	1198.5	980.3	830.2	719.8
Fe360 C50	6.	2702.4	1941.1	1655.0	1349.5	1153.0	1014.3	829.2	697.7	604.0	533.2
Fe360 C50	8.	1558.1	1174.9	1042.4	888.4	781.9	703.0	592.7	509.4	448.2	400.7
Fe360 C20	2.	5132.7	4118.0	3394.5	2621.6	2132.7	1795.8	1362.5	1077.8	885.4	746.8
Fe360 C20	4.	3713.5	2685.2	2209.1	1728.2	1433.6	1232.8	974.0	799.1	678.1	588.7
Fe360 C20	6.	2146.5	1570.9	1348.0	1106.2	948.7	836.7	686.2	578.4	501.4	443.0
Fe360 C20	8.	1295.3	978.4	868.5	740.6	652.1	586.4	494.5	425.2	374.1	334.5

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	6409.0	4950.8	3974.9	2986.2	2387.8	1987.2	1485.2	1164.1	950.3	797.9
Fe510 C50	4.	4182.6	2952.9	2405.0	1863.7	1537.7	1317.6	1036.6	848.3	718.6	623.2
Fe510 C50	6.	2306.3	1669.5	1427.2	1166.8	998.5	879.3	719.7	606.1	524.9	463.5
Fe510 C50	8.	1280.6	988.8	883.9	759.4	671.8	606.3	513.5	442.7	390.3	349.5
Fe510 C20	2.	4865.3	3829.2	3114.0	2370.7	1911.1	1599.3	1203.7	947.5	775.7	652.7
Fe510 C20	4.	3362.4	2384.8	1946.0	1510.7	1247.7	1069.8	842.3	689.6	584.4	506.9
Fe510 C20	6.	1929.3	1383.1	1178.5	960.3	820.2	721.4	589.5	496.0	429.3	378.9
Fe510 C20	8.	994.3	787.3	709.7	615.5	547.9	496.6	423.0	366.0	323.5	290.2
Fe360 C50	2.	5941.7	4688.1	3819.1	2912.8	2350.8	1968.8	1483.3	1168.3	956.9	805.4
Fe360 C50	4.	4046.4	2928.6	2410.4	1886.4	1565.2	1346.1	1063.7	872.8	740.6	643.1
Fe360 C50	6.	2302.8	1709.6	1474.4	1216.1	1046.2	924.7	760.3	641.9	557.0	492.5
Fe360 C50	8.	1342.2	1051.2	944.0	815.3	723.8	654.7	556.3	480.5	424.2	380.2
Fe360 C20	2.	4371.0	3543.9	2943.6	2292.2	1874.5	1584.3	1207.8	958.2	788.8	666.2
Fe360 C20	4.	3213.4	2369.9	1966.6	1551.4	1293.2	1115.6	884.8	727.6	618.4	537.5
Fe360 C20	6.	1910.3	1433.4	1241.0	1027.6	886.2	784.5	646.4	546.4	474.5	419.8
Fe360 C20	8.	1164.5	910.3	817.0	705.1	625.7	565.8	480.5	415.0	366.2	328.2

DESIGNATION > AFC – HE 600 A + 2 * 1/2 HE 140 M
SECTION > AFC-COLUMN
BUCKLING > WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	13340.0	10311.8	8283.0	6225.7	4979.6	4144.9	3098.6	2429.0	1983.2	1665.3
Fe510 C50	4.	8425.6	6038.0	4948.4	3857.1	3193.0	2742.0	2162.8	1772.7	1503.2	1304.5
Fe510 C50	6.	3383.0	2805.6	2529.4	2189.6	1943.3	1755.3	1485.0	1276.3	1121.1	1000.1
Fe510 C50	8.	1628.7	1478.2	1406.2	1304.2	1219.2	1147.2	1031.0	925.3	839.8	768.7
Fe510 C20	2.	9916.8	7795.2	6333.7	4817.4	3881.3	3246.8	2442.4	1922.0	1573.3	1323.5
Fe510 C20	4.	5675.2	4299.3	3612.0	2884.2	2421.6	2099.0	1674.8	1382.2	1177.4	1025.0
Fe510 C20	6.	2285.6	1976.2	1816.8	1610.0	1452.7	1328.3	1143.0	993.4	879.5	789.2
Fe510 C20	8.	1224.4	1123.5	1074.2	1003.3	943.2	891.6	807.2	728.3	663.7	609.6
Fe360 C50	2.	11786.7	9177.6	7408.3	5596.6	4490.3	3745.5	2807.4	2204.3	1801.7	1514.1
Fe360 C50	4.	8185.3	5690.1	4605.3	3548.1	2917.8	2495.0	1957.9	1599.9	1354.0	1173.4
Fe360 C50	6.	3818.3	2908.1	2531.7	2108.6	1824.9	1619.3	1338.3	1133.5	985.6	872.8
Fe360 C50	8.	1996.6	1635.2	1491.6	1311.4	1178.3	1075.1	924.3	804.4	713.8	642.2
Fe360 C20	2.	8386.8	6646.2	5430.8	4155.2	3360.3	2818.1	2126.9	1677.0	1374.6	1157.5
Fe360 C20	4.	5566.5	4029.2	3316.3	2595.5	2153.6	1852.2	1463.6	1201.0	1019.1	884.9
Fe360 C20	6.	2628.2	2080.6	1838.9	1556.6	1361.1	1216.4	1014.6	864.2	754.4	669.9
Fe360 C20	8.	1467.0	1225.1	1125.7	998.3	902.5	827.2	715.5	625.2	556.4	501.7

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	10175.9	7512.0	5855.9	4272.6	3357.3	2761.8	2034.5	1581.0	1283.3	1073.1
Fe510 C50	4.	6464.2	4223.9	3339.0	2519.2	2048.1	1738.6	1352.6	1099.8	927.7	802.2
Fe510 C50	6.	3080.8	2156.4	1823.1	1474.4	1253.6	1099.3	895.2	751.4	649.5	572.7
Fe510 C50	8.	1464.8	1153.2	1037.5	897.7	798.0	722.5	614.6	531.3	469.3	420.8
Fe510 C20	2.	7458.4	5572.7	4377.5	3217.6	2539.4	2094.9	1548.7	1206.0	980.2	820.5
Fe510 C20	4.	4743.8	3161.7	2517.6	1911.5	1559.3	1326.6	1034.6	842.5	711.4	615.5
Fe510 C20	6.	2281.1	1635.7	1393.8	1135.9	970.1	853.3	697.3	586.7	507.8	448.2
Fe510 C20	8.	1073.6	872.0	793.1	694.8	622.8	567.3	486.5	422.8	374.7	336.9
Fe360 C50	2.	9258.3	6997.1	5537.0	4099.6	3249.4	2688.4	1994.5	1556.4	1266.8	1061.4
Fe360 C50	4.	6303.3	4164.0	3304.8	2502.0	2037.8	1732.0	1349.2	1097.9	926.7	801.5
Fe360 C50	6.	3176.5	2206.1	1860.5	1501.1	1274.5	1116.7	908.3	762.0	658.3	580.3
Fe360 C50	8.	1757.4	1297.1	1143.5	967.9	848.2	760.4	638.6	547.6	481.0	429.6
Fe360 C20	2.	6527.9	5035.1	4038.5	3030.9	2422.1	2014.8	1505.0	1179.3	962.5	808.1
Fe360 C20	4.	4558.5	3119.3	2508.8	1921.9	1575.5	1344.5	1052.5	858.9	726.2	628.9
Fe360 C20	6.	2429.5	1723.6	1463.5	1188.6	1013.1	889.8	726.0	610.2	527.8	465.7
Fe360 C20	8.	1389.4	1036.8	917.1	778.9	684.1	614.2	516.8	443.7	390.0	348.5

DESIGNATION	> AFC - HE 600 A + 2 * 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	8402.3	6345.9	5019.6	3715.0	2943.8	2435.1	1806.2	1409.2	1147.0	961.0
Fe510 C50	4.	5332.9	3653.9	2940.3	2253.5	1847.8	1577.1	1234.8	1007.8	852.2	738.1
Fe510 C50	6.	2812.2	1990.2	1688.6	1370.3	1167.5	1025.2	836.1	702.6	607.7	536.1
Fe510 C50	8.	1462.5	1128.0	1007.9	865.7	765.7	690.8	585.0	504.3	444.5	398.0
Fe510 C20	2.	6183.5	4750.0	3799.4	2843.5	2268.5	1884.9	1406.0	1100.7	897.9	753.5
Fe510 C20	4.	4054.9	2816.9	2279.2	1755.6	1443.5	1234.2	968.4	791.3	669.7	580.3
Fe510 C20	6.	2225.2	1576.4	1337.9	1086.1	925.5	812.8	663.0	557.1	481.9	425.1
Fe510 C20	8.	1072.7	858.4	776.6	676.3	603.7	548.2	468.3	405.8	359.1	322.4
Fe360 C50	2.	7729.1	5976.4	4801.5	3609.7	2887.5	2403.7	1797.1	1408.9	1150.3	966.0
Fe360 C50	4.	5189.2	3626.8	2941.7	2270.9	1869.6	1599.8	1256.5	1027.3	869.7	753.9
Fe360 C50	6.	2836.5	2034.0	1733.3	1412.6	1206.5	1061.2	867.3	729.6	631.6	557.5
Fe360 C50	8.	1625.5	1226.3	1088.2	927.6	816.5	734.2	619.0	532.1	468.1	418.6
Fe360 C20	2.	5502.7	4370.6	3577.0	2741.5	2219.4	1862.6	1407.1	1110.1	910.3	766.7
Fe360 C20	4.	3876.0	2791.0	2292.0	1790.0	1483.4	1274.8	1006.4	825.3	700.1	607.7
Fe360 C20	6.	2219.1	1624.5	1394.1	1144.1	981.3	865.5	709.8	598.4	518.7	458.3
Fe360 C20	8.	1329.9	1009.9	898.0	767.1	676.1	608.5	513.7	441.9	389.0	348.0

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7050.6	5375.3	4278.0	3185.6	2533.6	2100.9	1563.1	1221.8	995.6	834.9
Fe510 C50	4.	4446.5	3125.8	2541.3	1966.1	1620.7	1387.9	1091.1	892.6	755.9	655.4
Fe510 C50	6.	2411.1	1751.3	1498.9	1226.8	1050.5	925.6	758.1	638.6	553.2	488.6
Fe510 C50	8.	1347.1	1040.9	930.8	799.9	707.8	638.8	541.2	466.6	411.4	368.4
Fe510 C20	2.	5269.2	4095.2	3301.5	2490.9	1996.9	1664.8	1247.0	978.7	799.7	671.9
Fe510 C20	4.	3521.2	2488.9	2028.1	1572.3	1297.6	1112.1	875.1	716.2	606.8	526.2
Fe510 C20	6.	1988.6	1433.0	1223.2	998.5	853.6	751.3	614.5	517.2	447.8	395.4
Fe510 C20	8.	1071.7	837.9	752.0	649.1	575.9	520.8	442.4	382.0	337.2	302.2
Fe360 C50	2.	6479.5	5062.2	4095.7	3101.4	2492.0	2080.7	1561.5	1227.0	1003.4	843.5
Fe360 C50	4.	4326.4	3108.0	2549.8	1989.4	1647.8	1415.6	1117.0	915.8	776.7	674.1
Fe360 C50	6.	2415.4	1791.0	1543.9	1272.8	1094.7	967.3	795.2	671.3	582.4	514.9
Fe360 C50	8.	1397.4	1094.9	983.5	849.5	754.2	682.3	579.8	500.9	442.2	396.4
Fe360 C20	2.	4703.1	3774.7	3112.3	2404.4	1956.3	1647.5	1250.2	989.0	812.5	685.3
Fe360 C20	4.	3368.1	2472.6	2047.8	1612.2	1342.4	1157.1	916.9	753.6	640.2	556.3
Fe360 C20	6.	1970.9	1481.8	1283.9	1064.0	918.0	812.9	670.0	566.5	492.1	435.4
Fe360 C20	8.	1196.2	939.0	844.0	729.5	648.0	586.4	498.5	430.8	380.4	341.0

DESIGNATION	> AFC - HE 650 A + 2 * 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	14293.0	11015.5	8830.4	6623.5	5291.1	4400.5	3286.1	2574.4	2101.0	1763.7
Fe510 C50	4.	8946.1	6426.5	5272.3	4113.6	3407.2	2927.0	2309.7	1893.6	1606.0	1393.9
Fe510 C50	6.	3543.8	2961.5	2679.2	2328.6	2072.5	1875.8	1591.3	1370.1	1205.0	1075.9
Fe510 C50	8.	1731.0	1574.6	1499.6	1392.8	1303.6	1227.7	1105.0	992.8	901.8	826.0
Fe510 C20	2.	10556.2	8257.1	6686.2	5067.4	4073.8	3402.7	2554.9	2008.1	1642.5	1381.0
Fe510 C20	4.	5938.1	4497.7	3778.3	3016.7	2532.8	2195.3	1751.6	1445.5	1231.3	1072.0
Fe510 C20	6.	2386.9	2068.3	1903.4	1689.0	1525.5	1395.9	1202.3	1045.7	926.3	831.5
Fe510 C20	8.	1288.4	1182.4	1130.7	1056.1	993.0	938.8	850.0	767.0	699.0	642.0
Fe360 C50	2.	12667.1	9815.1	7896.7	5945.3	4760.0	3964.9	2966.5	2326.7	1900.3	1596.2
Fe360 C50	4.	8718.7	6069.6	4915.2	3788.9	3116.7	2665.6	2092.2	1709.9	1447.3	1254.3
Fe360 C50	6.	4009.8	3075.3	2684.3	2241.8	1943.5	1726.7	1429.2	1211.6	1054.2	933.9
Fe360 C50	8.	2103.9	1734.5	1586.0	1398.4	1259.0	1150.4	991.0	863.6	767.0	690.6
Fe360 C20	2.	9000.4	7073.1	5745.9	4369.5	3520.1	2944.3	2214.7	1742.7	1426.4	1200.0
Fe360 C20	4.	5836.1	4223.2	3475.6	2719.8	2256.6	1940.7	1533.5	1258.3	1067.8	927.1
Fe360 C20	6.	2750.2	2186.3	1935.7	1641.5	1437.1	1285.5	1073.4	915.0	799.0	709.8
Fe360 C20	8.	1518.7	1279.8	1180.0	1051.0	952.9	875.3	759.5	665.1	592.7	535.1

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	10927.4	8004.6	6209.9	4509.9	3534.3	2902.3	2133.4	1655.7	1342.8	1122.2
Fe510 C50	4.	6802.4	4443.3	3512.0	2649.4	2153.8	1828.3	1422.2	1156.4	975.5	843.4
Fe510 C50	6.	3218.4	2263.2	1916.2	1551.9	1320.6	1158.7	944.2	792.9	685.5	604.6
Fe510 C50	8.	1562.9	1226.5	1102.2	952.6	846.0	765.6	650.8	562.3	496.5	445.1
Fe510 C20	2.	7934.5	5869.9	4582.0	3347.5	2632.4	2166.5	1597.0	1241.4	1007.9	843.0
Fe510 C20	4.	4911.0	3272.8	2605.9	1978.5	1613.9	1373.0	1070.8	871.9	736.2	637.0
Fe510 C20	6.	2372.7	1702.6	1451.2	1182.9	1010.5	888.8	726.5	611.2	529.1	467.0
Fe510 C20	8.	1134.1	917.4	833.2	728.7	652.4	593.8	508.7	441.7	391.3	351.7
Fe360 C50	2.	9922.6	7449.1	5869.3	4327.1	3421.0	2825.5	2091.8	1630.3	1325.9	1110.3
Fe360 C50	4.	6645.6	4380.4	3473.7	2628.0	2139.6	1818.1	1415.9	1152.0	972.2	840.8
Fe360 C50	6.	3306.7	2306.5	1947.8	1573.5	1337.1	1172.1	953.9	800.5	691.8	609.9
Fe360 C50	8.	1836.3	1358.6	1198.6	1015.3	890.2	798.3	670.7	575.3	505.4	451.4
Fe360 C20	2.	6929.7	5298.9	4225.5	3152.7	2510.4	2083.4	1551.6	1213.5	989.3	829.8
Fe360 C20	4.	4735.6	3234.8	2600.0	1990.6	1631.3	1391.8	1089.3	888.7	751.4	650.7
Fe360 C20	6.	2493.3	1780.6	1515.2	1233.2	1052.5	925.2	755.7	635.5	549.9	485.3
Fe360 C20	8.	1429.2	1075.2	953.4	811.9	714.2	642.0	541.0	464.9	408.9	365.6

DESIGNATION > AFC - HE 650 A + 2 * 1/2 HE 140 M
SECTION > AFC-COLUMN
BUCKLING > WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	9082.5	6801.0	5349.8	3937.8	3110.2	2567.2	1899.1	1479.4	1202.8	1007.0
Fe510 C50	4.	5599.3	3845.5	3097.3	2375.8	1949.0	1664.0	1303.3	1063.9	899.7	779.3
Fe510 C50	6.	2931.9	2091.5	1779.2	1447.5	1235.1	1085.6	886.5	745.4	645.1	569.2
Fe510 C50	8.	1559.2	1202.0	1073.9	922.2	815.6	735.8	623.1	537.0	473.3	423.8
Fe510 C20	2.	6605.4	5022.5	3990.3	2966.2	2356.6	1952.8	1451.6	1134.1	923.8	774.5
Fe510 C20	4.	4195.7	2919.2	2363.5	1821.5	1498.2	1281.3	1005.5	821.8	695.5	602.8
Fe510 C20	6.	2291.1	1635.4	1391.5	1132.4	966.3	849.4	693.7	583.4	504.8	445.5
Fe510 C20	8.	1133.9	905.3	818.4	712.1	635.2	576.6	492.3	426.5	377.2	338.7
Fe360 C50	2.	8321.3	6386.3	5105.2	3818.4	3045.1	2529.6	1886.2	1476.4	1204.2	1010.4
Fe360 C50	4.	5462.7	3814.1	3092.3	2386.3	1964.2	1680.6	1319.7	1078.8	913.3	791.6
Fe360 C50	6.	2955.7	2128.4	1816.3	1482.3	1267.1	1115.0	911.9	767.5	664.5	586.7
Fe360 C50	8.	1699.1	1285.7	1142.0	974.4	858.2	772.0	651.3	560.0	492.8	440.8
Fe360 C20	2.	5856.8	4611.5	3751.2	2856.5	2303.2	1927.7	1451.1	1142.3	935.3	787.0
Fe360 C20	4.	4027.7	2894.5	2375.0	1853.3	1535.2	1318.9	1040.8	853.4	723.8	628.2
Fe360 C20	6.	2272.5	1675.7	1441.7	1186.2	1019.0	899.7	738.8	623.3	540.6	477.8
Fe360 C20	8.	1365.8	1045.8	932.4	798.7	705.3	635.7	537.5	462.9	407.7	364.9

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7665.9	5785.5	4574.1	3383.6	2680.4	2216.8	1643.9	1282.5	1043.7	874.4
Fe510 C50	4.	4686.6	3296.3	2680.5	2074.2	1710.0	1464.5	1151.4	941.9	797.7	691.7
Fe510 C50	6.	2514.5	1840.1	1578.9	1295.6	1111.2	980.0	803.7	677.5	587.2	518.8
Fe510 C50	8.	1417.5	1100.1	985.0	847.9	751.0	678.3	575.2	496.2	437.6	392.0
Fe510 C20	2.	5679.0	4359.4	3485.3	2607.2	2079.3	1727.4	1288.2	1008.3	822.5	690.1
Fe510 C20	4.	3664.5	2589.3	2109.6	1635.3	1349.5	1156.5	910.0	744.7	630.9	547.2
Fe510 C20	6.	2044.2	1485.9	1272.1	1041.4	891.9	785.9	643.7	542.3	469.8	415.0
Fe510 C20	8.	1133.7	884.5	793.4	684.2	606.9	548.6	465.7	402.1	354.8	317.9
Fe360 C50	2.	7043.0	5445.9	4375.4	3289.4	2631.3	2190.4	1637.7	1283.9	1048.3	880.3
Fe360 C50	4.	4568.0	3272.5	2681.6	2090.0	1730.0	1485.5	1171.7	960.3	814.3	706.7
Fe360 C50	6.	2511.1	1869.2	1613.6	1332.2	1146.8	1013.9	834.1	704.4	611.4	540.6
Fe360 C50	8.	1455.8	1144.3	1028.9	889.8	790.6	715.6	608.5	525.9	464.4	416.4
Fe360 C20	2.	5052.3	4012.0	3283.1	2515.8	2036.5	1709.0	1290.9	1018.4	835.1	703.4
Fe360 C20	4.	3515.0	2572.2	2127.2	1672.4	1391.3	1198.7	949.3	779.9	662.3	575.4
Fe360 C20	6.	2018.7	1527.3	1326.3	1101.7	951.9	843.8	696.4	589.3	512.1	453.3
Fe360 C20	8.	1225.5	969.9	874.2	758.0	674.6	611.4	520.8	450.6	398.2	357.2

DESIGNATION	> AFC – HE 700 A + 2 * 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	15384.4	11783.4	9406.9	7026.4	5598.7	4648.4	3463.8	2710.1	2209.8	1853.9
Fe510 C50	4.	9473.0	6762.3	5533.0	4306.1	3561.5	3056.7	2409.3	1973.9	1673.4	1451.9
Fe510 C50	6.	3785.9	3145.1	2837.6	2458.6	2183.4	1973.1	1670.2	1436.1	1261.7	1125.8
Fe510 C50	8.	1860.9	1685.8	1602.4	1484.4	1386.4	1303.5	1170.2	1049.3	951.6	870.7
Fe510 C20	2.	11274.7	8755.6	7054.8	5319.6	4263.1	3553.2	2660.7	2087.9	1705.8	1433.1
Fe510 C20	4.	6111.3	4654.9	3920.6	3138.7	2639.4	2290.2	1829.7	1511.2	1288.0	1121.7
Fe510 C20	6.	2489.3	2154.7	1982.0	1757.7	1586.7	1451.4	1249.5	1086.4	962.1	863.5
Fe510 C20	8.	1355.2	1251.3	1200.0	1125.4	1061.7	1006.5	915.3	828.6	757.1	696.8
Fe360 C50	2.	13515.1	10433.2	8372.9	6287.5	5026.2	4182.1	3124.9	2448.9	1999.1	1678.4
Fe360 C50	4.	9312.2	6428.2	5188.0	3986.8	3273.9	2797.0	2192.4	1790.4	1514.6	1312.2
Fe360 C50	6.	4237.8	3248.9	2835.4	2367.7	2052.5	1823.4	1509.1	1279.3	1113.0	986.0
Fe360 C50	8.	2211.9	1829.6	1675.0	1479.1	1333.0	1219.0	1051.1	916.6	814.5	733.7
Fe360 C20	2.	9532.8	7467.1	6052.3	4591.7	3693.7	3086.5	2318.7	1823.1	1491.5	1254.2
Fe360 C20	4.	6088.4	4400.9	3620.1	2831.6	2348.8	2019.6	1595.6	1309.0	1110.7	964.3
Fe360 C20	6.	2843.3	2260.1	2001.0	1696.9	1485.5	1328.7	1109.5	945.7	825.9	733.7
Fe360 C20	8.	1577.9	1329.6	1225.8	1091.7	989.8	909.2	788.9	690.8	615.6	555.7

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	11799.9	8564.9	6607.3	4772.9	3728.9	3056.0	2240.9	1736.6	1407.0	1175.1
Fe510 C50	4.	7200.6	4697.8	3711.5	2798.9	2274.8	1930.8	1501.8	1221.0	1029.9	890.4
Fe510 C50	6.	3354.2	2379.1	2020.0	1640.4	1398.1	1228.0	1001.9	842.1	728.4	642.6
Fe510 C50	8.	1710.6	1328.0	1189.2	1023.7	906.9	819.1	694.6	599.3	528.6	473.5
Fe510 C20	2.	8530.5	6235.5	4831.1	3504.2	2744.1	2252.3	1654.7	1283.7	1040.9	869.7
Fe510 C20	4.	5126.0	3411.0	2714.4	2059.9	1679.9	1428.9	1114.2	907.1	765.9	662.6
Fe510 C20	6.	2473.3	1780.7	1519.5	1240.0	1059.9	932.7	762.8	642.0	555.8	490.7
Fe510 C20	8.	1232.4	986.6	892.6	777.4	694.0	630.3	538.5	466.7	413.0	370.8
Fe360 C50	2.	10676.9	7957.2	6240.4	4579.7	3611.0	2977.2	2199.3	1711.8	1390.9	1164.0
Fe360 C50	4.	7049.6	4633.3	3670.3	2774.2	2257.6	1917.7	1492.9	1214.4	1024.7	886.2
Fe360 C50	6.	3458.9	2425.8	2052.1	1660.6	1412.4	1238.9	1009.1	847.2	732.4	645.8
Fe360 C50	8.	1918.8	1429.8	1264.0	1073.1	942.2	845.7	711.4	610.7	536.8	479.6
Fe360 C20	2.	7421.5	5618.1	4450.5	3298.7	2616.2	2165.4	1607.4	1254.7	1021.5	856.0
Fe360 C20	4.	4952.7	3373.8	2708.8	2071.9	1697.0	1447.4	1132.3	923.6	780.8	676.1
Fe360 C20	6.	2570.8	1851.7	1580.3	1289.8	1102.5	970.3	793.6	667.9	578.3	510.6
Fe360 C20	8.	1469.5	1119.7	996.7	852.4	751.8	677.1	571.9	492.2	433.4	387.8

DESIGNATION	> AFC - HE 700 A + 2 * 1/2 HE 140 M	ARBED RECHERCHES
SECTION	> AFC-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	9835.5	7299.1	5708.9	4178.7	3289.7	2709.6	1999.1	1554.8	1262.8	1056.4
Fe510 C50	4.	5926.2	4069.6	3277.7	2514.1	2062.4	1760.8	1379.1	1125.7	952.1	824.6
Fe510 C50	6.	3067.4	2207.2	1883.0	1536.3	1313.1	1155.4	944.8	795.1	688.4	607.7
Fe510 C50	8.	1703.0	1302.4	1160.7	993.9	877.4	790.6	668.4	575.5	506.9	453.6
Fe510 C20	2.	7115.0	5347.0	4215.8	3110.1	2459.8	2032.2	1505.0	1173.1	954.2	799.1
Fe510 C20	4.	4358.2	3040.0	2463.8	1900.6	1564.1	1338.0	1050.5	858.7	726.9	630.0
Fe510 C20	6.	2361.1	1701.8	1452.6	1185.9	1013.9	892.3	729.9	614.4	532.0	469.7
Fe510 C20	8.	1231.3	973.7	877.3	760.5	676.7	613.2	522.2	451.7	399.2	358.1
Fe360 C50	2.	8992.2	6841.7	5437.8	4043.9	3213.6	2663.4	1980.2	1547.2	1260.5	1056.8
Fe360 C50	4.	5773.5	4022.9	3259.0	2513.0	2067.6	1768.5	1388.3	1134.7	960.5	832.4
Fe360 C50	6.	3102.1	2241.1	1914.6	1564.2	1337.9	1177.9	963.9	811.5	702.8	620.5
Fe360 C50	8.	1786.1	1357.9	1207.9	1032.3	910.1	819.3	691.8	595.2	524.0	468.8
Fe360 C20	2.	6284.2	4898.5	3957.2	2991.8	2401.6	2003.9	1502.6	1180.1	964.7	810.8
Fe360 C20	4.	4197.3	3016.7	2475.4	1931.8	1600.2	1374.8	1084.9	889.5	754.5	654.8
Fe360 C20	6.	2346.1	1742.4	1502.9	1239.8	1066.6	942.7	775.2	654.5	568.0	502.2
Fe360 C20	8.	1406.9	1089.3	974.6	838.1	742.0	669.9	567.7	489.6	431.7	386.7

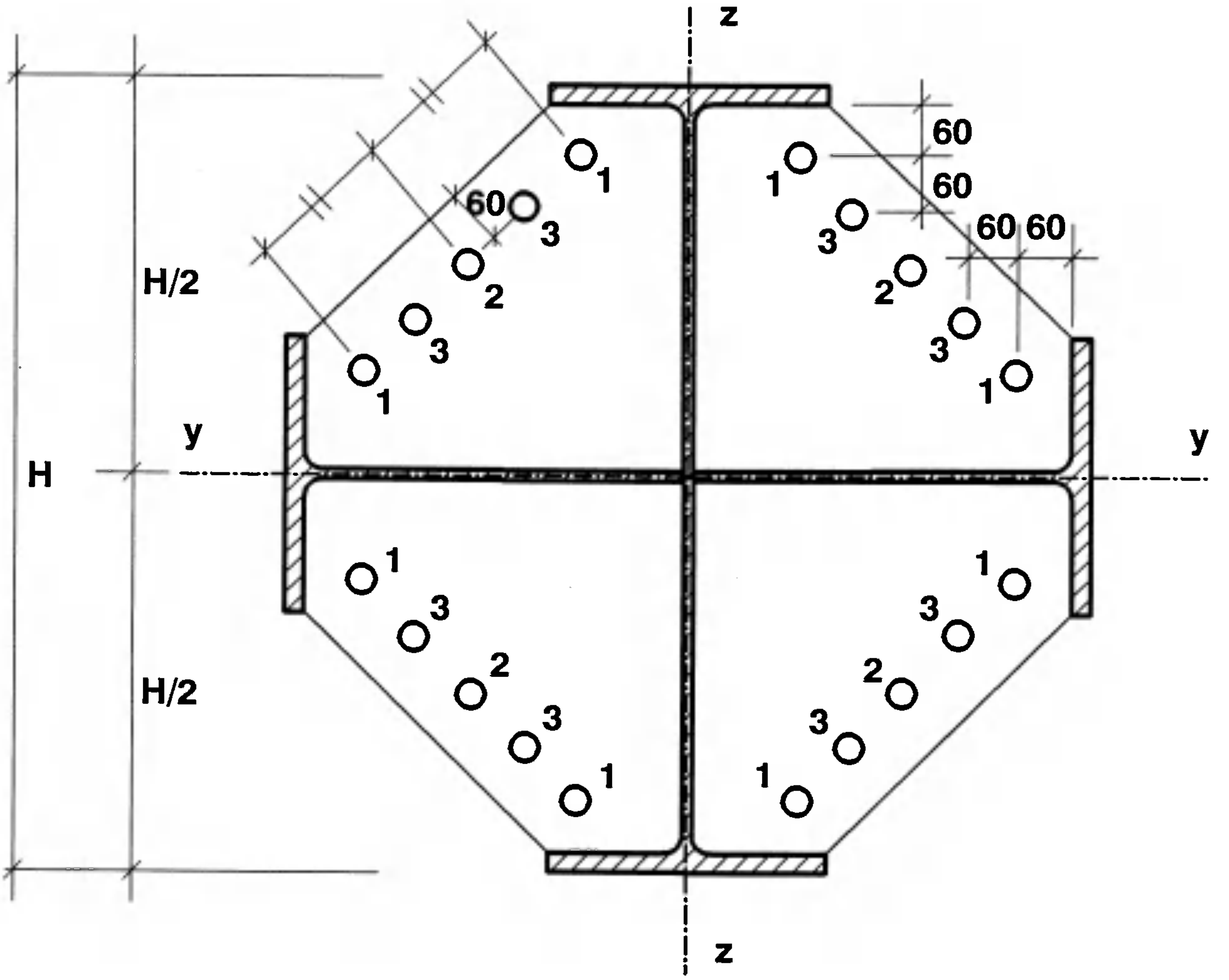
FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	8351.9	6239.0	4900.2	3601.4	2842.0	2344.5	1733.1	1349.5	1096.9	918.1
Fe510 C50	4.	4944.7	3481.6	2832.5	2192.7	1808.1	1548.8	1217.9	996.4	844.0	731.8
Fe510 C50	6.	2622.8	1935.1	1665.2	1370.4	1177.4	1039.6	853.8	720.4	624.8	552.2
Fe510 C50	8.	1490.2	1165.0	1045.7	902.5	800.8	724.1	615.0	531.1	468.8	420.1
Fe510 C20	2.	6160.3	4669.3	3701.9	2746.1	2179.0	1804.2	1339.7	1046.0	851.7	713.8
Fe510 C20	4.	3818.1	2697.8	2197.9	1703.8	1406.0	1204.9	948.0	775.9	657.3	570.1
Fe510 C20	6.	2106.5	1543.1	1324.5	1087.3	932.7	822.7	674.8	568.9	493.1	435.7
Fe510 C20	8.	1228.4	948.5	847.8	728.5	644.5	581.6	492.6	424.7	374.4	335.2
Fe360 C50	2.	7642.8	5856.2	4676.4	3494.0	2784.5	2312.1	1723.1	1348.3	1099.4	922.4
Fe360 C50	4.	4832.0	3453.3	2826.9	2201.1	1821.0	1563.1	1232.3	1009.8	856.1	742.8
Fe360 C50	6.	2629.9	1964.4	1697.9	1403.6	1209.1	1069.6	880.5	743.9	645.8	571.2
Fe360 C50	8.	1535.2	1209.1	1087.9	941.5	837.0	757.9	644.8	557.5	492.4	441.5
Fe360 C20	2.	5432.2	4271.1	3470.8	2640.3	2127.5	1779.8	1339.0	1053.8	862.6	725.7
Fe360 C20	4.	3661.5	2677.5	2213.6	1739.9	1447.2	1246.7	987.1	810.9	688.7	598.3
Fe360 C20	6.	2087.9	1586.9	1380.5	1148.8	993.7	881.5	728.2	616.6	536.0	474.6
Fe360 C20	8.	1261.6	1007.6	910.9	792.6	707.1	641.9	548.0	474.8	420.0	377.1

COLUMN CROSS SECTION TYPE AF8

TYPICAL LAYOUT OF REINFORCING BARS

FOR BENDING ABOUT MAJOR (STRONG) AXIS yy AND BENDING ABOUT MINOR (WEAK) AXIS zz, ULTIMATE LOADS ARE IDENTICAL, BECAUSE OF THE DOUBLE SYMMETRY OF THIS CROSS SECTION.



LAYOUT 1 WHEN 8 REINFORCING BARS
LAYOUT 1+2 WHEN 12 REINFORCING BARS
LAYOUT 1+3 WHEN 16 REINFORCING BARS

DESIGNATION	> AF8 - IPE 300 + 8 D 16
SECTION	> AF8-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	5487.1	4369.4	2606.4	1735.2	1041.9	745.4	522.9	403.0	247.7	138.2
Fe510 C50	4.	3257.8	2623.4	1712.7	1212.9	781.1	583.3	427.5	339.9	219.4	128.8
Fe510 C50	6.	1499.2	1303.3	995.4	780.0	556.9	440.0	339.7	279.6	189.9	116.7
Fe510 C50	8.	826.6	749.4	626.4	525.7	405.9	335.7	270.7	229.5	162.5	103.5
Fe510 C20	2.	3963.6	3267.3	2063.3	1414.4	869.8	628.7	444.5	344.0	212.6	119.1
Fe510 C20	4.	2266.3	1910.4	1333.9	980.3	651.6	493.5	365.6	292.4	190.2	112.2
Fe510 C20	6.	1159.0	1026.2	806.2	643.9	468.4	373.5	290.6	240.2	164.0	101.2
Fe510 C20	8.	663.4	609.0	519.1	442.3	347.4	290.0	235.8	200.8	143.1	91.6
Fe360 C50	2.	4779.3	3756.2	2195.7	1447.5	862.5	615.0	430.4	331.2	203.3	113.3
Fe360 C50	4.	3008.9	2353.1	1477.9	1026.5	650.8	482.7	351.9	279.1	179.6	105.1
Fe360 C50	6.	1425.8	1205.9	885.6	677.1	472.4	369.2	282.6	231.5	156.2	95.5
Fe360 C50	8.	763.8	680.9	555.2	457.5	346.4	283.5	226.7	191.2	134.4	85.2
Fe360 C20	2.	3279.5	2689.9	1684.1	1149.2	704.0	508.0	358.7	277.4	171.3	95.9
Fe360 C20	4.	2022.1	1671.4	1132.6	818.3	535.9	403.2	297.1	237.0	153.6	90.4
Fe360 C20	6.	1042.9	908.4	695.9	546.3	390.8	309.1	238.8	196.7	133.6	82.1
Fe360 C20	8.	594.0	537.8	448.7	376.0	289.8	239.5	193.0	163.5	115.7	73.7

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	3741.1	2908.4	1672.6	1094.2	648.1	461.0	322.0	247.6	151.8	84.5
Fe510 C50	4.	2096.9	1670.7	1075.1	755.7	483.8	360.3	263.5	209.3	134.9	79.1
Fe510 C50	6.	1031.1	876.9	648.9	498.4	349.3	273.5	209.7	171.9	116.1	71.1
Fe510 C50	8.	591.1	522.8	421.4	344.4	258.6	210.8	168.0	141.4	99.1	62.7
Fe510 C20	2.	2695.1	2169.9	1317.4	884.8	535.0	383.9	269.9	208.2	128.2	71.6
Fe510 C20	4.	1563.7	1283.9	861.5	619.1	403.6	303.0	222.9	177.7	115.0	67.6
Fe510 C20	6.	815.2	705.1	534.5	416.8	296.3	233.5	180.0	148.0	100.4	61.6
Fe510 C20	8.	482.3	431.0	352.6	291.2	221.0	181.1	145.0	122.4	86.1	54.6
Fe360 C50	2.	3345.6	2579.9	1466.2	953.9	562.7	399.5	278.7	214.1	131.1	73.0
Fe360 C50	4.	1975.2	1533.7	954.6	660.1	417.1	308.9	225.0	178.3	114.6	67.1
Fe360 C50	6.	980.7	814.6	584.0	440.2	303.3	235.7	179.6	146.7	98.7	60.2
Fe360 C50	8.	553.3	480.9	378.7	304.6	225.1	182.1	144.1	120.9	84.3	53.2
Fe360 C20	2.	2294.1	1845.3	1118.6	750.7	453.7	325.4	228.8	176.5	108.6	60.7
Fe360 C20	4.	1424.6	1150.7	754.4	535.4	345.4	258.2	189.3	150.6	97.2	57.1
Fe360 C20	6.	752.1	639.8	473.6	363.8	255.0	199.7	153.1	125.5	84.8	51.9
Fe360 C20	8.	440.5	388.3	311.6	253.9	190.1	154.7	123.1	103.5	72.5	45.8

DESIGNATION	> AF8 – IPE 300 + 8 D 16	ARBED RECHERCHES
SECTION	> AF8-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	2509.6	1940.2	1106.7	721.3	426.0	302.6	211.2	162.3	99.4	55.4
Fe510 C50	4.	1581.9	1215.8	747.2	513.6	323.0	238.8	173.7	137.5	88.3	51.6
Fe510 C50	6.	818.8	670.2	471.5	351.6	240.1	185.8	141.1	115.1	77.2	47.0
Fe510 C50	8.	481.1	410.9	316.5	250.9	182.9	147.0	115.7	96.8	67.2	42.3
Fe510 C20	2.	1804.0	1441.8	865.1	577.6	347.6	248.9	174.7	134.7	82.9	46.2
Fe510 C20	4.	1237.9	972.2	613.9	427.5	271.6	201.6	147.1	116.7	75.1	44.0
Fe510 C20	6.	672.7	557.5	398.4	299.8	206.3	160.1	122.0	99.6	67.0	40.9
Fe510 C20	8.	404.3	348.4	271.3	216.7	159.0	128.2	101.2	84.7	59.0	37.1
Fe360 C50	2.	2254.6	1733.3	980.7	636.8	375.0	266.1	185.5	142.5	87.3	48.6
Fe360 C50	4.	1456.5	1101.7	664.3	452.6	282.7	208.4	151.2	119.6	76.7	44.8
Fe360 C50	6.	753.3	606.5	418.4	308.7	208.8	160.9	121.9	99.2	66.4	40.4
Fe360 C50	8.	438.5	369.6	280.0	219.8	158.8	127.0	99.7	83.2	57.6	36.2
Fe360 C20	2.	1549.5	1240.1	745.6	498.4	300.2	215.0	151.0	116.4	71.6	40.0
Fe360 C20	4.	1106.1	859.4	535.3	370.3	234.0	173.4	126.3	100.1	64.3	37.6
Fe360 C20	6.	605.4	495.8	349.1	260.5	177.9	137.7	104.6	85.3	57.3	34.9
Fe360 C20	8.	362.4	309.3	238.0	188.6	137.4	110.3	86.9	72.6	50.5	31.7

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	1682.1	1297.2	737.2	479.7	282.9	200.9	140.1	107.7	65.9	36.7
Fe510 C50	4.	1128.6	852.1	512.8	349.0	217.9	160.5	116.5	92.1	59.1	34.5
Fe510 C50	6.	622.7	494.7	335.9	245.8	165.2	126.9	95.9	78.0	52.1	31.7
Fe510 C50	8.	368.3	306.7	229.2	178.4	127.9	101.9	79.8	66.5	46.0	28.8
Fe510 C20	2.	1208.0	961.2	572.8	381.1	228.7	163.6	114.8	88.4	54.4	30.3
Fe510 C20	4.	885.5	680.9	418.7	287.8	181.0	133.8	97.3	77.1	49.5	28.9
Fe510 C20	6.	521.2	417.4	286.0	210.3	141.8	109.2	82.6	67.2	45.0	27.3
Fe510 C20	8.	314.7	263.5	198.1	154.7	111.3	88.8	69.6	58.0	40.2	25.2
Fe360 C50	2.	1520.6	1165.6	656.8	425.7	250.3	177.5	123.7	95.0	58.2	32.4
Fe360 C50	4.	1018.6	762.1	453.7	307.4	191.2	140.7	102.0	80.6	51.6	30.1
Fe360 C50	6.	558.8	439.7	295.4	214.9	143.8	110.3	83.2	67.6	45.1	27.4
Fe360 C50	8.	325.4	269.6	200.3	155.4	111.1	88.4	69.1	57.6	39.8	24.9
Fe360 C20	2.	1039.3	829.0	495.9	330.6	198.7	142.2	99.8	76.9	47.3	26.4
Fe360 C20	4.	773.7	593.3	363.7	249.7	156.9	115.9	84.3	66.7	42.9	25.0
Fe360 C20	6.	452.7	361.3	246.6	180.9	121.8	93.7	70.8	57.6	38.6	23.4
Fe360 C20	8.	269.3	225.5	169.6	132.5	95.3	76.1	59.6	49.7	34.4	21.6

DESIGNATION	> AF8 – IPE 450 + 12 D 20	ARBED RECHERCHES
SECTION	> AF8-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	12600.1	10738.9	7202.7	5108.0	3234.4	2368.7	1691.8	1316.6	798.2	424.6
Fe510 C50	4.	11024.3	8911.2	5848.4	4153.2	2680.7	2003.7	1469.5	1168.9	735.2	407.1
Fe510 C50	6.	8022.7	6395.2	4359.1	3196.1	2151.3	1654.1	1250.5	1017.3	662.4	379.0
Fe510 C50	8.	4491.1	3813.7	2916.4	2302.1	1671.3	1340.0	1053.6	880.1	594.7	351.0
Fe510 C20	2.	8958.1	7840.1	5540.8	4058.0	2646.8	1965.6	1419.4	1111.4	679.2	363.4
Fe510 C20	4.	7815.2	6569.3	4566.5	3347.5	2219.9	1679.5	1243.2	993.9	629.3	350.0
Fe510 C20	6.	5391.6	4553.7	3337.9	2549.0	1776.8	1387.8	1062.0	869.7	571.1	328.8
Fe510 C20	8.	3294.3	2895.4	2314.5	1880.7	1403.8	1140.9	906.9	762.2	519.2	308.3
Fe360 C50	2.	11060.5	9363.9	6202.2	4366.3	2746.9	2005.7	1429.2	1110.9	672.4	357.2
Fe360 C50	4.	9817.3	7832.7	5049.8	3553.1	2276.2	1695.8	1240.6	985.5	618.8	342.2
Fe360 C50	6.	7391.8	5747.7	3810.2	2754.5	1833.0	1402.5	1056.4	857.7	557.0	318.2
Fe360 C50	8.	4479.6	3642.1	2650.0	2031.6	1437.1	1138.5	886.9	737.1	494.8	290.6
Fe360 C20	2.	7452.2	6515.0	4593.9	3359.7	2188.2	1624.0	1172.1	917.5	560.5	299.8
Fe360 C20	4.	6643.3	5554.8	3830.1	2794.5	1845.6	1393.7	1030.1	822.9	520.5	289.3
Fe360 C20	6.	4906.5	4057.2	2891.8	2172.4	1492.5	1158.1	881.6	720.0	471.0	270.5
Fe360 C20	8.	3091.9	2642.7	2037.2	1616.2	1178.8	947.2	746.1	623.9	422.1	249.4

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	9832.7	8228.5	5335.9	3711.4	2310.5	1679.2	1192.2	924.7	558.3	296.1
Fe510 C50	4.	8134.4	6495.7	4192.7	2951.8	1891.9	1409.8	1031.6	819.5	514.7	284.6
Fe510 C50	6.	5395.5	4336.9	2985.0	2199.9	1487.0	1145.5	867.2	706.0	460.1	263.5
Fe510 C50	8.	3198.3	2689.7	2032.9	1593.3	1149.1	918.5	720.5	601.0	405.4	239.0
Fe510 C20	2.	6817.3	5875.3	4026.0	2892.1	1852.6	1364.1	978.4	763.2	464.1	247.4
Fe510 C20	4.	5707.3	4734.4	3225.3	2337.3	1534.5	1155.7	852.5	680.2	429.6	238.5
Fe510 C20	6.	3886.1	3238.0	2330.8	1761.0	1215.9	945.6	721.1	589.4	386.1	221.9
Fe510 C20	8.	2467.8	2116.0	1637.7	1302.5	952.3	766.1	604.0	505.2	342.1	202.2
Fe360 C50	2.	8841.2	7362.8	4733.2	3276.4	2031.3	1473.5	1044.7	809.7	488.4	258.8
Fe360 C50	4.	7418.7	5859.9	3728.0	2605.6	1660.2	1234.1	901.2	715.2	448.6	247.9
Fe360 C50	6.	5149.4	4037.6	2701.1	1961.6	1310.1	1004.0	757.1	615.1	399.8	228.5
Fe360 C50	8.	3086.6	2530.3	1857.6	1431.3	1016.8	807.2	629.7	523.8	351.9	206.9
Fe360 C20	2.	5839.1	5039.8	3463.7	2492.7	1599.4	1178.6	845.9	660.1	401.6	214.1
Fe360 C20	4.	5007.9	4146.1	2816.2	2037.4	1335.8	1005.4	741.3	591.3	373.3	207.2
Fe360 C20	6.	3589.7	2953.5	2091.8	1565.8	1072.4	831.0	631.9	515.7	337.2	193.5
Fe360 C20	8.	2311.0	1951.9	1483.0	1166.0	843.3	675.0	530.0	442.4	298.7	176.1

DESIGNATION	> AF8 – IPE 450 + 12 D 20
SECTION	> AF8-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	8114.8	6735.8	4305.2	2970.7	1836.8	1330.8	942.7	730.3	440.2	233.1
Fe510 C50	4.	6332.8	5066.1	3277.9	2310.6	1482.4	1105.2	808.9	642.7	403.7	223.3
Fe510 C50	6.	4001.6	3265.4	2288.9	1703.6	1161.1	897.7	681.5	555.7	362.9	208.1
Fe510 C50	8.	2590.3	2170.4	1633.4	1276.8	918.8	733.6	574.9	479.4	323.2	190.4
Fe510 C20	2.	5594.1	4788.3	3237.9	2307.4	1467.4	1076.8	770.3	600.0	364.2	193.9
Fe510 C20	4.	4451.1	3695.1	2520.0	1827.3	1200.3	904.2	667.1	532.4	336.3	186.7
Fe510 C20	6.	3003.6	2513.2	1819.1	1378.9	954.7	743.5	567.5	464.2	304.3	175.0
Fe510 C20	8.	2053.0	1744.4	1334.9	1054.1	765.6	613.9	482.8	403.3	272.6	160.9
Fe360 C50	2.	7361.6	6093.1	3874.9	2666.5	1644.9	1190.6	842.7	652.5	393.1	208.1
Fe360 C50	4.	5777.1	4592.3	2946.2	2067.8	1322.0	984.1	719.5	571.3	358.6	198.2
Fe360 C50	6.	3737.8	3011.5	2078.6	1534.2	1038.3	800.3	606.1	493.6	321.8	184.3
Fe360 C50	8.	2454.9	2024.9	1496.8	1157.8	825.4	656.2	512.6	426.6	286.9	168.8
Fe360 C20	2.	4830.2	4148.3	2823.5	2019.9	1289.1	947.6	678.7	529.0	321.4	171.2
Fe360 C20	4.	3917.6	3254.3	2221.6	1611.7	1059.3	798.1	588.9	470.0	296.9	164.9
Fe360 C20	6.	2733.6	2273.4	1632.4	1231.6	849.3	660.1	503.2	411.2	269.3	154.7
Fe360 C20	8.	1905.2	1602.5	1211.5	949.7	685.0	547.6	429.5	358.3	241.7	142.5

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	6587.1	5433.3	3434.6	2355.8	1449.3	1047.8	740.9	573.4	345.2	182.7
Fe510 C50	4.	4813.8	3879.3	2535.3	1796.4	1157.4	864.5	633.6	503.8	316.8	175.3
Fe510 C50	6.	2966.4	2454.7	1751.3	1316.3	904.8	702.2	534.7	436.7	285.7	164.1
Fe510 C50	8.	1978.5	1670.3	1268.4	996.9	720.9	576.9	452.9	378.0	255.2	150.5
Fe510 C20	2.	4495.6	3828.9	2564.7	1817.4	1150.0	841.9	601.2	467.8	283.6	150.8
Fe510 C20	4.	3396.2	2830.9	1942.5	1413.4	931.3	702.5	518.8	414.3	261.9	145.5
Fe510 C20	6.	2249.7	1897.9	1389.1	1059.8	738.1	576.3	440.9	361.0	237.0	136.4
Fe510 C20	8.	1573.6	1342.2	1031.9	817.3	595.2	477.9	376.2	314.5	212.7	125.6
Fe360 C50	2.	5991.7	4930.3	3103.9	2124.3	1304.5	942.3	665.9	515.2	310.0	164.0
Fe360 C50	4.	4397.5	3525.7	2288.1	1615.4	1037.7	774.0	566.8	450.4	283.0	156.6
Fe360 C50	6.	2762.3	2263.8	1595.3	1190.9	813.7	629.8	478.5	390.4	255.1	146.3
Fe360 C50	8.	1866.8	1556.9	1165.3	907.9	651.4	519.4	406.7	338.9	228.3	134.4
Fe360 C20	2.	3892.4	3327.0	2243.7	1596.3	1013.7	743.4	531.5	413.9	251.1	133.6
Fe360 C20	4.	2994.2	2498.3	1717.0	1250.4	824.5	622.2	459.6	367.0	232.0	128.9
Fe360 C20	6.	2044.5	1717.7	1250.1	950.5	660.0	514.6	393.3	321.8	211.1	121.5
Fe360 C20	8.	1457.2	1232.7	938.2	738.5	534.7	428.1	336.3	280.8	189.6	111.8

DESIGNATION	> AF8 - IPE 600 + 12 D 25	ARBED RECHERCHES
SECTION	> AF8-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	21811.9	19359.0	14089.4	10520.6	6991.4	5239.7	3811.6	2997.0	1824.1	958.5
Fe510 C50	4.	20479.3	17393.9	12290.1	9096.4	6084.4	4621.5	3431.4	2748.0	1726.9	940.5
Fe510 C50	6.	18012.5	14638.8	10210.1	7578.4	5153.1	3980.0	3019.1	2460.8	1590.4	890.6
Fe510 C50	8.	14335.9	11434.7	8155.3	6184.5	4334.8	3420.3	2656.2	2203.7	1461.6	836.9
Fe510 C20	2.	15364.6	13932.5	10634.7	8211.5	5646.6	4305.9	3177.5	2519.1	1550.3	821.3
Fe510 C20	4.	14511.9	12699.9	9434.2	7205.4	4962.6	3822.1	2869.3	2312.1	1464.7	802.4
Fe510 C20	6.	12594.2	10705.8	7917.4	6078.8	4258.1	3333.6	2555.5	2095.0	1364.1	768.0
Fe510 C20	8.	9726.2	8227.8	6262.7	4929.5	3569.3	2858.2	2245.2	1874.4	1253.3	721.8
Fe360 C50	2.	19252.6	16997.8	12233.3	9066.5	5981.1	4466.4	3239.6	2543.0	1544.4	810.3
Fe360 C50	4.	18346.1	15413.9	10706.4	7844.8	5200.4	3933.8	2911.4	2327.4	1459.2	793.4
Fe360 C50	6.	16151.3	12932.1	8860.3	6514.0	4394.2	3382.1	2558.7	2082.4	1343.4	751.3
Fe360 C50	8.	13253.7	10262.0	7109.9	5311.6	3677.7	2886.5	2232.7	1848.3	1222.5	698.6
Fe360 C20	2.	12746.1	11546.7	8793.5	6778.6	4653.1	3545.0	2614.0	2071.4	1274.0	674.7
Fe360 C20	4.	12122.6	10578.8	7819.6	5952.9	4087.2	3143.1	2356.7	1897.7	1201.1	657.6
Fe360 C20	6.	10831.9	9132.8	6678.7	5093.0	3545.6	2767.9	2117.0	1733.3	1126.8	633.7
Fe360 C20	8.	8757.9	7255.4	5389.3	4180.5	2987.5	2377.9	1859.0	1547.9	1031.5	592.6

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	17789.6	15538.2	10936.3	7988.6	5197.4	3855.2	2781.2	2176.6	1316.6	688.7
Fe510 C50	4.	15980.4	13368.1	9223.5	6732.2	4447.8	3359.3	2483.3	1983.9	1242.8	675.3
Fe510 C50	6.	13227.1	10671.9	7378.2	5450.5	3691.5	2846.2	2156.1	1756.1	1133.9	634.6
Fe510 C50	8.	9740.9	7824.0	5620.1	4278.4	3008.4	2377.1	1848.1	1534.1	1018.2	583.3
Fe510 C20	2.	12063.4	10795.7	7999.5	6047.3	4068.4	3067.8	2242.9	1768.6	1080.6	569.4
Fe510 C20	4.	10877.0	9408.6	6850.6	5165.0	3513.9	2690.4	2010.2	1615.5	1019.9	557.3
Fe510 C20	6.	9018.4	7592.5	5541.2	4220.6	2935.1	2290.2	1750.9	1433.3	931.5	523.7
Fe510 C20	8.	6771.3	5677.5	4276.2	3344.4	2407.5	1922.6	1507.1	1256.7	839.0	482.6
Fe360 C50	2.	15986.1	13914.5	9724.7	7071.9	4581.7	3391.7	2442.9	1910.1	1154.1	603.2
Fe360 C50	4.	14456.9	12014.6	8207.7	5957.1	3916.4	2951.4	2178.0	1738.4	1087.7	590.5
Fe360 C50	6.	12215.5	9719.1	6610.3	4841.2	3255.5	2502.2	1891.0	1538.2	991.6	554.3
Fe360 C50	8.	9280.2	7265.2	5086.7	3820.4	2656.6	2088.9	1618.0	1340.5	887.4	507.5
Fe360 C20	2.	10268.2	9204.8	6846.3	5189.1	3500.3	2643.0	1934.4	1526.3	933.4	492.1
Fe360 C20	4.	9337.6	8087.0	5900.5	4454.5	3034.3	2324.6	1737.7	1396.8	882.1	482.2
Fe360 C20	6.	8003.5	6707.1	4864.8	3691.8	2559.0	1993.7	1522.5	1245.5	808.8	454.4
Fe360 C20	8.	6183.2	5125.7	3810.2	2956.8	2113.8	1682.8	1315.8	1095.7	730.2	419.5

DESIGNATION	> AF8 - IPE 600 + 12 D 25	ARBED RECHERCHES
SECTION	> AF8-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	15505.4	13429.5	9293.2	6716.3	4326.4	3193.9	2295.5	1792.7	1081.4	564.6
Fe510 C50	4.	13740.2	11375.5	7727.0	5590.3	3665.2	2758.7	2033.9	1622.5	1014.5	550.5
Fe510 C50	6.	10414.6	8479.7	5927.7	4405.3	2998.6	2317.1	1758.3	1433.4	926.6	519.0
Fe510 C50	8.	7029.0	5839.5	4351.5	3381.7	2420.6	1928.1	1508.3	1256.3	837.5	481.3
Fe510 C20	2.	10402.5	9245.2	6748.2	5048.8	3361.7	2521.8	1835.9	1444.2	879.5	462.4
Fe510 C20	4.	9185.7	7884.6	5667.5	4238.8	2862.3	2183.8	1627.1	1305.6	822.5	448.8
Fe510 C20	6.	6994.6	5938.6	4384.4	3362.8	2353.3	1841.6	1411.2	1156.7	753.0	423.9
Fe510 C20	8.	5052.9	4321.3	3333.5	2645.7	1930.5	1551.6	1222.3	1022.1	684.9	395.0
Fe360 C50	2.	14025.8	12122.7	8354.3	6022.3	3870.2	2854.0	2049.4	1599.7	964.4	503.2
Fe360 C50	4.	12473.1	10282.0	6939.8	5003.0	3270.3	2458.1	1810.4	1443.4	901.8	489.2
Fe360 C50	6.	9697.9	7800.4	5373.2	3961.6	2678.7	2063.8	1562.6	1272.3	821.2	459.5
Fe360 C50	8.	6574.5	5388.8	3955.4	3047.4	2164.7	1718.3	1340.6	1115.0	741.9	425.7
Fe360 C20	2.	8915.3	7948.1	5840.7	4390.0	2936.4	2207.8	1610.3	1268.1	773.4	407.0
Fe360 C20	4.	7954.9	6846.7	4943.6	3707.7	2510.1	1917.4	1430.0	1148.0	723.8	395.1
Fe360 C20	6.	6234.9	5278.7	3882.3	2970.7	2074.5	1621.8	1241.8	1017.4	661.9	372.4
Fe360 C20	8.	4554.4	3873.2	2967.2	2344.8	1704.1	1366.9	1075.2	898.4	601.3	346.5

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	13599.2	11677.6	7945.6	5683.3	3626.5	2665.4	1909.0	1487.9	895.3	466.5
Fe510 C50	4.	11623.4	9571.8	6450.8	4646.7	3035.2	2280.7	1679.3	1338.7	836.3	453.6
Fe510 C50	6.	7948.7	6585.0	4704.7	3539.2	2434.4	1890.0	1439.4	1175.7	762.0	427.6
Fe510 C50	8.	5224.4	4435.6	3391.1	2676.4	1942.7	1557.5	1224.6	1022.9	684.4	394.3
Fe510 C20	2.	9043.8	7980.8	5738.0	4249.8	2801.7	2091.6	1516.7	1190.4	722.8	379.2
Fe510 C20	4.	7659.9	6552.0	4682.7	3489.9	2349.0	1789.4	1331.7	1067.8	672.1	366.5
Fe510 C20	6.	5400.8	4630.7	3466.6	2681.7	1891.6	1485.8	1141.9	937.5	611.6	344.8
Fe510 C20	8.	3749.8	3264.3	2576.2	2075.2	1535.8	1242.8	984.5	825.8	555.6	321.4
Fe360 C50	2.	12306.2	10551.6	7158.9	5111.7	3256.6	2391.8	1712.1	1334.0	802.3	418.0
Fe360 C50	4.	10580.6	8672.7	5805.4	4166.4	2713.0	2035.8	1497.4	1193.0	744.7	403.7
Fe360 C50	6.	7421.6	6077.0	4277.9	3191.5	2179.5	1686.6	1281.3	1045.2	676.2	378.9
Fe360 C50	8.	4858.8	4083.7	3084.4	2416.4	1742.1	1392.3	1091.9	910.8	608.3	350.0
Fe360 C20	2.	7759.7	6870.0	4973.6	3700.6	2450.6	1833.5	1331.9	1046.4	636.2	334.1
Fe360 C20	4.	6615.3	5679.2	4083.2	3054.3	2062.7	1573.9	1172.7	941.0	592.9	323.5
Fe360 C20	6.	4836.1	4133.1	3079.8	2375.6	1671.2	1311.0	1006.6	825.9	538.4	303.4
Fe360 C20	8.	3366.4	2918.5	2290.9	1838.8	1356.1	1095.6	866.7	726.4	488.2	282.2

DESIGNATION > AF8 - HE 600 A + 12 D 25
SECTION > AF8-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	26452.8	23894.8	18078.8	13870.2	9473.9	7199.3	5297.2	4192.4	2573.1	1359.5
Fe510 C50	4.	25001.2	21743.5	15978.4	12117.9	8290.0	6364.1	4765.2	3834.1	2423.2	1324.3
Fe510 C50	6.	22090.5	18480.4	13373.5	10135.2	7016.8	5463.7	4170.6	3411.0	2213.3	1242.1
Fe510 C50	8.	17347.2	14286.2	10541.3	8145.6	5801.4	4610.4	3600.2	2995.8	1993.7	1143.4
Fe510 C20	2.	19425.8	17914.8	14231.0	11326.3	8049.8	6247.7	4680.4	3743.6	2331.0	1245.1
Fe510 C20	4.	18338.4	16345.4	12550.3	9802.3	6902.3	5374.7	4071.1	3297.2	2102.1	1156.2
Fe510 C20	6.	15953.0	13845.4	10549.2	8253.3	5884.0	4645.3	3584.8	2949.8	1929.3	1088.9
Fe510 C20	8.	11376.7	9981.4	7960.0	6457.3	4812.1	3907.5	3104.0	2607.7	1757.4	1017.1
Fe360 C50	2.	22591.2	20315.2	15215.7	11589.4	7857.0	5947.8	4362.4	3446.2	2109.9	1112.7
Fe360 C50	4.	21542.1	18575.2	13453.3	10109.2	6856.1	5241.6	3911.8	3141.6	1980.7	1080.6
Fe360 C50	6.	19284.7	15908.4	11304.1	8477.5	5815.5	4509.5	3431.1	2801.2	1813.4	1016.0
Fe360 C50	8.	15857.8	12696.4	9090.1	6907.7	4849.9	3829.7	2975.9	2469.7	1637.9	937.1
Fe360 C20	2.	15645.1	14376.5	11321.5	8949.9	6312.9	4879.5	3642.3	2907.2	1804.9	961.9
Fe360 C20	4.	14936.2	13274.3	10137.6	7888.4	5533.7	4300.8	3252.6	2632.0	1675.9	921.0
Fe360 C20	6.	13348.4	11499.2	8666.8	6733.3	4768.5	3752.7	2888.5	2373.5	1549.4	873.3
Fe360 C20	8.	10441.5	8928.6	6886.5	5465.2	3987.4	3204.6	2524.5	2111.0	1413.8	814.5

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	20230.1	17894.8	12930.6	9608.9	6355.4	4752.0	3450.3	2710.0	1646.4	863.4
Fe510 C50	4.	18626.8	15775.8	11096.6	8190.9	5465.6	4146.8	3076.3	2462.4	1545.8	840.6
Fe510 C50	6.	15957.2	12954.3	9023.2	6692.6	4548.0	3511.8	2663.3	2170.6	1402.0	784.2
Fe510 C50	8.	11947.5	9593.5	6889.2	5243.6	3686.6	2912.8	2264.4	1879.7	1247.0	713.6
Fe510 C20	2.	14033.8	12693.1	9631.9	7405.4	5069.4	3856.7	2840.5	2249.3	1381.6	730.4
Fe510 C20	4.	12993.1	11341.3	8387.0	6386.6	4386.1	3373.5	2529.7	2037.2	1288.9	705.0
Fe510 C20	6.	11098.4	9380.4	6882.7	5259.1	3667.9	2865.7	2193.3	1796.4	1167.9	656.3
Fe510 C20	8.	8170.5	6903.0	5246.3	4125.5	2984.5	2389.0	1876.0	1565.9	1046.4	601.8
Fe360 C50	2.	17942.4	15820.1	11354.0	8399.3	5531.1	4126.8	2991.1	2347.1	1424.0	746.1
Fe360 C50	4.	16680.6	14027.9	9758.1	7156.1	4747.5	3592.4	2659.5	2126.3	1332.8	724.1
Fe360 C50	6.	14465.2	11592.2	7950.6	5848.4	3947.0	3038.4	2299.0	1871.3	1206.8	674.2
Fe360 C50	8.	11458.6	8906.6	6193.4	4635.5	3214.3	2524.4	1953.6	1617.6	1069.8	610.8
Fe360 C20	2.	11774.2	10656.5	8098.8	6233.6	4272.2	3252.1	2396.4	1898.2	1166.4	616.8
Fe360 C20	4.	10952.9	9568.0	7085.3	5400.2	3711.9	2856.1	2142.5	1725.6	1092.1	597.4
Fe360 C20	6.	9667.1	8130.2	5925.2	4509.2	3133.4	2444.1	1868.1	1529.0	993.1	557.7
Fe360 C20	8.	7576.2	6279.4	4666.9	3621.2	2588.5	2060.6	1611.1	1341.6	893.7	512.9

DESIGNATION > AF8 – HE 600 A + 12 D 25 SECTION > AF8-COLUMN BUCKLING > STRONG AXIS	ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF :									
		0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	17291.8	15160.0	10752.3	7893.0	5159.3	3835.5	2772.0	2171.6	1314.7	687.7
Fe510 C50	4.	15693.2	13139.4	9078.0	6631.2	4384.0	3312.1	2449.0	1956.7	1225.4	665.3
Fe510 C50	6.	12884.7	10405.8	7202.7	5324.2	3607.8	2782.3	2108.1	1717.1	1108.4	619.7
Fe510 C50	8.	9128.1	7398.8	5365.7	4106.1	2900.0	2296.0	1787.7	1485.2	986.4	564.9
Fe510 C20	2.	11754.9	10554.0	7877.0	5984.9	4047.1	3059.7	2241.7	1769.9	1082.7	570.6
Fe510 C20	4.	10721.6	9278.9	6761.8	5100.8	3472.0	2658.9	1987.1	1597.1	1007.9	550.3
Fe510 C20	6.	8797.1	7417.6	5424.9	4137.1	2880.2	2248.5	1719.8	1408.1	915.0	514.0
Fe510 C20	8.	6532.3	5493.7	4152.5	3254.5	2347.3	1876.3	1471.8	1227.8	819.7	471.2
Fe360 C50	2.	15576.4	13624.6	9617.5	7038.4	4587.4	3405.6	2458.5	1924.8	1164.4	608.7
Fe360 C50	4.	14162.2	11810.2	8110.0	5903.4	3891.0	2935.6	2168.3	1731.4	1083.5	587.9
Fe360 C50	6.	11839.7	9464.9	6472.9	4754.3	3204.6	2465.6	1864.8	1517.5	978.3	546.5
Fe360 C50	8.	8615.7	6857.9	4880.8	3697.2	2589.0	2042.0	1585.3	1315.0	871.6	498.4
Fe360 C20	2.	9999.8	9002.4	6759.6	5157.8	3503.1	2654.3	1948.3	1539.9	943.3	497.7
Fe360 C20	4.	9187.2	7978.9	5849.3	4429.2	3025.6	2321.1	1736.9	1397.1	882.6	482.2
Fe360 C20	6.	7808.7	6568.2	4787.9	3644.1	2532.6	1975.5	1510.0	1235.9	802.8	450.8
Fe360 C20	8.	5965.3	4975.4	3724.4	2902.1	2082.3	1660.4	1300.0	1083.3	722.3	414.8

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF :									
		0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	15143.7	13166.6	9181.3	6667.2	4313.8	3191.4	2297.5	1795.9	1084.2	565.9
Fe510 C50	4.	13248.3	11035.5	7564.9	5501.2	3622.8	2732.2	2017.4	1610.7	1007.8	546.8
Fe510 C50	6.	9895.3	8121.3	5733.6	4284.3	2929.9	2268.7	1724.3	1406.9	910.1	509.6
Fe510 C50	8.	6705.7	5597.5	4193.9	3269.8	2347.3	1872.1	1466.0	1221.8	814.7	467.9
Fe510 C20	2.	10159.3	9065.0	6673.8	5022.6	3363.9	2530.8	1846.9	1454.8	887.2	466.6
Fe510 C20	4.	8877.7	7669.5	5572.5	4195.7	2850.9	2181.5	1629.2	1308.9	825.7	450.6
Fe510 C20	6.	6773.2	5785.4	4307.5	3321.0	2335.2	1831.5	1406.0	1153.5	751.6	423.0
Fe510 C20	8.	4886.1	4198.5	3258.0	2595.7	1900.8	1530.3	1207.2	1010.2	677.3	390.5
Fe360 C50	2.	13696.0	11893.1	8272.6	5998.0	3875.2	2864.9	2061.3	1610.8	972.1	507.3
Fe360 C50	4.	12057.4	10006.7	6822.0	4945.6	3248.2	2446.7	1805.0	1440.3	900.6	488.4
Fe360 C50	6.	9266.3	7515.6	5229.1	3876.1	2632.7	2032.4	1541.1	1255.8	811.1	453.6
Fe360 C50	8.	6302.1	5190.4	3830.1	2959.8	2108.1	1675.3	1308.2	1088.6	724.5	415.5
Fe360 C20	2.	8714.1	7799.5	5781.2	4371.3	2941.5	2218.4	1622.0	1279.1	781.2	411.3
Fe360 C20	4.	7632.4	6621.9	4846.1	3665.5	2501.4	1917.9	1434.7	1153.7	728.7	398.0
Fe360 C20	6.	6049.5	5158.3	3831.3	2949.4	2071.0	1623.2	1245.4	1021.5	665.3	374.3
Fe360 C20	8.	4429.6	3790.1	2925.5	2322.8	1695.5	1363.0	1073.9	898.1	601.5	346.6

DESIGNATION > AF8 – HE 800 A + 16 D 25 SECTION > AF8-COLUMN BUCKLING > STRONG AXIS	ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	39768.7	36547.7	28788.4	22762.0	16058.7	12413.8	9267.4	7397.2	4568.9	2405.5
Fe510 C50	4.	38671.9	34469.2	26466.1	20671.2	14555.6	11334.3	8585.2	6953.3	4409.6	2394.7
Fe510 C50	6.	36628.3	31460.8	23610.4	18293.4	12922.5	10157.3	7810.8	6414.5	4162.3	2314.4
Fe510 C50	8.	32969.2	27267.7	20216.4	15664.8	11183.7	8897.6	6953.8	5789.1	3834.4	2170.5
Fe510 C20	2.	27811.8	26001.3	21370.4	17485.4	12832.0	10140.5	7718.3	6233.1	3913.1	2086.2
Fe510 C20	4.	26959.2	24580.9	19718.0	15900.5	11579.2	9175.7	7052.9	5761.1	3696.0	2024.7
Fe510 C20	6.	25534.5	22668.2	17883.3	14323.9	10451.1	8346.1	6501.0	5377.9	3523.5	1973.1
Fe510 C20	8.	22804.7	19759.9	15499.3	12434.7	9166.5	7403.7	5855.7	4907.4	3278.8	1867.7
Fe360 C50	2.	34576.9	31657.3	24713.3	19405.6	13587.1	10460.3	7781.6	6198.4	3817.5	2005.5
Fe360 C50	4.	33702.5	29850.1	22654.2	17552.0	12259.7	9507.8	7177.8	5802.3	3670.3	1989.5
Fe360 C50	6.	31848.3	27101.2	20071.9	15424.5	10813.4	8469.0	6494.1	5324.7	3448.0	1914.3
Fe360 C50	8.	29111.6	23702.8	17272.5	13253.0	9381.5	7435.1	5793.6	4815.3	3182.7	1798.9
Fe360 C20	2.	22721.0	21210.1	17366.0	14163.7	10354.9	8165.1	6202.7	5003.1	3135.6	1669.5
Fe360 C20	4.	22063.4	20077.6	16042.6	12898.4	9362.6	7406.4	5684.5	4639.4	2972.8	1627.0
Fe360 C20	6.	21006.0	18578.8	14571.0	11623.0	8445.4	6730.3	5233.4	4325.0	2830.0	1583.2
Fe360 C20	8.	19234.3	16498.4	12774.8	10163.3	7432.5	5980.0	4715.1	3944.6	2629.5	1495.4

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	32522.3	29419.7	22331.8	17173.8	11759.3	8947.4	6590.4	5219.2	3189.2	1665.5
Fe510 C50	4.	31036.3	27093.8	20039.9	15262.2	10483.0	8063.2	6046.7	4869.5	3064.9	1655.3
Fe510 C50	6.	28479.0	23848.1	17280.2	13105.9	9079.6	7072.1	5399.6	4416.8	2851.2	1579.4
Fe510 C50	8.	24979.0	20065.7	14415.4	10974.6	7717.3	6098.1	4741.0	3935.6	2597.1	1466.3
Fe510 C20	2.	21525.6	19851.2	15769.1	12550.4	8919.7	6922.9	5186.1	4148.1	2569.3	1355.7
Fe510 C20	4.	20489.7	18390.5	14306.3	11277.7	8016.9	6272.9	4770.5	3872.6	2463.5	1340.9
Fe510 C20	6.	18753.4	16310.7	12467.4	9774.4	6982.3	5517.8	4261.4	3508.1	2283.6	1272.7
Fe510 C20	8.	16369.7	13822.3	10497.9	8251.8	5967.4	4775.8	3749.8	3129.8	2079.9	1180.2
Fe360 C50	2.	29124.8	26267.0	19802.8	15154.0	10323.2	7833.9	5757.5	4553.8	2777.8	1448.8
Fe360 C50	4.	27843.0	24184.4	17733.7	13430.4	9175.8	7039.6	5268.3	4237.7	2663.1	1436.7
Fe360 C50	6.	25726.1	21339.9	15271.8	11499.5	7916.3	6148.2	4683.7	3826.4	2466.1	1364.6
Fe360 C50	8.	22916.4	18095.4	12776.1	9637.3	6725.2	5296.3	4107.1	3404.7	2242.8	1264.7
Fe360 C20	2.	18129.9	16729.1	13307.3	10602.6	7544.6	5859.5	4392.0	3514.2	2177.7	1149.5
Fe360 C20	4.	17358.3	15576.7	12112.6	9545.7	6783.7	5307.2	4035.6	3275.7	2083.6	1134.1
Fe360 C20	6.	16093.8	13972.2	10651.1	8335.7	5944.4	4693.8	3622.6	2981.1	1939.6	1080.6
Fe360 C20	8.	14382.0	12061.4	9086.6	7107.5	5117.1	4086.8	3203.6	2671.5	1773.3	1005.3

DESIGNATION > AF8 – HE 800 A + 16 D 25
SECTION > AF8-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
		ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF :									
Fe510 C50	2.	28910.2	25958.1	19376.5	14723.3	9957.2	7528.2	5515.9	4354.9	2650.2	1379.8
Fe510 C50	4.	27523.7	23763.6	17248.3	12978.4	8813.2	6741.8	5033.8	4043.8	2537.0	1366.9
Fe510 C50	6.	24829.4	20544.0	14654.3	11013.9	7569.8	5874.7	4472.8	3653.0	2353.4	1301.8
Fe510 C50	8.	21070.3	16828.7	12018.6	9120.8	6396.7	5048.7	3921.6	3253.8	2145.9	1211.0
Fe510 C20	2.	18763.3	17192.6	13446.8	10574.0	7415.2	5713.6	4253.5	3389.6	2088.8	1097.8
Fe510 C20	4.	17833.0	15847.6	12101.1	9415.3	6604.1	5132.5	3881.4	3140.7	1989.3	1079.4
Fe510 C20	6.	15972.4	13762.6	10375.8	8062.5	5710.9	4494.6	3459.9	2843.0	1846.2	1027.1
Fe510 C20	8.	13382.4	11289.0	8564.0	6726.9	4861.5	3889.6	3053.3	2548.1	1693.0	960.6
Fe360 C50	2.	26182.8	23460.0	17430.6	13201.6	8898.5	6716.5	4914.3	3876.9	2356.7	1226.1
Fe360 C50	4.	24930.8	21449.2	15476.9	11602.8	7852.1	5996.9	4471.8	3589.8	2250.0	1211.5
Fe360 C50	6.	22677.1	18626.4	13163.4	9841.7	6733.5	5215.1	3964.3	3234.9	2081.8	1150.6
Fe360 C50	8.	19609.1	15415.7	10837.0	8156.3	5681.2	4470.6	3464.7	2871.2	1890.6	1065.7
Fe360 C20	2.	16031.0	14713.6	11554.0	9113.5	6412.6	4950.1	3690.8	2943.9	1816.5	955.6
Fe360 C20	4.	15243.9	13581.6	10420.1	8134.1	5724.5	4456.4	3374.7	2732.9	1732.8	940.9
Fe360 C20	6.	13905.5	11988.5	9045.8	7032.8	4984.0	3923.5	3020.8	2482.5	1612.3	897.1
Fe360 C20	8.	11960.3	10044.4	7579.4	5934.4	4276.3	3416.7	2679.2	2234.6	1483.6	841.3

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
		ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF :									
Fe510 C50	2.	26461.5	23605.2	17369.3	13067.0	8748.3	6580.6	4801.5	3781.8	2294.0	1191.5
Fe510 C50	4.	24873.4	21306.1	15262.7	11391.1	7677.2	5851.9	4357.0	3494.7	2187.9	1177.1
Fe510 C50	6.	21943.7	18049.8	12778.9	9563.8	6549.1	5074.2	3858.4	3149.0	2026.9	1120.5
Fe510 C50	8.	17619.9	14185.3	10214.2	7785.8	5480.7	4332.7	3369.7	2797.8	1846.7	1042.8
Fe510 C20	2.	16970.0	15466.9	11946.2	9305.2	6458.5	4949.2	3667.3	2914.4	1789.2	937.7
Fe510 C20	4.	15873.4	14023.0	10593.2	8181.5	5696.7	4411.1	3325.9	2686.6	1697.8	919.7
Fe510 C20	6.	13774.9	11848.5	8910.4	6912.9	4889.2	3845.2	2958.3	2430.1	1577.4	877.3
Fe510 C20	8.	10799.7	9229.4	7113.3	5642.5	4115.0	3306.5	2604.3	2177.5	1450.4	824.4
Fe360 C50	2.	24036.1	21404.1	15689.8	11772.7	7861.3	5905.8	4304.5	3388.3	2053.6	1066.1
Fe360 C50	4.	22625.6	19306.5	13743.9	10218.4	6862.8	5222.6	3883.5	3112.7	1947.0	1046.8
Fe360 C50	6.	20137.7	16422.7	11503.1	8558.0	5830.7	4507.3	3421.4	2789.7	1793.4	990.6
Fe360 C50	8.	16564.1	13096.5	9258.6	6988.7	4879.6	3843.8	2981.3	2471.6	1628.4	918.3
Fe360 C20	2.	14554.8	13292.8	10316.3	8064.7	5619.3	4315.0	3202.9	2548.0	1566.5	821.9
Fe360 C20	4.	13629.1	12076.3	9172.0	7110.0	4968.7	3854.4	2910.4	2353.0	1488.6	807.0
Fe360 C20	6.	12056.5	10370.1	7798.1	6049.6	4278.6	3364.9	2588.7	2126.5	1380.3	767.7
Fe360 C20	8.	9742.6	8271.4	6323.5	4990.7	3622.6	2904.3	2283.5	1907.4	1268.8	720.5

DESIGNATION > AF8 - HE 1000 A + 16 D 25
SECTION > AF8-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F30

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	54583.3	50794.2	41260.3	33432.7	24254.7	19041.8	14408.8	11594.6	7224.1	3813.5
Fe510 C50	4.	53571.6	48640.1	38691.7	31003.8	22423.3	17704.0	13565.9	11061.0	7060.3	3836.5
Fe510 C50	6.	52377.0	45984.1	35652.1	28216.6	20342.7	16148.6	12517.2	10325.8	6722.8	3730.3
Fe510 C50	8.	49411.3	41876.3	31946.2	25179.7	18254.7	14626.8	11495.1	9599.3	6367.1	3590.7
Fe510 C20	2.	36384.2	34356.2	28978.5	24243.4	18282.5	14681.6	11339.5	9240.8	5862.1	3138.8
Fe510 C20	4.	35709.7	33096.8	27459.8	22740.4	17064.7	13747.5	10719.6	8831.6	5718.8	3141.8
Fe510 C20	6.	34589.4	31315.2	25517.0	20923.4	15645.7	12654.4	9962.2	8292.1	5464.3	3059.3
Fe510 C20	8.	32757.7	28884.5	23192.6	18903.0	14153.5	11520.0	9168.6	7711.3	5163.3	2931.9
Fe360 C50	2.	48027.5	44495.1	35744.9	28704.3	20608.5	16084.9	12108.7	9713.5	6025.8	3170.2
Fe360 C50	4.	47115.4	42473.0	33317.1	26422.9	18901.5	14837.7	11314.6	9199.4	5849.5	3169.4
Fe360 C50	6.	45840.4	39886.7	30507.6	23927.8	17099.6	13515.7	10439.8	8595.1	5581.3	3091.0
Fe360 C50	8.	43498.7	36292.4	27177.5	21182.2	15201.3	12122.7	9491.9	7910.1	5232.6	2945.3
Fe360 C20	2.	29795.5	28076.1	23551.2	19608.1	14698.2	11760.8	9053.4	7362.4	4656.5	2487.3
Fe360 C20	4.	29262.2	27043.9	22303.4	18380.4	13715.2	11014.2	8564.3	7044.0	4550.5	2495.4
Fe360 C20	6.	28390.0	25616.5	20755.2	16946.7	12614.5	10178.2	7996.5	6648.1	4373.8	2445.8
Fe360 C20	8.	27154.6	23787.0	18929.3	15333.7	11410.7	9259.0	7350.7	6173.5	4125.7	2339.5

FIRE CLASS F60

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	46336.7	42510.7	33347.7	26283.2	18477.8	14256.7	10625.8	8473.3	5213.3	2725.5
Fe510 C50	4.	44998.2	40058.7	30687.8	23930.4	16823.5	13089.6	9908.2	8021.7	5071.5	2736.2
Fe510 C50	6.	42867.6	36723.2	27456.2	21223.0	14958.9	11745.6	9024.8	7408.0	4791.8	2646.2
Fe510 C50	8.	39740.8	32546.1	23867.2	18378.1	13049.4	10356.2	8078.3	6718.1	4432.2	2490.0
Fe510 C20	2.	29189.2	27237.5	22279.0	18155.8	13260.5	10450.4	7934.7	6398.3	3998.1	2115.3
Fe510 C20	4.	28379.2	25863.0	20726.0	16701.0	12152.2	9625.6	7395.9	6040.0	3863.9	2103.0
Fe510 C20	6.	26921.4	23831.4	18716.0	14943.6	10868.5	8665.5	6740.9	5572.1	3637.7	2022.5
Fe510 C20	8.	24794.2	21252.8	16441.8	13073.5	9555.7	7686.3	6059.3	5068.6	3369.5	1903.4
Fe360 C50	2.	41605.4	38038.3	29595.1	23179.7	16184.5	12441.4	9243.6	7357.5	4515.3	2356.1
Fe360 C50	4.	40527.0	35869.1	27186.9	21045.3	14686.7	11385.1	8592.0	6944.0	4380.1	2359.2
Fe360 C50	6.	38847.0	32941.9	24279.9	18603.3	13006.7	10173.9	7793.7	6386.8	4122.1	2272.8
Fe360 C50	8.	36127.0	29134.8	21016.4	16035.5	11297.2	8934.3	6950.4	5771.7	3800.6	2132.3
Fe360 C20	2.	24610.3	22942.1	18718.5	15222.6	11090.9	8728.4	6618.9	5333.2	3329.0	1759.8
Fe360 C20	4.	23922.7	21778.2	17415.1	14010.2	10176.3	8052.8	6182.5	5046.6	3226.3	1755.2
Fe360 C20	6.	22821.9	20171.7	15803.9	12597.5	9146.9	7286.8	5664.5	4680.5	3054.0	1697.3
Fe360 C20	8.	21348.8	18201.6	13987.3	11074.9	8062.9	6473.3	5095.4	4258.8	2828.0	1596.2

DESIGNATION	> AF8 – HE 1000 A + 16 D 25
SECTION	> AF8-COLUMN
BUCKLING	> STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	42066.6	38330.5	29587.2	23035.7	15980.7	12242.8	9069.7	7206.7	4412.5	2298.4
Fe510 C50	4.	40866.9	36005.6	27067.5	20836.9	14461.8	11180.3	8418.8	6795.6	4279.3	2302.0
Fe510 C50	6.	38661.8	32670.5	23964.5	18308.4	12766.9	9974.1	7633.2	6252.0	4032.3	2222.2
Fe510 C50	8.	35331.7	28522.4	20596.6	15724.4	11083.5	8767.2	6821.6	5665.2	3730.9	2093.3
Fe510 C20	2.	26019.7	24118.8	19401.4	15596.5	11211.3	8756.3	6595.7	5292.9	3285.1	1729.0
Fe510 C20	4.	25302.9	22841.1	17965.0	14275.2	10232.6	8041.2	6137.4	4992.6	3176.8	1722.2
Fe510 C20	6.	23786.3	20816.6	16060.7	12669.5	9104.7	7216.1	5586.2	4604.9	2995.2	1660.7
Fe510 C20	8.	21527.3	18254.5	13935.1	10988.1	7969.1	6386.5	5019.8	4192.2	2781.0	1568.4
Fe360 C50	2.	38260.4	34770.8	26675.7	20674.7	14273.2	10906.8	8062.5	6398.4	3910.9	2034.5
Fe360 C50	4.	37147.4	32586.8	24309.2	18617.5	12856.7	9915.0	7451.2	6007.7	3777.5	2029.9
Fe360 C50	6.	35256.3	29565.0	21462.9	16296.2	11301.0	8806.3	6726.0	5502.8	3544.1	1951.1
Fe360 C50	8.	32509.1	25880.5	18422.2	13956.0	9773.5	7708.8	5985.0	4964.5	3264.5	1829.7
Fe360 C20	2.	22196.5	20577.1	16556.8	13312.6	9571.9	7477.0	5632.7	4520.5	2806.0	1476.9
Fe360 C20	4.	21544.0	19456.3	15315.7	12177.6	8734.7	6866.4	5242.2	4265.1	2714.5	1471.8
Fe360 C20	6.	20426.8	17872.3	13784.1	10871.0	7810.4	6189.6	4791.1	3949.2	2568.5	1424.1
Fe360 C20	8.	18802.4	15896.3	12091.1	9512.8	6885.1	5512.5	4329.6	3614.3	2396.2	1350.9

FIRE CLASS F120

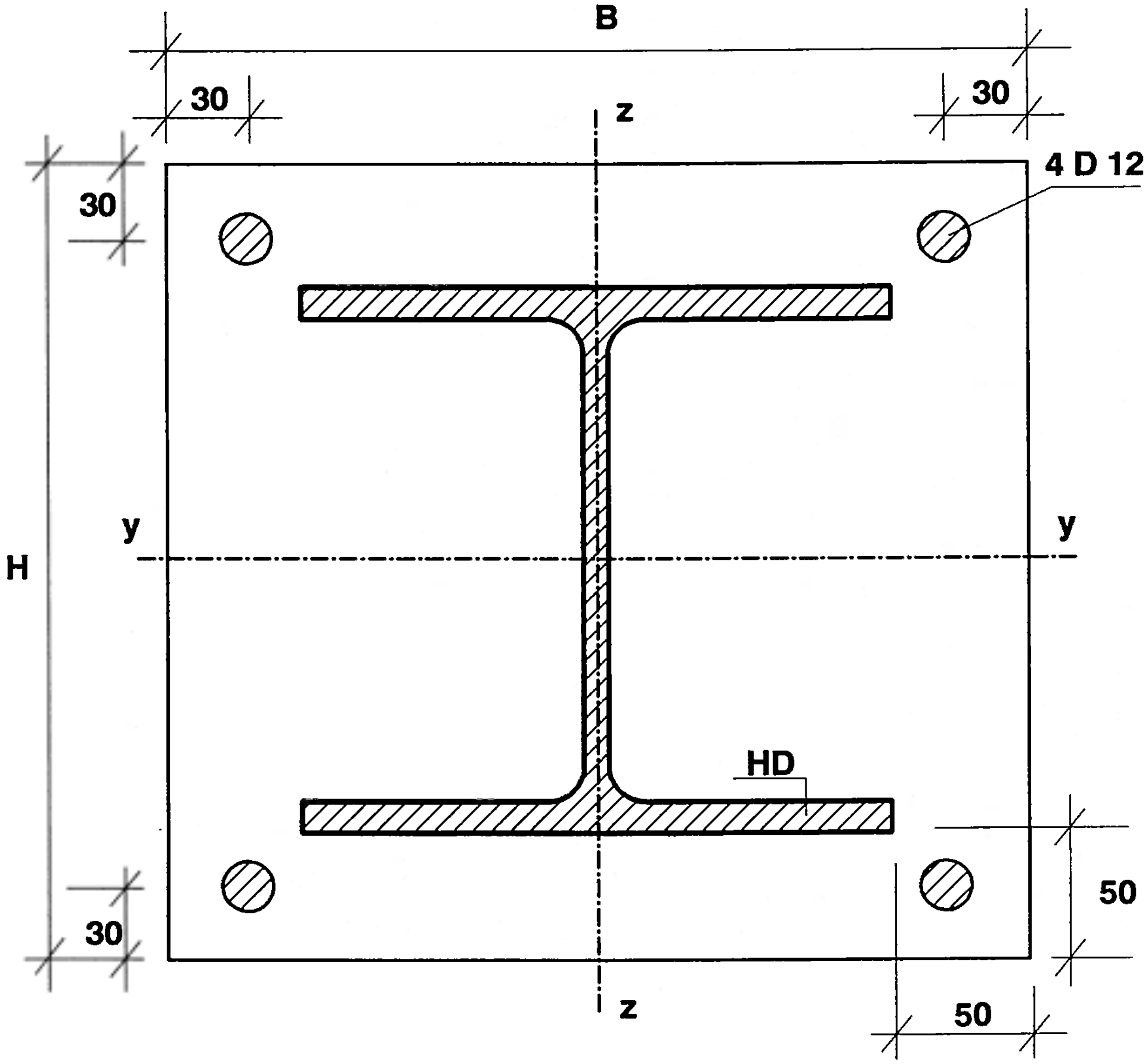
MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	39213.1	35525.7	27059.9	20862.1	14322.5	10912.6	8047.1	6377.1	3890.3	2020.9
Fe510 C50	4.	37877.7	33111.8	24550.0	18726.4	12881.7	9915.5	7440.2	5993.6	3764.4	2021.1
Fe510 C50	6.	35452.1	29700.9	21534.2	16338.1	11322.5	8820.4	6735.2	5509.6	3547.8	1952.9
Fe510 C50	8.	31842.5	25547.1	18329.5	13944.6	9800.1	7741.9	6017.8	4994.9	3287.2	1843.5
Fe510 C20	2.	24005.4	22136.3	17580.8	13990.2	9941.3	7715.0	5779.1	4622.1	2855.5	1497.6
Fe510 C20	4.	23122.1	20743.1	16121.6	12700.3	9022.0	7056.9	5365.1	4354.5	2762.4	1494.1
Fe510 C20	6.	21449.9	18664.7	14276.6	11197.9	8002.7	6325.5	4886.0	4022.7	2612.2	1446.7
Fe510 C20	8.	18924.5	16034.0	12227.6	9635.6	6984.2	5595.6	4397.2	3671.9	2435.4	1373.4
Fe360 C50	2.	35760.8	32311.8	24462.7	18776.6	12831.3	9753.0	7177.7	5681.4	3460.5	1795.5
Fe360 C50	4.	34569.2	30075.6	22115.1	16778.6	11482.8	8816.7	6602.5	5312.9	3331.9	1787.0
Fe360 C50	6.	32457.1	26945.4	19303.8	14544.4	10017.8	7782.2	5929.5	4844.7	3114.9	1712.7
Fe360 C50	8.	29462.4	23236.6	16386.8	12353.3	8616.2	6784.1	5260.0	4360.0	2864.3	1604.3
Fe360 C20	2.	20537.2	18945.2	15060.1	11992.8	8528.8	6621.8	4962.0	3969.6	2453.1	1286.8
Fe360 C20	4.	19808.6	17778.9	13830.2	10902.2	7749.8	6063.8	4611.5	3743.5	2375.3	1284.9
Fe360 C20	6.	18541.6	16118.0	12310.3	9646.2	6887.3	5441.4	4201.6	3458.5	2245.2	1243.2
Fe360 C20	8.	16649.4	14033.8	10636.1	8349.7	6031.2	4824.3	3786.2	3159.4	2093.5	1179.8

COLUMN CROSS SECTION TYPE HEC

TYPICAL LAYOUT OF REINFORCING BARS
valid for any steel shape

For bending about major axis ≡ strong axis yy

For bending about minor axis ≡ weak axis zz



DESIGNATION	> HD 210 x 210 x 71 ENCASED IN CONCRETE	ARBED RECHERCHES
SECTION	> HEC-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	4513.0	3872.8	2631.8	1881.0	1199.4	881.3	631.0	491.8	306.6	172.7
Fe510 C50	4.	3257.7	2763.1	1948.0	1439.9	962.0	730.3	542.0	433.9	280.6	163.2
Fe510 C50	6.	2542.3	2115.9	1520.9	1148.1	792.1	615.8	469.5	383.7	254.5	150.5
Fe510 C50	8.	1913.2	1587.5	1181.3	917.2	656.1	522.4	408.6	340.2	230.3	137.4
Fe510 C20	2.	3309.4	2927.4	2115.4	1572.0	1039.8	777.5	564.5	443.4	279.2	158.5
Fe510 C20	4.	2569.0	2235.2	1643.7	1247.2	853.6	655.4	490.8	395.0	257.1	150.2
Fe510 C20	6.	2140.3	1813.8	1335.8	1022.9	714.9	559.0	428.2	350.9	233.5	138.4
Fe510 C20	8.	1672.6	1405.8	1061.8	831.8	599.7	479.3	375.9	313.6	212.7	127.1
Fe360 C50	2.	3745.9	3159.8	2078.8	1457.8	914.0	666.3	474.2	368.4	228.6	128.4
Fe360 C50	4.	2556.2	2130.3	1461.4	1063.2	700.4	528.3	390.2	311.5	200.8	116.4
Fe360 C50	6.	1857.0	1533.8	1091.7	819.4	562.6	436.4	332.1	271.2	179.6	106.2
Fe360 C50	8.	1516.2	1218.3	875.6	666.7	468.9	370.5	288.1	239.2	161.2	95.9
Fe360 C20	2.	2506.0	2209.8	1586.3	1173.6	772.9	576.7	418.0	328.0	206.3	117.0
Fe360 C20	4.	1852.3	1609.5	1181.0	894.8	611.6	469.3	351.3	282.6	183.9	107.4
Fe360 C20	6.	1466.1	1252.9	933.5	720.0	506.5	397.3	305.0	250.3	166.8	99.0
Fe360 C20	8.	1238.9	1032.4	772.0	601.2	431.1	343.7	269.0	224.2	151.8	90.6

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	3683.6	3161.9	2149.8	1537.0	980.4	720.4	515.9	402.1	250.7	141.2
Fe510 C50	4.	2591.0	2211.1	1574.3	1170.6	786.3	598.4	445.0	356.6	231.0	134.4
Fe510 C50	6.	2033.4	1705.8	1239.0	941.0	652.7	508.7	388.6	317.9	211.1	125.0
Fe510 C50	8.	1582.7	1315.5	980.8	762.5	546.0	434.9	340.3	283.4	191.9	114.5
Fe510 C20	2.	2711.2	2398.8	1734.2	1289.1	852.9	637.8	463.2	363.8	229.2	130.0
Fe510 C20	4.	2069.6	1807.7	1338.4	1020.0	701.0	539.4	404.6	325.8	212.4	124.2
Fe510 C20	6.	1729.1	1473.4	1093.3	841.2	590.4	462.6	354.9	291.0	193.9	115.1
Fe510 C20	8.	1389.0	1167.0	881.0	690.0	497.3	397.4	311.7	259.9	176.3	105.3
Fe360 C50	2.	3057.7	2576.7	1692.0	1185.3	742.5	541.1	385.0	299.0	185.5	104.2
Fe360 C50	4.	2034.2	1705.9	1181.4	864.2	572.0	432.4	319.9	255.6	164.9	95.7
Fe360 C50	6.	1478.4	1234.3	890.8	674.1	466.0	362.6	276.7	226.2	150.1	88.8
Fe360 C50	8.	1203.5	983.4	719.4	553.2	392.3	311.2	242.6	201.7	136.3	81.2
Fe360 C20	2.	2048.0	1805.7	1295.8	958.6	631.2	470.9	341.3	267.8	168.5	95.5
Fe360 C20	4.	1497.3	1303.8	960.2	729.2	499.5	383.7	287.4	231.3	150.6	88.0
Fe360 C20	6.	1180.2	1014.1	761.4	590.1	417.0	327.8	252.1	207.0	138.2	82.1
Fe360 C20	8.	979.4	826.1	626.6	492.2	355.7	284.5	223.4	186.4	126.5	75.6

DESIGNATION	> HD 260 x 260 x 131 ENCASED IN CONCRETE	ARBED RECHERCHES
SECTION	> HEC-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	8231.0	7317.2	5344.0	3999.8	2664.3	1999.0	1455.6	1145.1	714.1	395.7
Fe510 C50	4.	6443.5	5644.9	4201.2	3212.6	2215.2	1707.1	1282.1	1033.4	666.0	379.5
Fe510 C50	6.	5042.2	4370.5	3323.7	2597.1	1849.4	1459.2	1125.6	926.0	611.8	353.9
Fe510 C50	8.	4239.4	3602.8	2757.8	2178.2	1582.2	1268.9	997.9	833.7	559.6	324.8
Fe510 C20	2.	6286.2	5705.7	4364.5	3375.4	2324.9	1774.5	1310.4	1039.3	655.3	366.1
Fe510 C20	4.	5130.5	4583.8	3535.1	2769.6	1956.4	1525.8	1157.3	938.0	609.1	348.9
Fe510 C20	6.	4286.0	3762.6	2916.9	2308.4	1664.1	1321.0	1023.9	844.6	560.1	324.9
Fe510 C20	8.	3702.3	3175.0	2457.7	1954.9	1429.4	1149.9	906.6	758.5	510.0	296.5
Fe360 C50	2.	6664.3	5851.0	4162.0	3061.0	2004.4	1491.4	1078.6	845.3	524.5	289.6
Fe360 C50	4.	5014.0	4331.6	3147.2	2369.6	1610.1	1232.0	920.1	739.2	474.4	269.5
Fe360 C50	6.	3768.4	3236.4	2428.5	1881.4	1328.9	1044.5	803.2	659.6	434.8	251.1
Fe360 C50	8.	3020.9	2565.4	1961.8	1548.6	1124.3	901.4	708.8	592.1	397.3	230.6
Fe360 C20	2.	4679.3	4237.4	3224.3	2483.9	1703.9	1297.7	956.6	758.0	477.2	266.3
Fe360 C20	4.	3714.7	3310.6	2541.4	1984.7	1397.3	1088.0	824.0	667.4	432.9	247.8
Fe360 C20	6.	2961.5	2612.3	2040.2	1622.7	1175.7	935.6	726.6	600.1	398.5	231.4
Fe360 C20	8.	2511.0	2178.8	1712.2	1375.3	1015.0	820.3	649.0	544.1	366.8	213.7

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	7160.8	6366.8	4651.5	3482.3	2320.0	1741.0	1267.8	997.4	622.0	344.7
Fe510 C50	4.	5429.9	4777.7	3583.2	2754.0	1908.5	1474.3	1109.5	895.2	577.8	329.6
Fe510 C50	6.	4193.2	3662.8	2817.8	2218.6	1591.4	1260.1	974.8	803.2	531.8	308.1
Fe510 C50	8.	3540.2	3032.3	2343.6	1862.4	1360.5	1094.0	862.2	721.2	484.8	281.8
Fe510 C20	2.	5496.0	5005.0	3858.1	3000.8	2079.5	1592.2	1178.9	936.5	591.7	331.1
Fe510 C20	4.	4392.3	3933.8	3047.7	2395.6	1697.8	1326.4	1007.4	817.2	531.2	304.5
Fe510 C20	6.	3616.0	3191.5	2494.8	1985.5	1439.4	1145.8	890.1	735.2	488.4	283.6
Fe510 C20	8.	3128.2	2696.7	2101.3	1678.5	1232.3	993.3	784.3	656.7	442.1	257.2
Fe360 C50	2.	5830.6	5120.1	3643.7	2680.6	1755.8	1306.6	945.1	740.7	459.6	253.8
Fe360 C50	4.	4232.4	3674.0	2691.1	2036.7	1390.6	1066.5	798.0	641.8	412.5	234.5
Fe360 C50	6.	3132.6	2712.6	2060.0	1608.3	1144.2	902.4	695.9	572.3	378.0	218.7
Fe360 C50	8.	2492.1	2140.0	1659.3	1321.3	967.1	778.4	613.9	513.7	345.5	200.9
Fe360 C20	2.	4117.6	3737.1	2858.3	2210.3	1522.3	1161.8	857.9	680.4	429.0	239.6
Fe360 C20	4.	3180.7	2840.6	2189.1	1714.2	1210.2	943.6	715.5	579.9	376.5	215.6
Fe360 C20	6.	2499.0	2215.0	1743.1	1393.7	1015.1	809.9	630.4	521.3	346.8	201.6
Fe360 C20	8.	2089.0	1826.4	1449.6	1172.2	870.8	706.0	560.1	470.2	317.6	185.3

DESIGNATION	> HD 310 x 310 x 179 ENCASED IN CONCRETE	ARBED RECHERCHES
SECTION	> HEC-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	11910.2	10788.2	8213.9	6330.6	4344.7	3309.8	2440.3	1933.7	1196.7	642.9
Fe510 C50	4.	9846.8	8777.1	6739.8	5264.4	3707.1	2886.8	2186.7	1771.0	1128.8	620.4
Fe510 C50	6.	7783.6	6885.0	5400.6	4308.5	3130.9	2495.2	1940.4	1603.6	1047.1	582.8
Fe510 C50	8.	6344.4	5563.2	4433.3	3594.5	2677.4	2173.5	1726.2	1450.1	962.8	536.6
Fe510 C20	2.	9034.6	8326.9	6604.9	5250.7	3726.9	2890.5	2164.0	1730.3	1084.0	587.8
Fe510 C20	4.	7642.0	6943.7	5531.7	4437.5	3213.2	2538.6	1946.2	1587.4	1021.3	565.3
Fe510 C20	6.	6330.5	5690.4	4581.2	3723.1	2757.6	2219.2	1739.7	1444.5	949.2	530.7
Fe510 C20	8.	5476.2	4839.4	3897.7	3183.5	2388.8	1946.4	1550.5	1304.7	868.3	484.8
Fe360 C50	2.	9658.3	8644.4	6407.2	4844.5	3259.8	2458.4	1797.5	1417.4	871.5	465.9
Fe360 C50	4.	7763.7	6823.3	5106.8	3919.7	2712.6	2094.1	1575.1	1270.5	805.5	441.0
Fe360 C50	6.	5993.4	5231.8	4021.0	3163.8	2267.9	1795.3	1388.4	1143.9	743.8	412.7
Fe360 C50	8.	4674.3	4072.0	3216.7	2592.7	1920.0	1554.2	1231.5	1033.1	684.8	381.2
Fe360 C20	2.	6731.0	6183.9	4867.2	3846.0	2711.6	2095.4	1563.8	1248.0	779.9	422.0
Fe360 C20	4.	5581.1	5057.0	4006.5	3200.8	2307.5	1818.7	1391.6	1133.7	728.3	402.7
Fe360 C20	6.	4510.4	4054.7	3265.0	2653.8	1965.9	1582.2	1240.4	1030.0	676.8	378.4
Fe360 C20	8.	3705.3	3308.6	2704.0	2231.7	1692.6	1386.8	1109.7	936.2	625.3	350.0

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	10732.5	9722.0	7403.0	5706.2	3916.6	2983.8	2200.1	1743.4	1078.9	579.6
Fe510 C50	4.	8509.6	7620.4	5902.6	4638.8	3287.1	2567.9	1950.2	1581.9	1010.3	556.1
Fe510 C50	6.	6597.8	5881.5	4671.1	3759.0	2755.9	2206.2	1721.9	1426.1	933.9	520.8
Fe510 C50	8.	5300.1	4697.8	3799.5	3112.5	2342.5	1911.6	1524.6	1283.9	855.3	477.8
Fe510 C20	2.	8206.5	7592.7	6079.4	4869.0	3485.2	2715.6	2041.3	1636.1	1028.4	559.0
Fe510 C20	4.	6726.6	6128.3	4908.2	3953.2	2875.0	2276.7	1748.9	1428.1	920.3	510.0
Fe510 C20	6.	5456.3	4929.8	4003.3	3274.2	2441.5	1971.8	1550.4	1289.6	849.4	475.8
Fe510 C20	8.	4615.1	4114.9	3355.9	2765.5	2094.1	1714.2	1370.8	1156.1	771.7	431.8
Fe360 C50	2.	8743.3	7837.3	5828.5	4417.2	2979.4	2249.6	1646.4	1299.0	799.3	427.5
Fe360 C50	4.	6752.8	5963.9	4502.8	3476.5	2419.8	1873.4	1412.3	1140.7	724.4	397.1
Fe360 C50	6.	5106.1	4493.7	3497.0	2774.7	2005.4	1593.9	1236.7	1020.8	665.4	369.9
Fe360 C50	8.	3921.0	3453.2	2768.1	2253.5	1685.3	1370.9	1090.6	917.0	609.7	340.1
Fe360 C20	2.	6166.8	5683.6	4508.1	3583.7	2543.6	1972.7	1476.9	1180.9	739.8	401.1
Fe360 C20	4.	4937.7	4483.5	3567.0	2858.6	2067.7	1632.6	1251.1	1020.1	656.1	363.1
Fe360 C20	6.	3911.0	3532.0	2865.9	2342.6	1745.8	1409.5	1107.9	921.4	606.7	339.8
Fe360 C20	8.	3152.0	2834.2	2340.0	1945.6	1487.2	1223.4	982.4	830.5	556.2	311.9

DESIGNATION > HD 360 x 360 x 148 ENCASED IN CONCRETE
SECTION > HEC-COLUMN
BUCKLING > STRONG AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	12382.6	11162.7	8407.5	6429.3	4376.6	3320.0	2439.3	1929.0	1181.4	622.2
Fe510 C50	4.	10292.6	9104.0	6892.5	5331.4	3717.7	2880.8	2173.4	1756.2	1107.2	595.9
Fe510 C50	6.	7942.8	6984.8	5429.2	4304.3	3108.4	2469.6	1915.6	1580.8	1022.1	556.8
Fe510 C50	8.	6124.9	5385.3	4307.3	3501.2	2614.4	2125.1	1689.4	1420.0	936.1	510.9
Fe510 C20	2.	8471.5	7830.8	6256.2	5001.8	3573.1	2781.0	2088.4	1672.9	1042.7	556.5
Fe510 C20	4.	7101.7	6487.6	5224.2	4225.2	3086.9	2450.4	1886.3	1542.1	987.8	537.9
Fe510 C20	6.	5779.9	5242.4	4285.1	3521.9	2640.3	2138.4	1685.4	1403.8	919.1	505.3
Fe510 C20	8.	4727.0	4262.1	3533.0	2946.4	2259.5	1861.9	1497.2	1266.7	842.5	462.9
Fe360 C50	2.	10551.3	9360.2	6805.3	5078.0	3372.2	2526.4	1837.3	1444.4	877.7	459.6
Fe360 C50	4.	8785.6	7560.3	5457.1	4092.0	2769.8	2115.6	1577.7	1266.6	791.7	423.4
Fe360 C50	6.	6490.8	5565.0	4165.6	3222.3	2272.8	1785.1	1372.0	1126.3	723.3	392.0
Fe360 C50	8.	4895.3	4203.1	3258.4	2594.4	1898.7	1528.2	1205.3	1008.5	660.8	359.1
Fe360 C20	2.	6617.0	6078.5	4783.1	3778.8	2663.6	2058.1	1535.8	1225.6	759.9	404.0
Fe360 C20	4.	5484.4	4969.8	3938.0	3146.5	2268.6	1788.2	1368.4	1114.8	710.6	385.6
Fe360 C20	6.	4325.7	3900.3	3156.3	2574.8	1914.7	1544.2	1212.7	1007.9	658.0	361.0
Fe360 C20	8.	3446.1	3100.5	2562.0	2131.6	1630.5	1341.8	1077.7	911.2	605.5	332.5

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	11188.8	10074.6	7567.6	5776.0	3924.1	2973.8	2183.1	1725.5	1056.1	555.9
Fe510 C50	4.	9009.5	7985.1	6067.6	4705.0	3289.1	2551.9	1927.2	1558.2	983.1	529.4
Fe510 C50	6.	6599.8	5864.5	4633.6	3715.2	2713.6	2168.3	1689.7	1398.1	907.2	495.5
Fe510 C50	8.	5009.6	4463.9	3637.4	2995.6	2266.8	1855.0	1483.0	1250.5	827.9	453.3
Fe510 C20	2.	7674.4	7089.4	5654.6	4515.0	3220.6	2504.6	1879.6	1504.9	937.5	500.1
Fe510 C20	4.	6195.3	5674.1	4592.9	3729.5	2736.8	2177.7	1679.8	1375.1	882.2	481.0
Fe510 C20	6.	4885.4	4458.4	3683.2	3052.0	2308.5	1878.7	1486.8	1241.4	815.5	449.5
Fe510 C20	8.	3912.1	3558.0	2988.1	2516.8	1951.1	1617.1	1306.7	1108.8	740.4	408.1
Fe360 C50	2.	9542.7	8465.7	6155.2	4593.1	3050.3	2285.3	1662.0	1306.6	794.0	415.7
Fe360 C50	4.	7744.7	6677.9	4836.4	3634.1	2464.6	1884.2	1406.2	1129.3	706.3	377.9
Fe360 C50	6.	5415.5	4699.7	3580.4	2801.0	1996.7	1576.3	1216.4	1000.9	644.7	350.2
Fe360 C50	8.	4036.5	3517.2	2779.1	2240.5	1659.4	1343.4	1064.5	893.1	587.2	319.9
Fe360 C20	2.	6024.9	5535.0	4356.3	3442.2	2426.8	1875.3	1399.5	1116.9	692.6	368.2
Fe360 C20	4.	4824.1	4378.4	3480.2	2787.1	2014.6	1590.0	1218.1	993.0	633.5	344.0
Fe360 C20	6.	3682.1	3339.1	2728.5	2242.1	1680.5	1360.8	1072.5	893.2	584.7	321.5
Fe360 C20	8.	2887.6	2617.9	2187.8	1835.9	1417.4	1172.1	945.4	801.3	534.2	294.1

DESIGNATION	> HD 400 x 400 x 509 ENCASED IN CONCRETE	ARBED RECHERCHES
SECTION	> HEC-COLUMN	
BUCKLING	> STRONG AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	27436.8	25644.2	21063.0	17224.4	12632.1	9978.8	7592.7	6130.4	3819.1	2000.0
Fe510 C50	4.	24907.1	22940.3	18784.6	15392.3	11410.8	9130.4	7077.1	5809.7	3698.4	1964.1
Fe510 C50	6.	22014.4	19999.1	16392.3	13501.2	10144.5	8226.1	6490.2	5409.1	3502.2	1867.2
Fe510 C50	8.	19290.9	17293.5	14214.2	11780.1	8973.4	7368.4	5907.5	4989.6	3270.8	1734.7
Fe510 C20	2.	23138.5	21738.9	18095.0	14965.3	11126.0	8859.2	6789.4	5506.0	3451.7	1816.6
Fe510 C20	4.	21275.2	19694.1	16296.9	13467.2	10080.9	8109.9	6315.9	5199.6	3323.2	1770.2
Fe510 C20	6.	19161.7	17476.2	14422.6	11941.3	9024.3	7340.4	5806.8	4847.2	3145.1	1679.6
Fe510 C20	8.	17393.9	15587.8	12806.2	10609.5	8078.7	6632.5	5316.6	4490.1	2943.0	1560.7
Fe360 C50	2.	21520.4	20035.2	16292.4	13213.4	9596.1	7538.1	5707.1	4593.9	2849.7	1487.3
Fe360 C50	4.	19203.3	17626.9	14332.8	11679.7	8604.7	6861.5	5302.6	4345.3	2759.3	1462.6
Fe360 C50	6.	16682.3	15134.8	12376.8	10176.2	7631.6	6182.1	4873.3	4059.5	2626.5	1399.6
Fe360 C50	8.	14342.6	12888.6	10631.1	8833.5	6747.4	5548.5	4453.8	3764.4	2470.0	1310.9
Fe360 C20	2.	17137.2	16096.3	13389.0	11066.6	8221.6	6543.7	5012.9	4064.4	2547.1	1340.1
Fe360 C20	4.	15610.6	14464.6	11994.5	9928.7	7446.8	5997.5	4675.3	3851.3	2463.4	1313.1
Fe360 C20	6.	13925.6	12739.0	10568.9	8786.7	6670.7	5439.5	4312.3	3604.3	2342.7	1252.7
Fe360 C20	8.	12395.8	11189.4	9291.0	7758.4	5957.8	4912.9	3953.0	3345.8	2199.4	1169.0

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	5.0cm	10.0cm	20.0cm	30.0cm	45.0cm	60.0cm	100.0cm	180.0cm
Fe510 C50	2.	26170.6	24494.3	20189.4	16558.8	12186.9	9646.7	7353.5	5943.9	3708.8	1944.7
Fe510 C50	4.	23181.3	21403.2	17615.4	14493.2	10794.3	8659.3	6727.1	5529.8	3526.8	1875.7
Fe510 C50	6.	19902.0	18180.0	15044.8	12483.1	9456.1	7701.6	6099.3	5094.6	3308.6	1768.1
Fe510 C50	8.	17198.4	15535.3	12912.9	10791.2	8293.6	6842.2	5507.4	4662.4	3065.9	1629.9
Fe510 C20	2.	22266.1	20981.9	17602.0	14656.1	10987.3	8792.0	6768.4	5504.4	3464.7	1829.2
Fe510 C20	4.	19970.1	18556.2	15479.7	12876.6	9713.4	7848.5	6136.0	5063.3	3246.7	1733.9
Fe510 C20	6.	17597.4	16136.6	13444.7	11214.9	8546.2	6983.2	5546.0	4640.3	3020.6	1617.0
Fe510 C20	8.	15724.5	14195.4	11788.7	9845.1	7561.0	6235.4	5017.3	4246.7	2791.8	1483.9
Fe360 C50	2.	20740.7	19348.9	15816.1	12882.0	9402.6	7407.3	5622.3	4532.7	2817.8	1473.2
Fe360 C50	4.	17980.9	16548.2	13528.4	11071.2	8195.5	6552.3	5075.2	4164.6	2649.6	1406.5
Fe360 C50	6.	15218.6	13870.6	11433.6	9458.0	7140.5	5805.0	4590.0	3830.4	2484.4	1326.4
Fe360 C50	8.	12848.3	11623.2	9682.7	8105.4	6240.9	5153.7	4151.7	3516.4	2313.9	1230.7
Fe360 C20	2.	16791.1	15796.5	13194.4	10944.9	8167.0	6517.1	5004.4	4063.4	2551.8	1344.9
Fe360 C20	4.	14838.6	13793.5	11516.6	9586.7	7237.8	5850.9	4576.3	3777.2	2422.9	1294.3
Fe360 C20	6.	12876.9	11839.4	9911.3	8298.8	6351.1	5201.9	4139.8	3468.0	2261.3	1212.2
Fe360 C20	8.	11242.5	10222.2	8581.2	7225.6	5599.4	4640.0	3748.9	3180.8	2098.1	1118.0

DESIGNATION	> HD 210 X 210 X 71 ENCASED IN CONCRETE
SECTION	> HEC-COLUMN
BUCKLING	> WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	4118.1	3212.8	2596.9	1964.5	1577.5	1316.6	987.6	773.4	630.3	528.1
Fe510 C50	4.	2239.9	1742.0	1482.1	1198.8	1014.4	884.0	710.1	586.5	499.4	434.2
Fe510 C50	6.	1268.9	1025.7	914.5	781.6	687.7	617.4	518.0	441.5	385.1	341.5
Fe510 C50	8.	787.2	661.3	609.0	541.6	490.5	450.2	390.2	340.4	302.3	271.8
Fe510 C20	2.	2973.1	2361.0	1932.1	1480.6	1198.6	1005.9	759.8	597.6	488.4	410.0
Fe510 C20	4.	1680.3	1324.0	1133.8	923.4	784.7	685.8	552.9	457.8	390.3	339.7
Fe510 C20	6.	1004.1	812.3	724.4	619.4	545.1	489.5	410.8	350.2	305.5	270.9
Fe510 C20	8.	635.8	533.4	490.9	436.3	394.9	362.4	313.9	273.8	243.0	218.5
Fe360 C50	2.	3475.9	2684.4	2155.0	1618.7	1294.2	1077.0	804.9	628.9	511.8	428.3
Fe360 C50	4.	1867.5	1440.4	1220.5	983.1	829.8	721.8	578.5	477.2	406.0	352.7
Fe360 C50	6.	1077.6	857.9	760.0	644.9	564.8	505.4	422.2	358.9	312.4	276.7
Fe360 C50	8.	696.3	569.7	519.5	456.6	410.1	374.1	321.5	278.9	246.7	221.2
Fe360 C20	2.	2261.2	1799.9	1475.3	1132.5	917.8	770.8	582.8	458.6	375.0	314.9
Fe360 C20	4.	1298.2	1022.1	875.0	712.3	605.2	528.8	426.3	352.9	300.9	261.8
Fe360 C20	6.	790.3	636.7	566.9	483.7	425.2	381.4	319.7	272.3	237.4	210.5
Fe360 C20	8.	531.6	437.2	399.4	351.8	316.5	289.1	248.8	216.1	191.2	171.6

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	3314.1	2585.3	2089.5	1580.6	1269.2	1059.2	794.5	622.2	507.0	424.8
Fe510 C50	4.	1775.4	1391.5	1188.5	965.3	818.9	714.8	575.4	476.0	405.6	352.9
Fe510 C50	6.	1028.8	833.3	743.6	636.1	560.1	503.1	422.3	360.1	314.2	278.7
Fe510 C50	8.	650.2	545.2	501.8	445.9	403.6	370.3	320.7	279.7	248.2	223.2
Fe510 C20	2.	2431.9	1925.2	1572.0	1201.8	971.4	814.4	614.4	482.8	394.4	331.0
Fe510 C20	4.	1356.9	1074.6	922.6	753.4	641.4	561.2	453.1	375.5	320.4	279.0
Fe510 C20	6.	831.5	671.5	598.4	511.2	449.7	403.6	338.5	288.5	251.6	223.1
Fe510 C20	8.	537.3	447.6	410.9	364.0	328.8	301.2	260.3	226.7	201.0	180.6
Fe360 C50	2.	2783.9	2148.3	1723.6	1293.9	1034.2	860.4	642.8	502.2	408.6	341.9
Fe360 C50	4.	1475.3	1144.9	973.1	786.2	664.9	579.1	464.9	383.9	326.8	284.1
Fe360 C50	6.	861.0	689.5	612.3	521.0	457.2	409.6	342.7	291.6	254.1	225.1
Fe360 C50	8.	565.0	463.8	423.4	372.6	335.0	305.8	263.1	228.4	202.1	181.2
Fe360 C20	2.	1837.9	1457.8	1191.9	912.6	738.3	619.4	467.6	367.7	300.5	252.2
Fe360 C20	4.	1044.9	825.6	708.1	577.5	491.3	429.6	346.7	287.2	245.0	213.3
Fe360 C20	6.	640.6	518.1	462.1	395.0	347.7	312.1	261.9	223.3	194.8	172.7
Fe360 C20	8.	431.8	357.2	327.0	288.7	260.2	237.9	205.2	178.3	158.0	141.8

DESIGNATION	> HD 260 X 260 X 131 ENCASED IN CONCRETE
SECTION	> HEC-COLUMN
BUCKLING	> WEAK AXIS

ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	7741.1	6304.8	5254.3	4106.4	3366.1	2849.6	2177.1	1720.1	1409.0	1183.8
Fe510 C50	4.	4856.4	3854.7	3313.4	2709.1	2308.1	2020.5	1632.6	1350.1	1149.4	998.4
Fe510 C50	6.	2980.3	2418.9	2160.3	1849.9	1629.9	1464.5	1230.3	1046.8	911.3	806.2
Fe510 C50	8.	1955.7	1630.0	1496.6	1326.1	1197.9	1097.5	948.7	824.0	728.8	653.1
Fe510 C20	2.	5819.5	4809.6	4052.1	3205.5	2648.6	2254.8	1735.4	1377.5	1132.0	953.3
Fe510 C20	4.	3700.6	2986.0	2588.8	2136.3	1830.9	1609.3	1307.2	1084.6	925.4	805.2
Fe510 C20	6.	2398.9	1952.6	1746.0	1497.2	1320.4	1187.2	998.1	849.8	740.1	654.9
Fe510 C20	8.	1598.4	1334.3	1225.8	1086.9	982.4	900.3	778.7	676.6	598.6	536.5
Fe360 C50	2.	6353.8	5136.9	4257.9	3308.2	2701.5	2280.9	1736.5	1369.0	1119.8	939.8
Fe360 C50	4.	3968.8	3123.6	2673.4	2175.9	1848.5	1615.0	1301.6	1074.8	914.0	793.3
Fe360 C50	6.	2410.7	1948.4	1737.0	1484.5	1306.2	1172.5	983.7	836.4	727.7	643.5
Fe360 C50	8.	1610.0	1331.7	1219.2	1076.6	970.2	887.3	765.1	663.5	586.2	524.8
Fe360 C20	2.	4320.9	3582.4	3025.4	2399.8	1986.4	1693.2	1305.4	1037.3	853.1	718.8
Fe360 C20	4.	2836.5	2276.2	1967.6	1618.6	1384.3	1215.1	985.2	816.5	696.1	605.3
Fe360 C20	6.	1786.9	1464.6	1313.5	1130.2	999.0	899.8	758.2	646.4	563.5	499.0
Fe360 C20	8.	1243.1	1033.7	948.3	839.4	757.7	693.8	599.3	520.3	460.0	412.1

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	6630.9	5393.2	4490.0	3505.2	2871.2	2429.4	1854.8	1464.8	1199.6	1007.7
Fe510 C50	4.	4025.2	3220.5	2779.6	2282.7	1950.2	1710.5	1385.6	1147.6	978.0	850.2
Fe510 C50	6.	2457.7	2011.7	1803.2	1550.5	1369.9	1233.4	1038.8	885.4	771.7	683.3
Fe510 C50	8.	1641.5	1371.4	1260.2	1117.9	1010.6	926.4	801.4	696.5	616.3	552.4
Fe510 C20	2.	5033.9	4149.1	3488.5	2753.4	2271.6	1931.8	1484.7	1177.4	967.0	814.0
Fe510 C20	4.	3116.2	2527.3	2197.0	1818.3	1561.3	1374.2	1118.2	928.8	793.0	690.3
Fe510 C20	6.	2016.3	1649.8	1478.6	1271.2	1123.0	1011.0	851.5	725.7	632.4	560.0
Fe510 C20	8.	1392.0	1153.9	1057.3	934.5	842.8	771.1	665.3	577.3	510.2	456.9
Fe360 C50	2.	5489.0	4414.8	3645.7	2821.0	2297.7	1936.5	1470.8	1157.8	946.1	793.5
Fe360 C50	4.	3286.9	2602.8	2234.7	1824.8	1553.4	1359.1	1097.4	907.1	772.0	670.5
Fe360 C50	6.	1967.4	1605.6	1437.3	1234.1	1089.3	980.1	824.7	702.5	612.0	541.7
Fe360 C50	8.	1325.2	1104.3	1013.9	898.3	811.5	743.4	642.6	558.1	493.7	442.4
Fe360 C20	2.	3728.6	3080.6	2594.8	2052.1	1695.3	1443.0	1110.5	881.4	724.2	609.9
Fe360 C20	4.	2389.2	1922.5	1664.3	1371.2	1174.0	1031.2	836.8	693.9	591.8	514.8
Fe360 C20	6.	1482.7	1224.0	1101.2	951.0	842.7	760.3	642.2	548.3	478.5	424.1
Fe360 C20	8.	1035.7	867.1	797.5	708.1	640.6	587.5	508.6	442.2	391.4	350.9

DESIGNATION > HD 310 X 310 X 179 ENCASED IN CONCRETE SECTION > HEC-COLUMN BUCKLING > WEAK AXIS	ARBED RECHERCHES

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	11425.9	9561.8	8132.9	6503.7	5412.7	4631.8	3589.6	2852.3	2342.8	1970.1
Fe510 C50	4.	7849.4	6330.3	5486.6	4526.1	3878.1	3408.4	2768.1	2288.8	1945.8	1686.5
Fe510 C50	6.	4976.5	4083.2	3663.9	3154.4	2789.2	2512.7	2118.0	1800.1	1563.9	1380.0
Fe510 C50	8.	3355.9	2810.4	2585.0	2295.5	2076.9	1904.9	1649.3	1429.3	1260.8	1126.2
Fe510 C20	2.	8454.7	7191.8	6195.6	5028.4	4227.4	3644.1	2852.3	2281.0	1882.0	1587.9
Fe510 C20	4.	5875.0	4823.1	4220.6	3518.8	3035.8	2681.0	2191.2	1819.0	1550.7	1346.7
Fe510 C20	6.	3866.8	3205.9	2890.0	2501.4	2219.8	2005.0	1696.0	1444.7	1257.2	1110.6
Fe510 C20	8.	2727.3	2281.7	2097.9	1862.0	1684.2	1544.3	1336.6	1158.1	1021.3	912.2
Fe360 C50	2.	9301.8	7752.4	6573.2	5237.6	4348.5	3714.7	2872.1	2278.8	1869.9	1571.2
Fe360 C50	4.	6427.8	5141.1	4436.7	3642.9	3112.0	2729.3	2210.6	1824.7	1549.5	1341.9
Fe360 C50	6.	4043.6	3298.7	2952.5	2534.6	2236.9	2012.4	1693.1	1437.3	1247.7	1100.3
Fe360 C50	8.	2705.4	2262.4	2079.8	1845.7	1669.2	1530.4	1324.4	1147.4	1011.8	903.7
Fe360 C20	2.	6364.0	5412.2	4661.8	3782.8	3179.8	2740.8	2145.0	1715.2	1415.1	1193.9
Fe360 C20	4.	4521.6	3687.6	3215.3	2669.9	2297.4	2025.1	1651.1	1368.6	1165.4	1011.4
Fe360 C20	6.	2921.1	2422.8	2184.3	1891.0	1678.4	1516.1	1282.6	1092.7	950.9	840.1
Fe360 C20	8.	2013.2	1703.5	1573.2	1403.8	1274.6	1172.1	1018.5	884.9	781.9	699.3

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	10204.6	8494.3	7195.4	5727.1	4751.5	4056.8	3134.5	2485.9	2039.1	1713.1
Fe510 C50	4.	6605.9	5369.4	4673.3	3873.0	3328.3	2931.2	2387.0	1977.1	1682.8	1459.8
Fe510 C50	6.	4086.2	3397.5	3066.5	2658.2	2361.4	2134.4	1807.3	1540.6	1341.2	1185.2
Fe510 C50	8.	2761.8	2340.1	2162.2	1930.7	1753.8	1613.3	1402.6	1219.0	1077.3	963.8
Fe510 C20	2.	7532.5	6382.6	5481.7	4433.1	3717.7	3199.0	2497.8	1994.3	1643.6	1385.6
Fe510 C20	4.	5038.0	4150.9	3639.6	3041.1	2627.5	2322.8	1901.1	1579.6	1347.3	1170.7
Fe510 C20	6.	3213.1	2695.3	2442.6	2127.4	1896.0	1717.9	1459.4	1246.6	1086.9	961.6
Fe510 C20	8.	2268.3	1917.4	1770.0	1578.7	1432.9	1317.3	1144.3	993.9	878.0	785.3
Fe360 C50	2.	8336.6	6897.8	5816.4	4605.7	3808.0	3243.3	2497.7	1976.8	1619.2	1358.8
Fe360 C50	4.	5425.2	4363.3	3776.3	3110.4	2662.3	2338.2	1897.2	1567.8	1332.4	1154.5
Fe360 C50	6.	3304.5	2731.3	2458.7	2124.7	1883.5	1699.8	1436.4	1222.7	1063.5	939.1
Fe360 C50	8.	2215.4	1874.0	1730.4	1543.9	1401.6	1288.8	1119.8	972.8	859.5	768.8
Fe360 C20	2.	5665.2	4795.8	4115.9	3325.6	2787.4	2397.4	1870.8	1493.1	1230.3	1036.9
Fe360 C20	4.	3870.6	3164.7	2763.2	2298.0	1979.4	1746.1	1424.9	1181.8	1006.8	873.9
Fe360 C20	6.	2423.9	2029.9	1838.1	1599.4	1424.6	1290.1	1095.3	935.2	815.1	721.0
Fe360 C20	8.	1671.5	1427.0	1322.5	1185.3	1079.6	995.2	867.7	755.5	668.7	598.8

DESIGNATION	> HD 360 X 360 X 148 ENCASED IN CONCRETE	ARBED RECHERCHES
SECTION	> HEC-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	12093.3	10312.9	8902.3	7242.3	6098.7	5263.6	4126.7	3290.0	2704.7	2272.7
Fe510 C50	4.	8962.9	7287.4	6343.7	5258.2	4519.2	3980.4	3241.7	2674.1	2266.2	1956.8
Fe510 C50	6.	5737.0	4738.5	4264.3	3683.7	3264.7	2945.9	2488.6	2109.4	1826.5	1605.4
Fe510 C50	8.	3815.8	3228.6	2981.6	2660.6	2415.7	2221.4	1930.3	1670.0	1469.2	1308.0
Fe510 C20	2.	8176.5	7088.3	6200.5	5125.3	4364.5	3798.2	3012.1	2419.6	1999.8	1687.1
Fe510 C20	4.	5890.9	4941.8	4377.0	3699.5	3221.1	2863.3	2360.8	1962.6	1672.2	1449.7
Fe510 C20	6.	3962.5	3347.2	3043.1	2660.6	2377.6	2158.4	1838.6	1566.8	1361.8	1200.3
Fe510 C20	8.	2760.4	2366.1	2196.3	1972.5	1799.2	1660.3	1449.9	1258.6	1109.9	990.0
Fe360 C50	2.	10291.4	8733.8	7510.1	6082.1	5105.7	4396.5	3436.1	2733.9	2244.3	1883.8
Fe360 C50	4.	8309.9	6508.6	5557.0	4511.3	3826.3	3339.4	2687.6	2200.8	1855.8	1596.7
Fe360 C50	6.	4866.6	3980.4	3566.6	3065.7	2707.9	2437.5	2052.5	1736.1	1501.1	1318.0
Fe360 C50	8.	3209.9	2693.4	2479.3	2203.6	1995.1	1830.7	1586.1	1369.5	1203.1	1070.0
Fe360 C20	2.	6411.8	5545.4	4841.5	3992.6	3394.3	2950.2	2335.6	1874.0	1547.6	1304.8
Fe360 C20	4.	4663.5	3889.3	3433.4	2890.9	2510.6	2227.6	1832.0	1520.6	1294.1	1121.0
Fe360 C20	6.	3118.3	2621.2	2377.7	2073.2	1849.2	1676.4	1425.3	1213.1	1053.5	927.9
Fe360 C20	8.	2152.5	1844.6	1712.1	1537.4	1402.2	1293.8	1129.8	980.7	864.8	771.3

FIRE CLASS F120

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	10877.1	9197.5	7886.4	6365.6	5331.5	4583.2	3573.9	2839.4	2328.5	1953.0
Fe510 C50	4.	7339.0	6037.2	5288.9	4414.9	3812.0	3368.4	2755.2	2278.8	1934.8	1673.0
Fe510 C50	6.	4580.1	3846.6	3487.8	3039.6	2710.3	2456.5	2087.7	1776.5	1542.5	1358.5
Fe510 C50	8.	3037.8	2611.8	2427.3	2183.3	1993.7	1841.4	1610.1	1398.8	1234.3	1101.4
Fe510 C20	2.	7344.7	6318.2	5492.1	4505.4	3816.0	3307.6	2608.5	2087.7	1721.0	1449.0
Fe510 C20	4.	4965.0	4177.8	3706.8	3139.4	2737.1	2435.5	2010.7	1673.0	1426.4	1237.1
Fe510 C20	6.	3207.6	2740.5	2504.9	2204.2	1978.8	1802.5	1542.6	1318.7	1148.7	1014.1
Fe510 C20	8.	2204.8	1916.5	1789.2	1618.5	1484.2	1375.3	1208.2	1053.0	931.3	832.5
Fe360 C50	2.	9279.8	7798.4	6654.5	5341.3	4456.5	3820.5	2968.1	2352.4	1925.9	1613.3
Fe360 C50	4.	7031.7	5512.4	4708.6	3824.3	3244.6	2832.3	2280.1	1867.3	1574.8	1355.0
Fe360 C50	6.	3861.6	3218.3	2907.9	2523.8	2243.9	2029.5	1719.9	1460.8	1266.7	1114.5
Fe360 C50	8.	2559.2	2180.8	2019.6	1808.4	1646.0	1516.5	1321.3	1145.2	1008.7	899.0
Fe360 C20	2.	5783.0	4953.3	4290.7	3505.2	2960.3	2560.3	2013.2	1608.1	1323.8	1113.5
Fe360 C20	4.	3941.6	3291.1	2907.2	2449.7	2128.5	1889.3	1554.6	1290.7	1098.7	951.9
Fe360 C20	6.	2512.4	2140.2	1953.5	1716.1	1538.7	1400.4	1197.0	1022.4	890.1	785.5
Fe360 C20	8.	1744.7	1509.4	1406.4	1269.1	1161.7	1074.9	942.3	820.2	724.6	647.3

DESIGNATION	> HD 400 X 400 X 509 + 4 D 12 ENCASED	ARBED RECHERCHES
SECTION	> HEC-COLUMN	
BUCKLING	> WEAK AXIS	

FIRE CLASS F90

MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	26889.4	24030.5	21565.7	18406.4	16045.4	14215.0	11563.5	9394.5	7812.0	6607.6
Fe510 C50	4.	22747.2	19346.3	17272.1	14735.0	12911.2	11530.3	9566.4	7937.6	6739.2	5814.6
Fe510 C50	6.	17314.2	14474.9	13097.4	11386.3	10135.3	9174.5	7784.0	6576.8	5669.5	4956.3
Fe510 C50	8.	12925.9	10826.4	9958.7	8844.1	8002.3	7339.8	6355.1	5452.3	4757.9	4201.7
Fe510 C20	2.	22465.9	20225.6	18267.8	15721.7	13791.4	12278.3	10060.2	8214.2	6855.9	5815.3
Fe510 C20	4.	19053.0	16328.3	14643.6	12559.7	11046.1	9891.8	8237.8	6852.0	5827.6	5034.5
Fe510 C20	6.	14564.6	12281.4	11156.6	9744.6	8702.2	7896.1	6721.4	5691.1	4913.4	4300.2
Fe510 C20	8.	11242.0	9417.7	8663.6	7694.5	6962.6	6386.4	5530.0	4744.6	4140.4	3656.5
Fe360 C50	2.	21192.7	18940.5	16998.6	14509.3	12648.7	11206.2	9116.4	7406.7	6159.2	5209.7
Fe360 C50	4.	17856.1	15227.0	13615.9	11637.4	10210.1	9126.7	7582.0	6296.4	5348.9	4617.1
Fe360 C50	6.	13841.1	11549.3	10441.2	9067.8	8065.9	7297.5	6187.1	5225.2	4502.9	3935.5
Fe360 C50	8.	10268.9	8617.5	7932.8	7051.2	6384.2	5858.4	5075.9	4356.7	3803.0	3359.3
Fe360 C20	2.	16617.7	15003.4	13585.2	11730.2	10315.8	9202.2	7561.9	6187.0	5171.8	4392.0
Fe360 C20	4.	14332.7	12321.6	11071.1	9516.9	8383.3	7515.9	6269.3	5220.2	4443.0	3840.6
Fe360 C20	6.	11153.9	9409.1	8549.0	7468.6	6670.7	6053.4	5153.6	4364.1	3768.0	3297.9
Fe360 C20	8.	8430.9	7139.0	6594.7	5886.9	5346.3	4917.3	4274.2	3676.5	3214.2	2842.4

FIRE CLASS F120

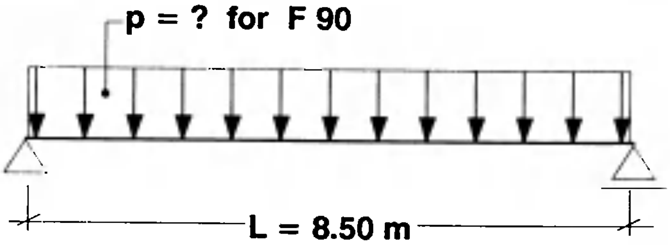
MATERIAL COMBINATION	LENGTH [m]	ULTIMATE LOADS [kN] FOR AN ECCENTRICITY OF : 0.0cm	1.0cm	2.5cm	5.0cm	7.5cm	10.0cm	15.0cm	20.0cm	25.0cm	30.0cm
Fe510 C50	2.	25430.6	22732.3	20404.9	17420.3	15188.9	13458.3	10950.5	8897.8	7399.9	6259.6
Fe510 C50	4.	20837.5	17762.4	15879.3	13568.2	11901.8	10637.4	8835.2	7336.2	6231.7	5378.8
Fe510 C50	6.	15313.6	12911.0	11727.8	10242.6	9146.4	8298.8	7063.7	5980.8	5163.3	4518.8
Fe510 C50	8.	11245.1	9531.3	8808.1	7866.5	7146.6	6574.8	5717.0	4918.8	4301.0	3804.0
Fe510 C20	2.	21291.7	19195.1	17358.1	14962.5	13141.4	11710.7	9608.7	7853.3	6559.4	5567.0
Fe510 C20	4.	17672.5	15167.4	13614.3	11689.0	10287.9	9217.7	7682.1	6393.0	5439.0	4700.1
Fe510 C20	6.	13068.9	11101.9	10120.0	8875.8	7949.5	7228.6	6171.5	5235.8	4526.6	3965.7
Fe510 C20	8.	9931.3	8409.8	7768.8	6935.1	6298.4	5793.0	5035.4	4331.4	3786.7	3348.7
Fe360 C50	2.	20156.5	18004.7	16151.2	13777.7	12005.6	10632.6	8645.4	7021.5	5837.4	4936.6
Fe360 C50	4.	16421.5	14015.2	12538.3	10722.6	9411.3	8415.1	6993.6	5809.3	4936.0	4261.3
Fe360 C50	6.	12337.5	10341.8	9369.1	8156.7	7267.7	6583.6	5591.3	4727.2	4076.9	3565.3
Fe360 C50	8.	8930.5	7566.8	6991.6	6243.1	5671.1	5216.8	4535.6	3902.0	3411.6	3017.3
Fe360 C20	2.	15901.0	14370.5	13023.5	11258.1	9909.4	8845.8	7276.5	5957.8	4982.9	4233.3
Fe360 C20	4.	13377.1	11504.4	10339.2	8890.2	7832.7	7023.3	5859.5	4879.6	4153.5	3590.6
Fe360 C20	6.	10120.3	8564.3	7792.9	6820.1	6099.1	5539.8	4722.3	4002.2	3457.6	3027.5
Fe360 C20	8.	7466.5	6372.0	5904.4	5290.9	4818.4	4441.0	3871.7	3336.9	2921.4	2586.3

PART II

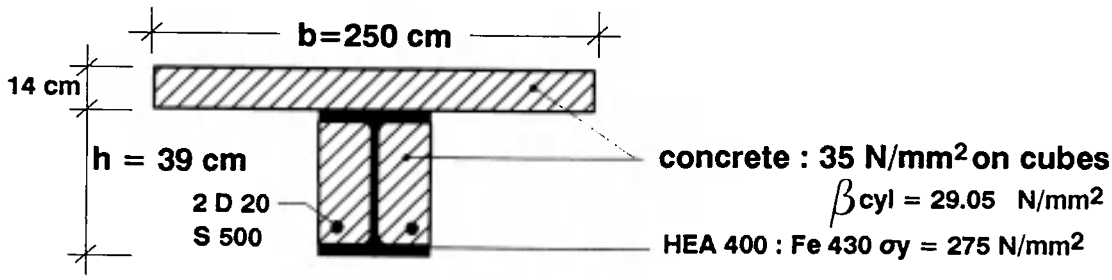
APPENDIX B. TABLES OF THE ULTIMATE BENDING MOMENTS OF BEAMS

PART II: APPENDIX B. TABLES OF THE ULTIMATE BENDING MOMENTS OF BEAMS

TABLES FOR BEAMS - EXAMPLE OF USE



Cross section and material qualities



AF-BEAM HE 400 A + 2 D 20
SUCCESSIVE INTERPOLATIONS

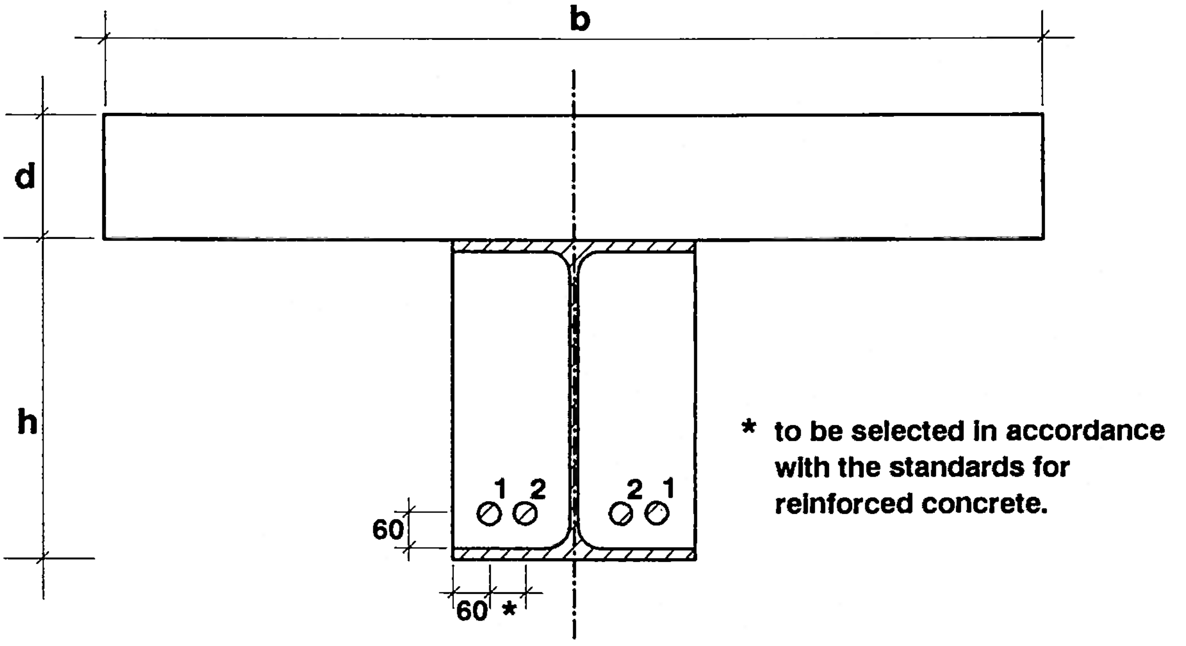
FROM TABLES

MATERIALS STEEL Fe	CONCRETE C	SLAB THICKNESS [cm]	M_{ult} F 90 for an effective width of 5 h = 195 cm	7.5 h = 292.5 cm	250 cm
360	**20**	**12.0**	**54085.0**	**59919.0**	
360	**20**	**16.0**	**64215.0**	**71010.0**	
360	20	14.0	59150.0	65464.5	62712.03
360	**50**	**12.0**	**65688.0**	**69972.0**	
360	**50**	**16.0**	**79098.0**	**82325.0**	
360	50	14.0	72393.0	76148.5	74511.49
510	**20**	**12.0**	**64207.0**	**75679.0**	
510	**20**	**16.0**	**79654.0**	**90229.0**	
510	20	14.0	71930.5	82954.0	78148.88
510	**50**	**12.0**	**84974.0**	**90545.0**	
510	**50**	**16.0**	**101635.0**	**110739.0**	
510	50	14.0	93304.5	100642.0	97443.6
360	50	14.0			74511.49
360	20	14.0			62712.03
360	29.05	14.0			66271.53
510	50	14.0			97443.6
510	20	14.0			78148.88
510	29.05	14.0			83969.45
510	29.05	14.0			83969.45
360	29.05	14.0			66271.53
430	29.05	14.0			72170.84

$$72170.84 = \frac{p\,L^2}{8}$$

$$\longrightarrow \text{F 90 : } p = \frac{8 \times 72170.84}{850^2} \begin{array}{l} = 0.8 \text{ kN/cm} \\ = 80 \text{ kN/m} \end{array}$$

TYPICAL AF-BEAM CROSS SECTION



LAYOUT 1 WHEN 2 REINFORCING BARS
LAYOUT 1+2 WHEN 4 REINFORCING BARS

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > HE 400 A + 2 D 20 | h = 39cm

TYPE > AF-BEAM

ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	F60 0h	F60 5h	F60 7.5h	F60 10h	F90 0h	F90 5h	F90 7.5h	F90 10h	F120 0h	F120 5h	F120 7.5h	F120 10h
Fe360 C20	12	442	662	726	769	332	541	599	631	267	463	517	551
Fe360 C20	16	442	768	850	901	332	642	710	756	267	561	628	673
Fe360 C20	20	442	891	978	1034	332	750	840	870	267	662	755	796
Fe360 C50	12	443	794	843	856	332	657	700	709	266	578	607	616
Fe360 C50	16	443	924	980	1012	332	791	823	849	266	704	720	733
Fe360 C50	20	443	1082	1120	1118	332	931	914	979	266	818	843	844
Fe510 C20	12	601	774	920	990	449	642	757	812	363	550	651	701
Fe510 C20	16	601	937	1066	1163	449	797	902	966	363	692	787	848
Fe510 C20	20	601	1081	1241	1343	449	928	1056	1135	363	813	931	1018
Fe510 C50	12	602	1039	1101	1143	449	850	905	957	363	739	804	849
Fe510 C50	16	602	1219	1298	1344	449	1016	1107	1135	363	903	1003	1018
Fe510 C50	20	602	1411	1511	1539	449	1190	1300	1318	363	1074	1169	1185

Fire Resistance Classes

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > HE 500 A + 4 D 20 | h = 49cm

TYPE > AF-BEAM

ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	Fire Resistance Classes F60 0h	F60 5h	F60 7.5h	F60 10h	F90 0h	F90 5h	F90 7.5h	F90 10h	F120 0h	F120 5h	F120 7.5h	F120 10h
Fe360 C20	12	830	1139	1238	1297	680	965	1051	1099	548	818	894	936
Fe360 C20	16	830	1285	1400	1472	680	1102	1208	1265	548	947	1039	1095
Fe360 C20	20	830	1448	1576	1661	680	1244	1369	1441	548	1079	1191	1260
Fe360 C20	24	830	1617	1762	1853	680	1400	1539	1621	548	1222	1354	1423
Fe360 C50	12	830	1339	1429	1459	680	1135	1195	1220	546	971	1017	1033
Fe360 C50	16	830	1529	1618	1652	680	1310	1383	1397	546	1138	1177	1188
Fe360 C50	20	830	1731	1831	1847	680	1500	1562	1576	546	1291	1330	1345
Fe360 C50	24	830	1927	2030	2046	680	1684	1744	1759	546	1446	1488	1509
Fe510 C20	12	1109	1329	1552	1649	877	1122	1310	1383	714	951	1114	1181
Fe510 C20	16	1109	1553	1749	1874	877	1344	1496	1593	714	1164	1292	1376
Fe510 C20	20	1109	1743	1974	2114	877	1514	1703	1813	714	1317	1475	1578
Fe510 C20	24	1109	1955	2213	2366	877	1704	1922	2040	714	1487	1671	1793
Fe510 C50	12	1110	1716	1810	1891	877	1431	1509	1568	712	1226	1301	1345
Fe510 C50	16	1110	1953	2066	2148	877	1648	1764	1820	712	1430	1541	1591
Fe510 C50	20	1110	2202	2352	2436	877	1877	2024	2091	712	1641	1759	1818
Fe510 C50	24	1110	2458	2628	2714	877	2121	2278	2346	712	1874	1982	2042

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > HE 650 A + 4 D 25 | h = 64cm

TYPE > AF-BEAM

ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	F60 0h	F60 5h	F60 7.5h	F60 10h	F90 0h	F90 5h	F90 7.5h	F90 10h	F120 0h	F120 5h	F120 7.5h	F120 10h
Fe360 C20	12	1499	2041	2203	2301	1282	1768	1873	1946	1049	1495	1586	1649
Fe360 C20	16	1499	2246	2421	2532	1282	1956	2080	2166	1049	1672	1778	1858
Fe360 C20	20	1499	2449	2654	2790	1282	2149	2296	2405	1049	1847	1977	2067
Fe360 C20	24	1499	2679	2899	3053	1282	2358	2523	2645	1049	2034	2189	2284
Fe360 C50	12	1485	2381	2478	2527	1293	1998	2068	2095	1065	1695	1744	1762
Fe360 C50	16	1485	2641	2742	2782	1293	2230	2318	2336	1065	1915	1960	1976
Fe360 C50	20	1485	2879	3021	3042	1293	2487	2555	2576	1065	2118	2166	2185
Fe360 C50	24	1485	3164	3283	3306	1293	2730	2796	2818	1065	2325	2373	2401
Fe510 C20	12	2009	2436	2755	2882	1678	2074	2336	2421	1391	1761	1994	2077
Fe510 C20	16	2009	2734	3015	3182	1678	2387	2592	2705	1391	2061	2237	2335
Fe510 C20	20	2009	2993	3314	3498	1678	2614	2869	2992	1391	2263	2479	2596
Fe510 C20	24	2009	3251	3630	3828	1678	2857	3158	3291	1391	2488	2736	2876
Fe510 C50	12	2004	2968	3136	3222	1677	2490	2613	2670	1386	2134	2233	2274
Fe510 C50	16	2004	3281	3468	3554	1677	2776	2940	3005	1386	2403	2521	2570
Fe510 C50	20	2004	3609	3858	3944	1677	3086	3267	3341	1386	2682	2819	2875
Fe510 C50	24	2004	3954	4217	4302	1677	3410	3609	3682	1386	2983	3119	3180

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > HE 800 A + 4 D 25 | h = 79cm

TYPE > AF-BEAM

ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	F60 0h	F60 3.8h	F60 5.7h	F60 7.6h	F90 0h	F90 3.8h	F90 5.7h	F90 7.6h	F120 0h	F120 3.8h	F120 5.7h	F120 7.6h
Fe360 C20	12	2165	2769	3048	3175	1846	2402	2599	2692	1547	2047	2246	2333
Fe360 C20	16	2165	3060	3276	3425	1846	2680	2826	2934	1547	2320	2461	2566
Fe360 C20	20	2165	3272	3543	3706	1846	2884	3075	3200	1547	2506	2679	2815
Fe360 C20	24	2165	3519	3819	4020	1846	3115	3327	3479	1547	2718	2923	3071
Fe360 C50	12	2107	3282	3434	3486	1869	2767	2866	2904	1573	2394	2465	2495
Fe360 C50	16	2107	3558	3741	3796	1869	3022	3149	3194	1573	2643	2724	2755
Fe360 C50	20	2107	3870	4038	4096	1869	3308	3447	3476	1573	2910	2987	3010
Fe360 C50	24	2107	4177	4368	4400	1869	3623	3728	3759	1573	3154	3233	3231
Fe510 C20	12	2909	3491	3753	4027	2479	2986	3243	3418	2100	2561	2801	2974
Fe510 C20	16	2909	3726	4158	4354	2479	3266	3596	3732	2100	2865	3145	3273
Fe510 C20	20	2909	4051	4456	4723	2479	3585	3895	4077	2100	3161	3417	3572
Fe510 C20	24	2909	4348	4809	5103	2479	3848	4235	4418	2100	3396	3714	3892
Fe510 C50	12	2905	4142	4379	4497	2481	3503	3667	3754	2114	3058	3207	3268
Fe510 C50	16	2905	4492	4745	4918	2481	3837	4032	4127	2114	3367	3540	3611
Fe510 C50	20	2905	4872	5175	5319	2481	4182	4428	4514	2114	3688	3895	3978
Fe510 C50	24	2905	5270	5634	5773	2481	4545	4811	4929	2114	4016	4243	4340

Fire Resistance Classes

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > HE 1000 A + 4 D 25 | h = 99cm

TYPE > AF-BEAM

ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	Fire Resistance Classes F60 0h	F60 3h	F60 4.6h	F60 6.1h	F90 0h	F90 3h	F90 4.6h	F90 6.1h	F120 0h	F120 3h	F120 4.6h	F120 6.1h
Fe360 C20	12	3233	4099	4409	4670	2769	3564	3817	3986	2338	3082	3327	3483
Fe360 C20	16	3233	4377	4729	4924	2769	3872	4101	4255	2338	3402	3605	3746
Fe360 C20	20	3233	4686	5013	5249	2769	4145	4379	4559	2338	3645	3859	4017
Fe360 C20	24	3233	4942	5345	5601	2769	4396	4681	4881	2338	3874	4135	4335
Fe360 C50	12	3151	4825	5000	5071	2807	4090	4220	4273	2401	3564	3659	3701
Fe360 C50	16	3151	5099	5362	5439	2807	4386	4555	4617	2401	3857	3970	4015
Fe360 C50	20	3151	5437	5738	5820	2807	4707	4903	4973	2401	4159	4283	4334
Fe360 C50	24	3151	5846	6096	6186	2807	5069	5253	5323	2401	4483	4616	4651
Fe510 C20	12	4394	5227	5589	5898	3801	4541	4845	5102	3239	3941	4232	4493
Fe510 C20	16	4394	5544	6045	6354	3801	4866	5310	5493	3239	4290	4714	4876
Fe510 C20	20	4394	5863	6453	6752	3801	5210	5667	5884	3239	4641	5033	5229
Fe510 C20	24	4394	6227	6819	7209	3801	5560	6038	6316	3239	4962	5374	5620
Fe510 C50	12	4361	6140	6476	6634	3816	5254	5498	5613	3259	4637	4843	4928
Fe510 C50	16	4361	6532	6907	7136	3816	5638	5920	6062	3259	5009	5241	5343
Fe510 C50	20	4361	6985	7386	7643	3816	6052	6379	6528	3259	5378	5649	5767
Fe510 C50	24	4361	7452	7927	8133	3816	6484	6853	6998	3259	5781	6099	6222

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > IPE 500 + 2 D 20 | h = 50cm

TYPE > AF-BEAM

ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	Fire Resistance Classes F60 0h	5h	7.5h	10h	F90 0h	5h	7.5h	10h	F120 0h	5h	7.5h	10h
Fe360 C20	12	476	777	818	850	371	657	693	712	272	509	531	543
Fe360 C20	16	476	881	928	972	371	752	796	815	272	584	609	620
Fe360 C20	20	476	986	1053	1081	371	854	897	916	272	666	690	696
Fe360 C20	24	476	1099	1173	1209	371	958	998	1014	272	745	767	773
Fe360 C50	12	481	869	886	896	381	725	735	741	278	546	554	555
Fe360 C50	16	481	994	1003	1013	381	823	836	836	278	625	630	630
Fe360 C50	20	481	1109	1128	1129	381	921	932	933	278	705	705	705
Fe360 C50	24	481	1228	1247	1247	381	1021	1031	1031	278	781	781	781
Fe510 C20	12	658	1002	1067	1106	518	846	909	950	382	672	718	740
Fe510 C20	16	658	1125	1210	1255	518	960	1041	1093	382	773	826	851
Fe510 C20	20	658	1265	1362	1420	518	1084	1185	1247	382	876	941	972
Fe510 C20	24	658	1413	1519	1589	518	1220	1336	1400	382	987	1057	1091
Fe510 C50	12	658	1130	1176	1195	522	979	1010	1020	384	752	767	776
Fe510 C50	16	658	1302	1348	1360	522	1123	1158	1170	384	869	881	890
Fe510 C50	20	658	1464	1517	1515	522	1273	1306	1325	384	984	1004	1005
Fe510 C50	24	658	1630	1677	1702	522	1431	1451	1467	384	1099	1117	1118

ULTIMATE BENDING MOMENTS [kNm]

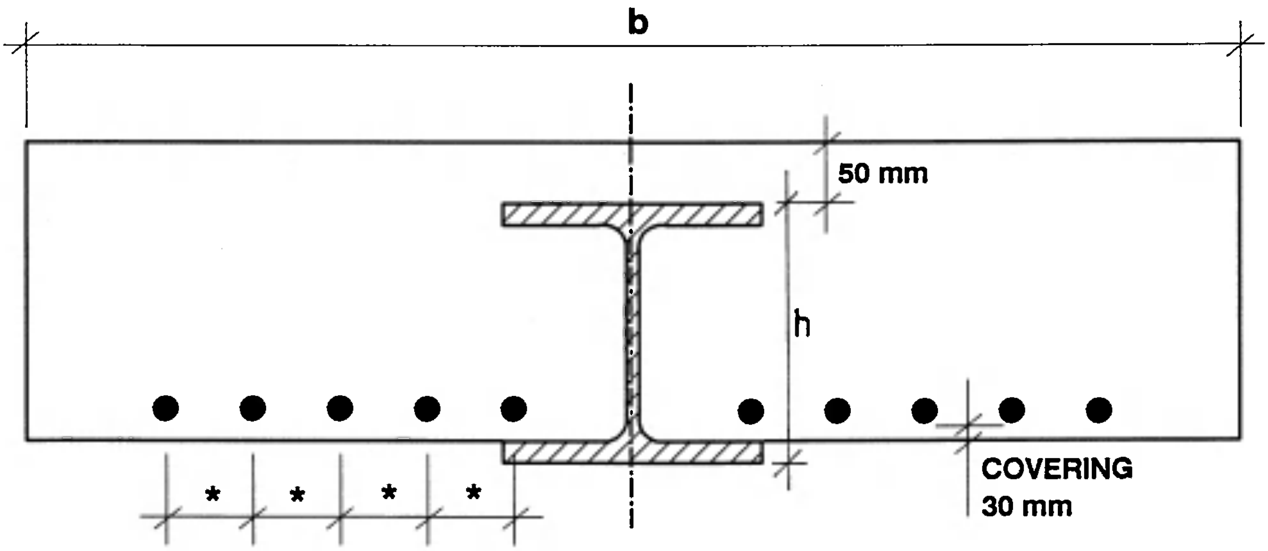
BEAM SHAPE > IPE 600 + 2 D 25 | h = 60cm

TYPE > AF-BEAM

ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	Fire Resistance Classes F60 0h	5h	7.5h	10h	F90 0h	5h	7.5h	10h	F120 0h	5h	7.5h	10h
Fe360 C20	12	831	1298	1363	1412	665	1082	1145	1188	517	916	952	973
Fe360 C20	16	831	1439	1517	1578	665	1209	1290	1340	517	1029	1074	1097
Fe360 C20	20	831	1587	1676	1745	665	1344	1437	1484	517	1146	1194	1218
Fe360 C20	24	831	1741	1841	1912	665	1487	1591	1630	517	1266	1316	1336
Fe360 C50	12	835	1444	1472	1483	687	1211	1232	1243	531	985	997	1004
Fe360 C50	16	835	1604	1634	1653	687	1366	1380	1390	531	1107	1123	1123
Fe360 C50	20	835	1780	1800	1817	687	1505	1527	1532	531	1225	1240	1240
Fe360 C50	24	835	1948	1969	1984	687	1655	1675	1682	531	1345	1358	1358
Fe510 C20	12	1135	1657	1753	1821	923	1392	1478	1539	725	1202	1282	1321
Fe510 C20	16	1135	1827	1951	2029	923	1546	1657	1731	725	1351	1444	1490
Fe510 C20	20	1135	2014	2156	2242	923	1712	1844	1925	725	1500	1607	1666
Fe510 C20	24	1135	2217	2367	2468	923	1894	2042	2144	725	1662	1779	1844
Fe510 C50	12	1134	1865	1935	1964	928	1585	1637	1652	729	1346	1376	1388
Fe510 C50	16	1134	2077	2168	2186	928	1794	1851	1868	729	1516	1550	1564
Fe510 C50	20	1134	2322	2396	2416	928	2011	2062	2080	729	1697	1727	1748
Fe510 C50	24	1134	2560	2627	2648	928	2220	2275	2295	729	1885	1908	1928

TYPICAL ENCASED BEAM CROSS SECTION



* any distance in accordance with the standards for reinforced concrete

- suggested first bar at the edge of the steel shape

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > HD 260x260x73 + 8 D 12 h = 25,3 cm

TYPE > ENCASED SHAPE ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	Fire Resistance Classes								
		F60			F90			F120		
		5h	7.5	10h	5h	7.5	10h	5h	7.5	10h
Fe360 C20	28.9	237	252	268	183	198	212	151	165	180
Fe360 C50	28.9	283	316	323	232	253	258	195	213	218
Fe510 C20	28.9	291	305	318	221	233	248	179	192	207
Fe510 C50	28.9	334	379	399	263	304	325	221	256	276

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > HD 260x260x131 + 8 D 16 h = 27,5 cm

TYPE > ENCASED SHAPE

ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	Fire Resistance Classes								
		F60			F90			F120		
		5h	7.5h	10h	5h	7.5h	10h	5h	7.5h	10h
Fe360 C20	30	455	474	501	340	363	382	274	297	315
Fe360 C50	30	520	575	628	403	447	492	335	380	410
Fe510 C20	30	580	592	603	425	436	457	337	351	370
Fe510 C50	30	625	675	734	475	527	570	389	437	475

ULTIMATE BENDING MOMENTS [kNm]

BEAM SHAPE > HD 310x310x130 + 8 D 16 h = 31,8 cm

TYPE > ENCASED SHAPE ARBED RECHERCHES

Mat. Comb.	Eff. Width b d [cm]	Fire Resistance Classes								
		F60			F90			F120		
		5h	7.5h	10h	5h	7.5h	10h	5h	7.5h	10h
Fe360 C20	34.75	561	580	607	428	448	470	347	370	388
Fe360 C50	34.75	627	680	715	490	548	573	408	460	482
Fe510 C20	34.75	700	719	742	526	545	566	425	446	463
Fe510 C50	34.75	764	817	869	583	638	696	482	533	587

ULTIMATE SHEAR FORCES FOR COMPOSITE BEAMS (KN)

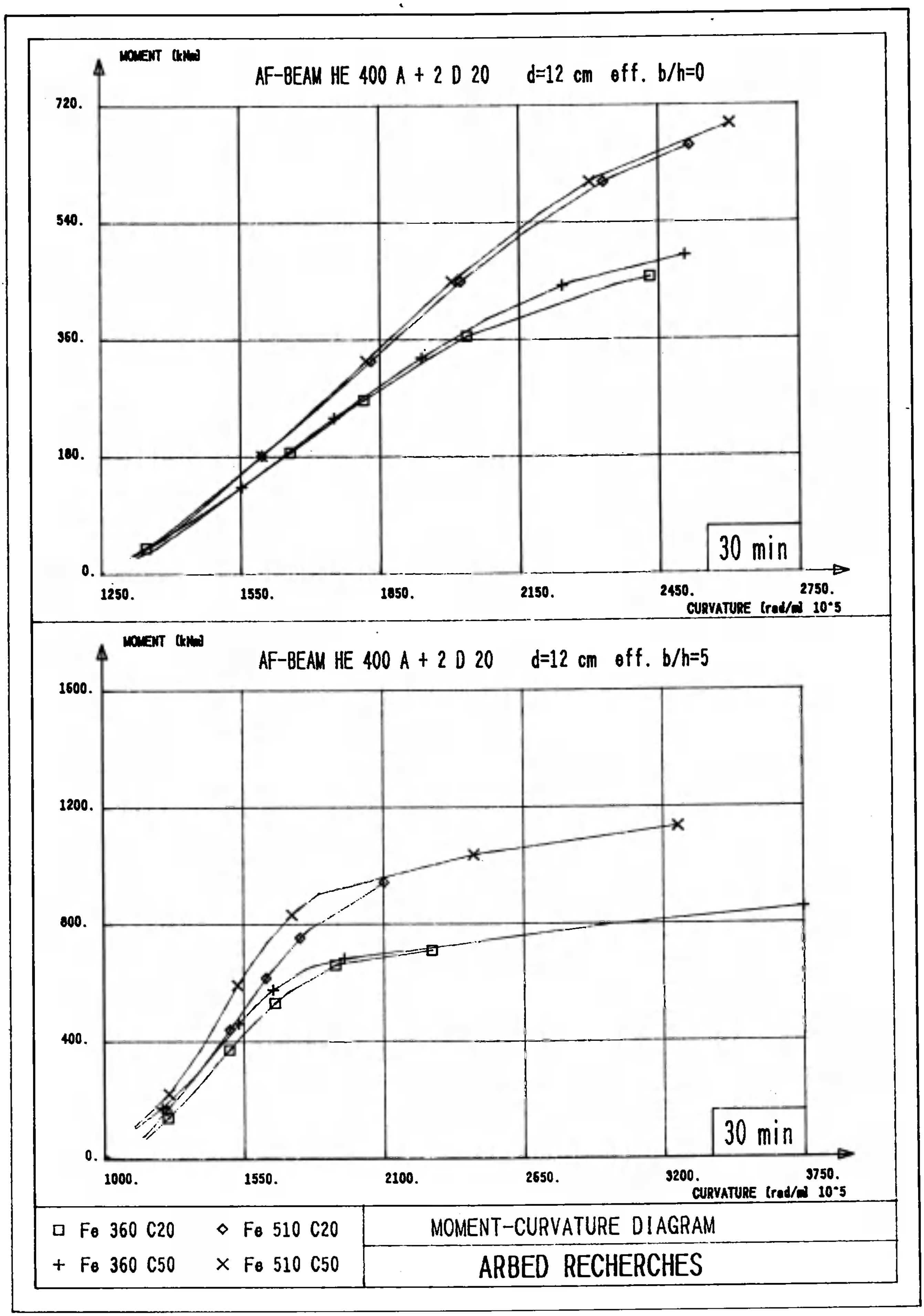
TYPE OF BEAM	MAIN STEEL SHAPE	STEEL QUALTITY OF THE MAIN SHAPE Fe 360 FIRE RESISTANCE CLASS F30	F60	F90	F120	Fe 510 FIRE RESISTANCE CLASS F30	F60	F90	F120
AF (TYPES E AND F)	HE 400 A	517	485	449	400	781	733	678	604
	HE 500 A	714	680	640	585	1079	1027	967	884
	HE 650 A	1068	1030	982	917	1614	1556	1484	1385
	HE 800 A	1464	1395	1331	1249	2212	2107	2011	1887
	HE 1000 A	2053	1952	1836	1706	3101	2949	2773	2577
	IPE 500	636	591	506	412	961	893	765	623
	IPE 600	871	824	738	626	1316	1245	1115	945
FULLY ENCASED (TYPE G)	HD 260X260X73	266	243	224	210	402	367	339	317
	HD 260X260X131	463	422	384	355	700	638	581	536
	HD 310X310X130	498	463	431	406	752	699	652	614

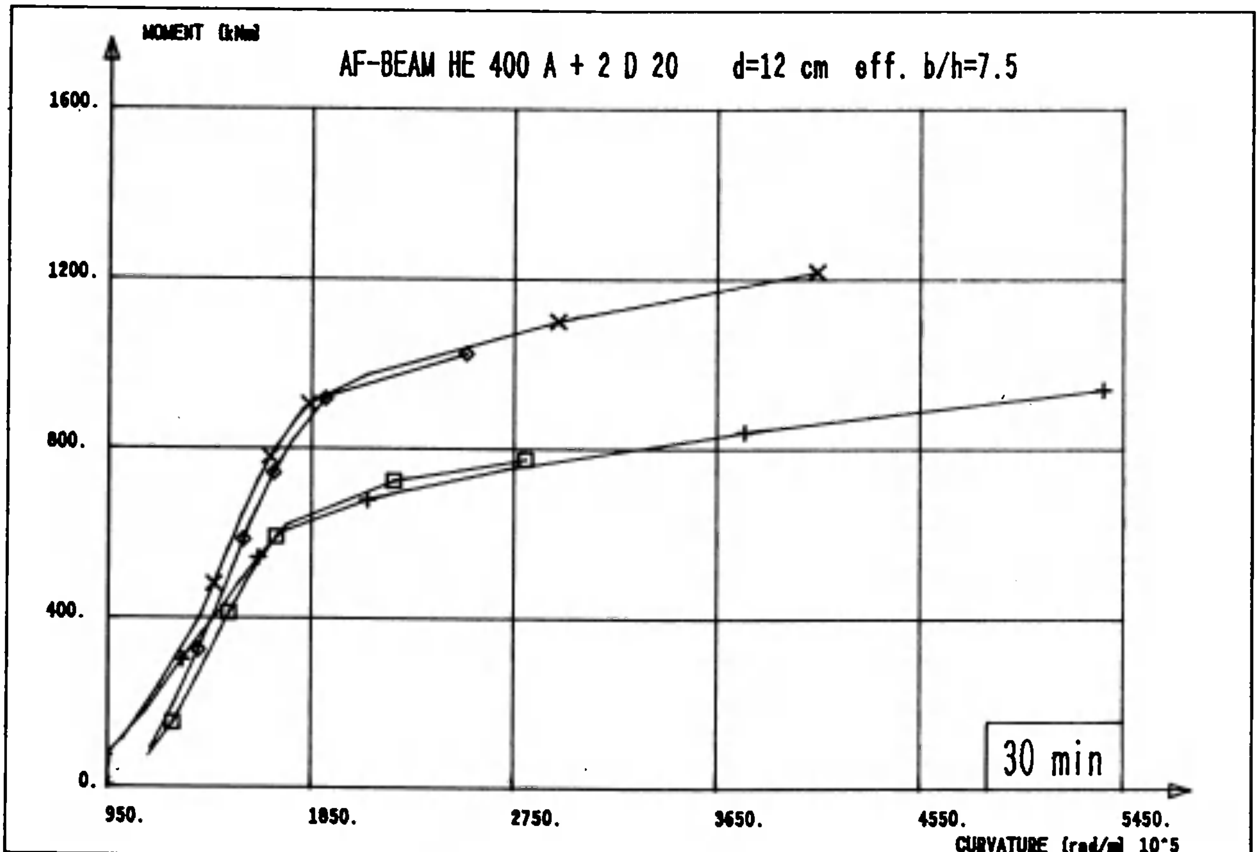
PART II

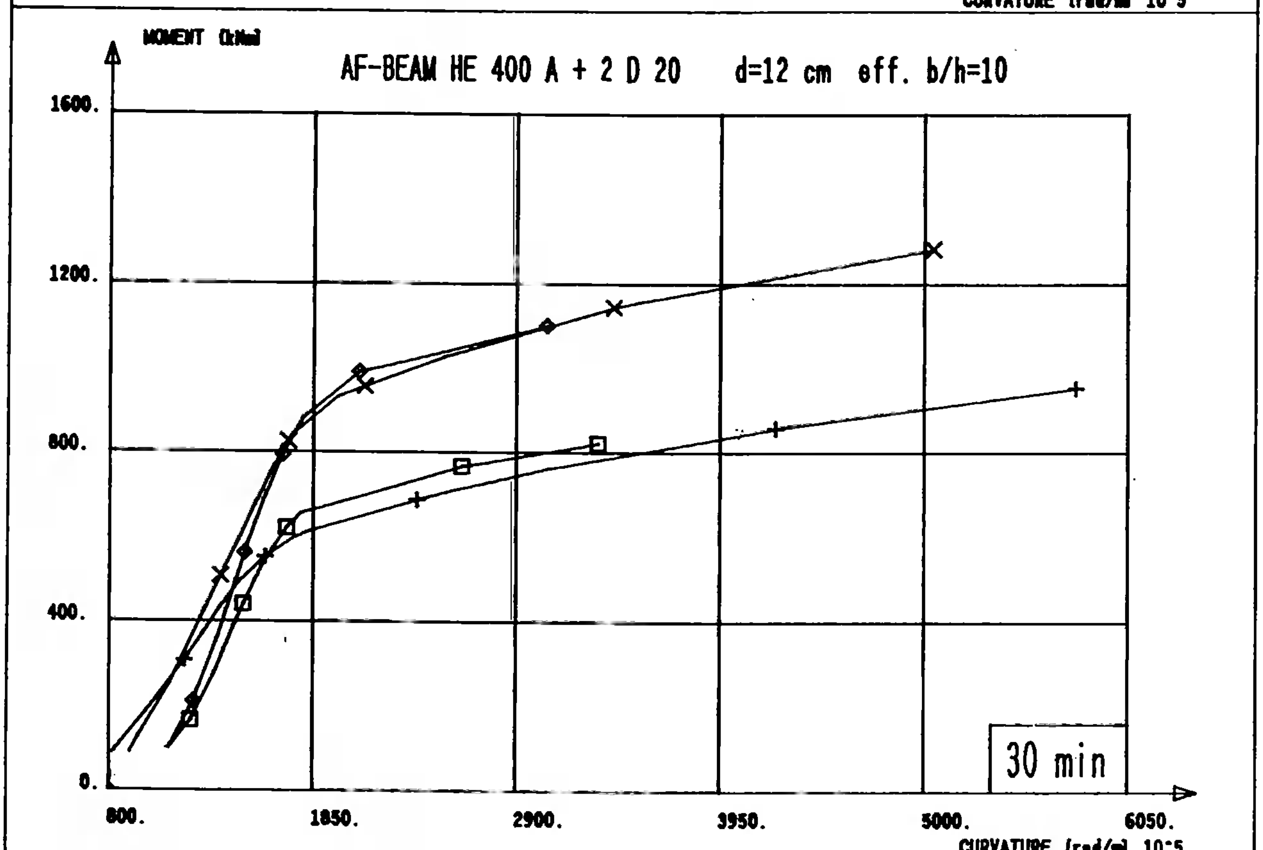
APPENDIX C. MOMENT - CURVATURE DIAGRAMS FOR BEAMS

PART II

APPENDIX C. MOMENT - CURVATURE DIAGRAMS FOR BEAMS


MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=0
720.
540.
360.
180.
0.
1250.
1550.
1850.
2150.
2450.
2750.
CURVATURE (rad/m) 10^5
30 min
MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=5
1600.
1200.
800.
400.
0.
1000.
1550.
2100.
2650.
3200.
3750.
CURVATURE (rad/m) 10^5
30 min
□ Fe 360 C20
◇ Fe 510 C20
+ Fe 360 C50
× Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES

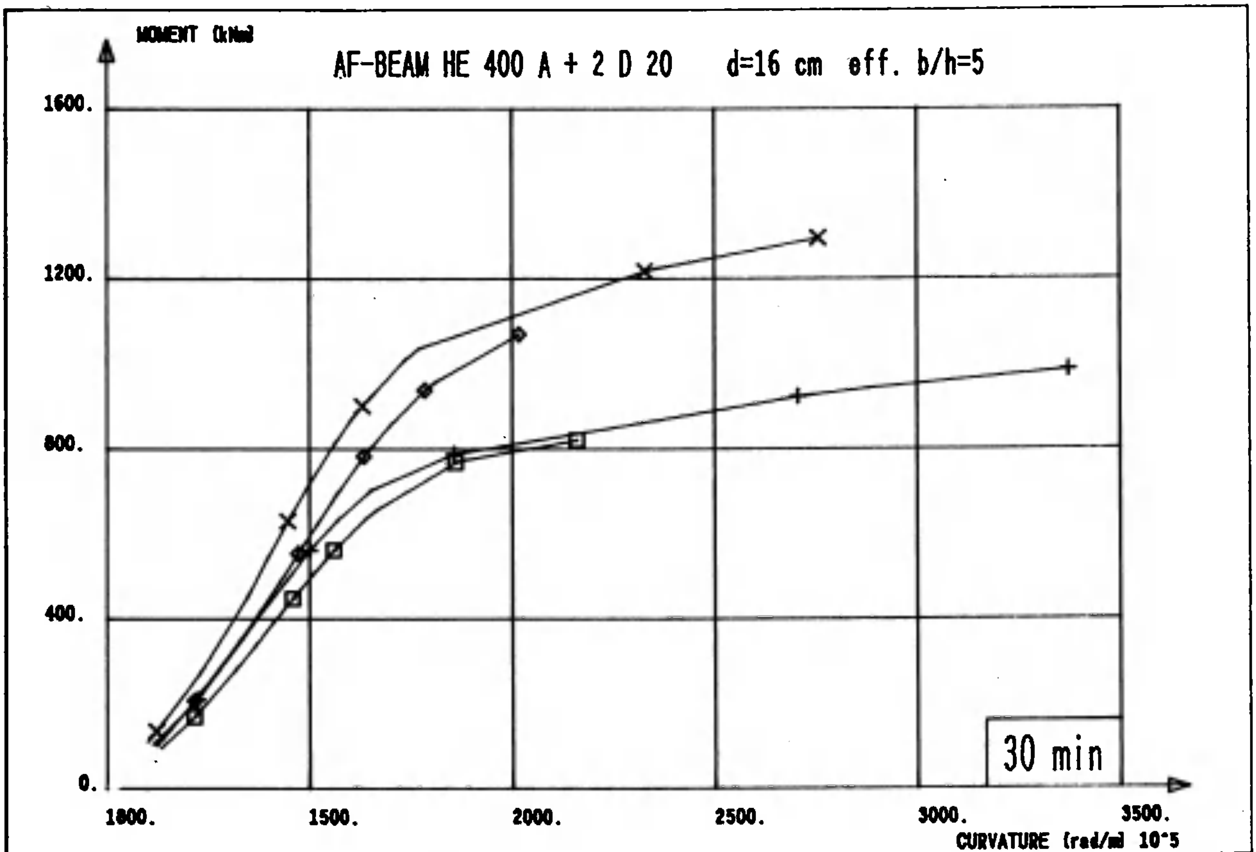


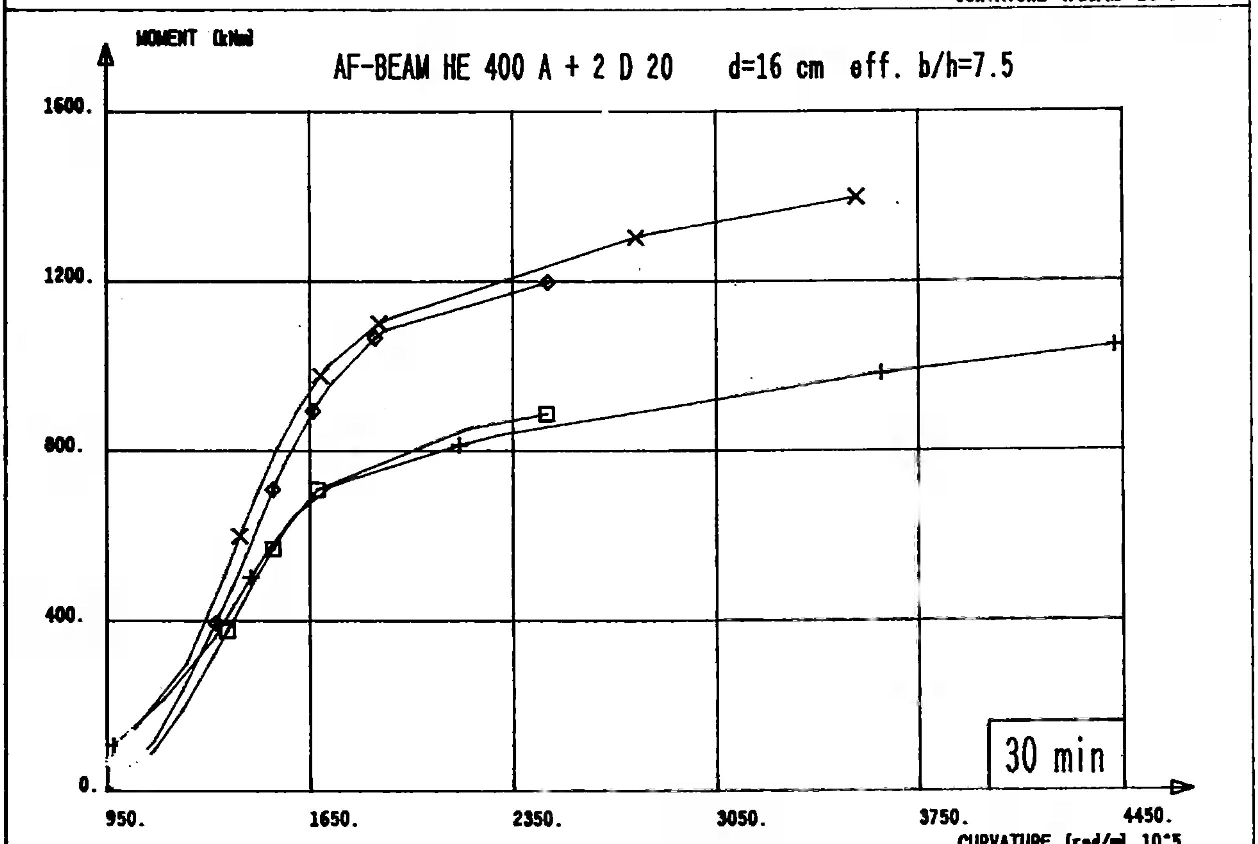


□ Fe 360 C20	◇ Fe 510 C20
+ Fe 360 C50	× Fe 510 C50

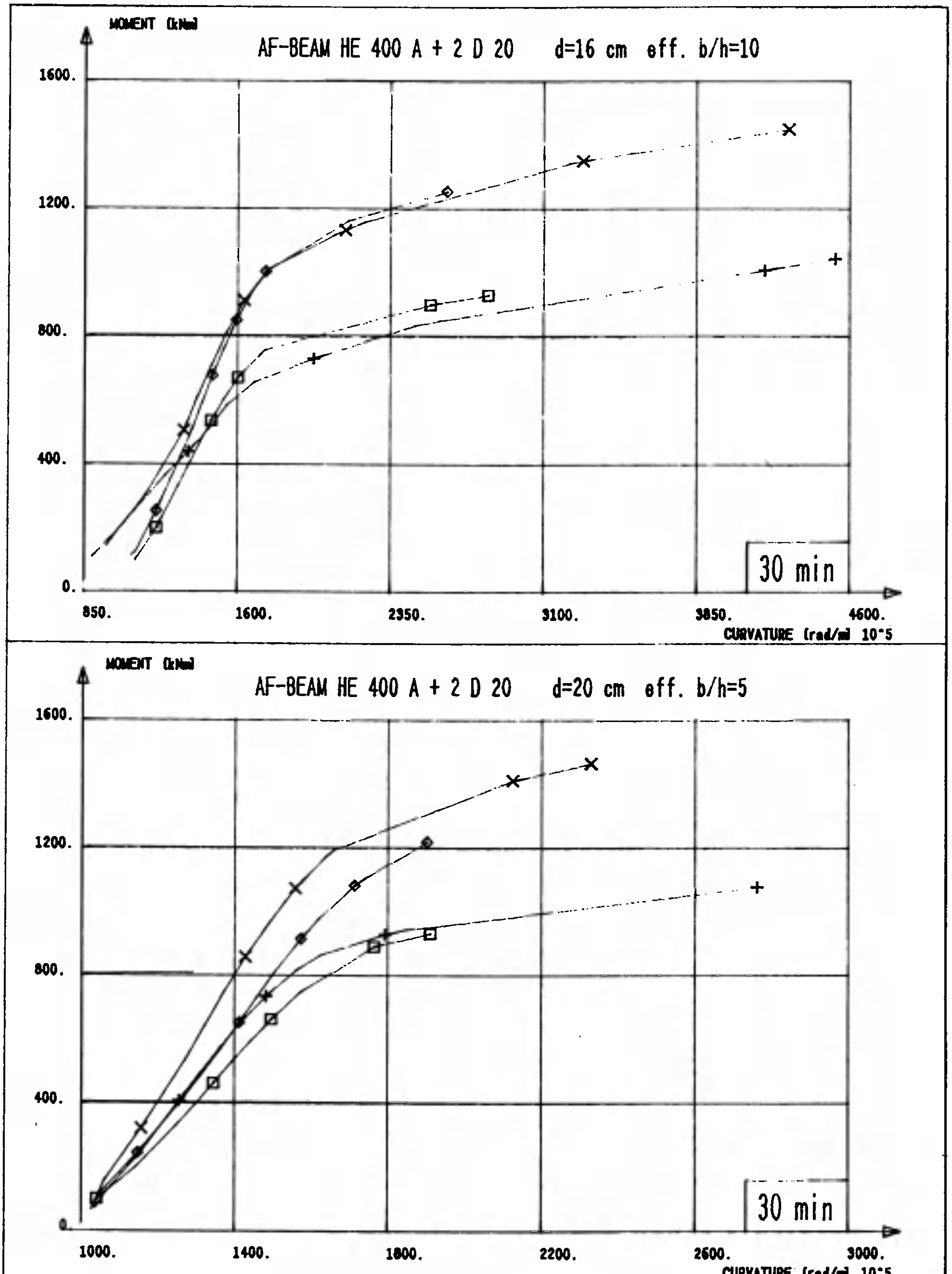
MOMENT-CURVATURE DIAGRAM

ARBED RECHERCHES

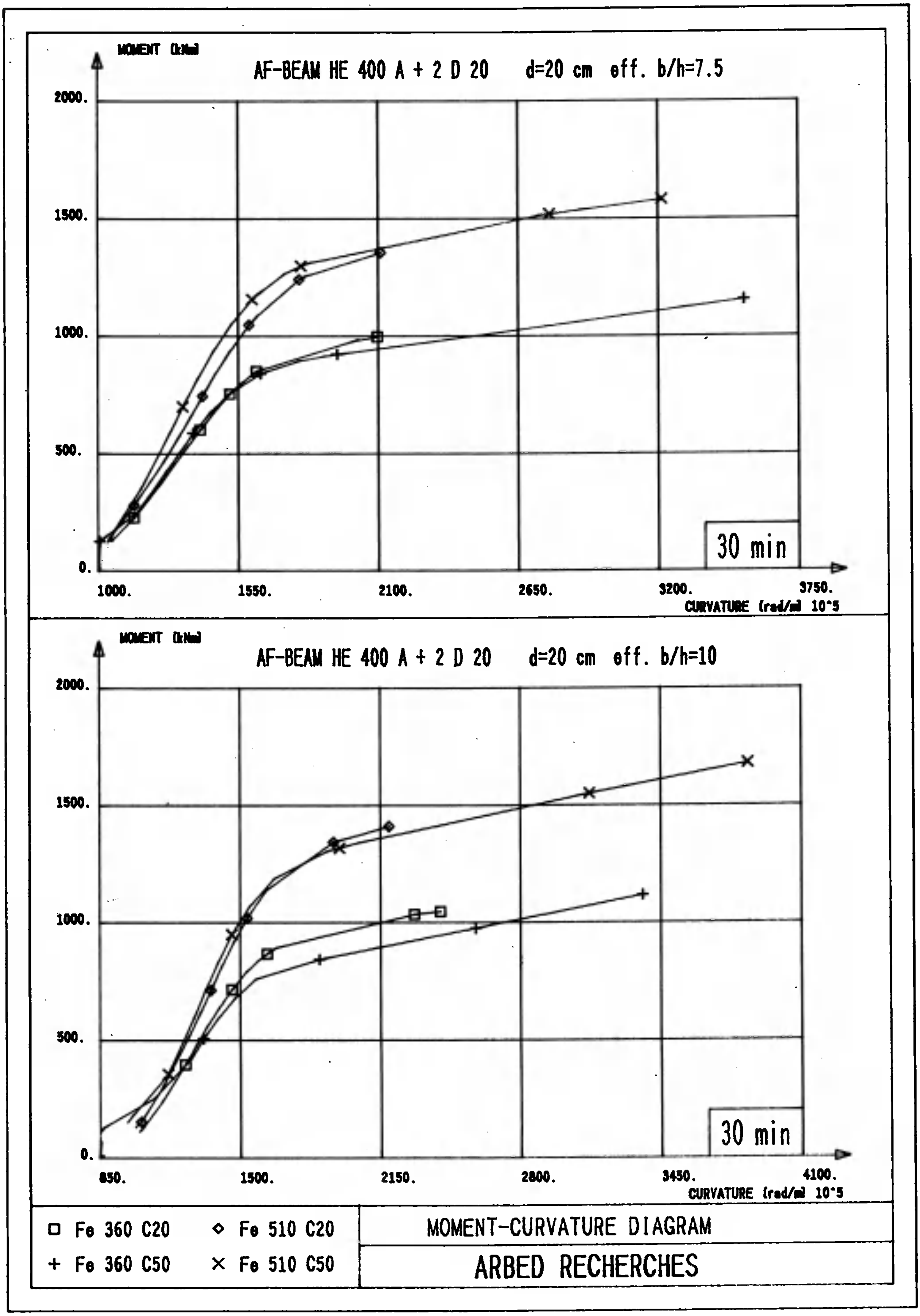


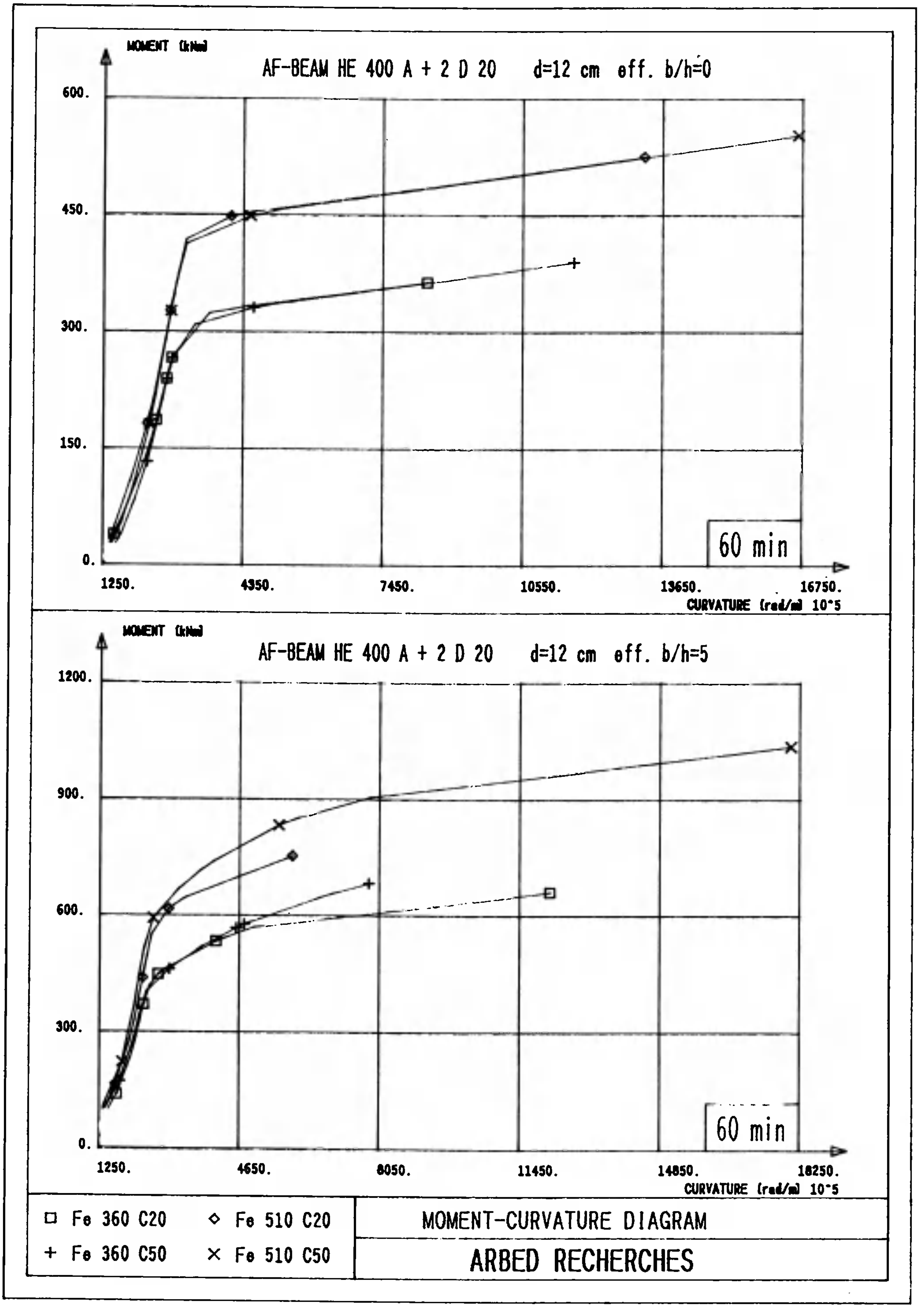


□ Fe 360 C20	◇ Fe 510 C20	MOMENT-CURVATURE DIAGRAM
+ Fe 360 C50	× Fe 510 C50	ARBED RECHERCHES

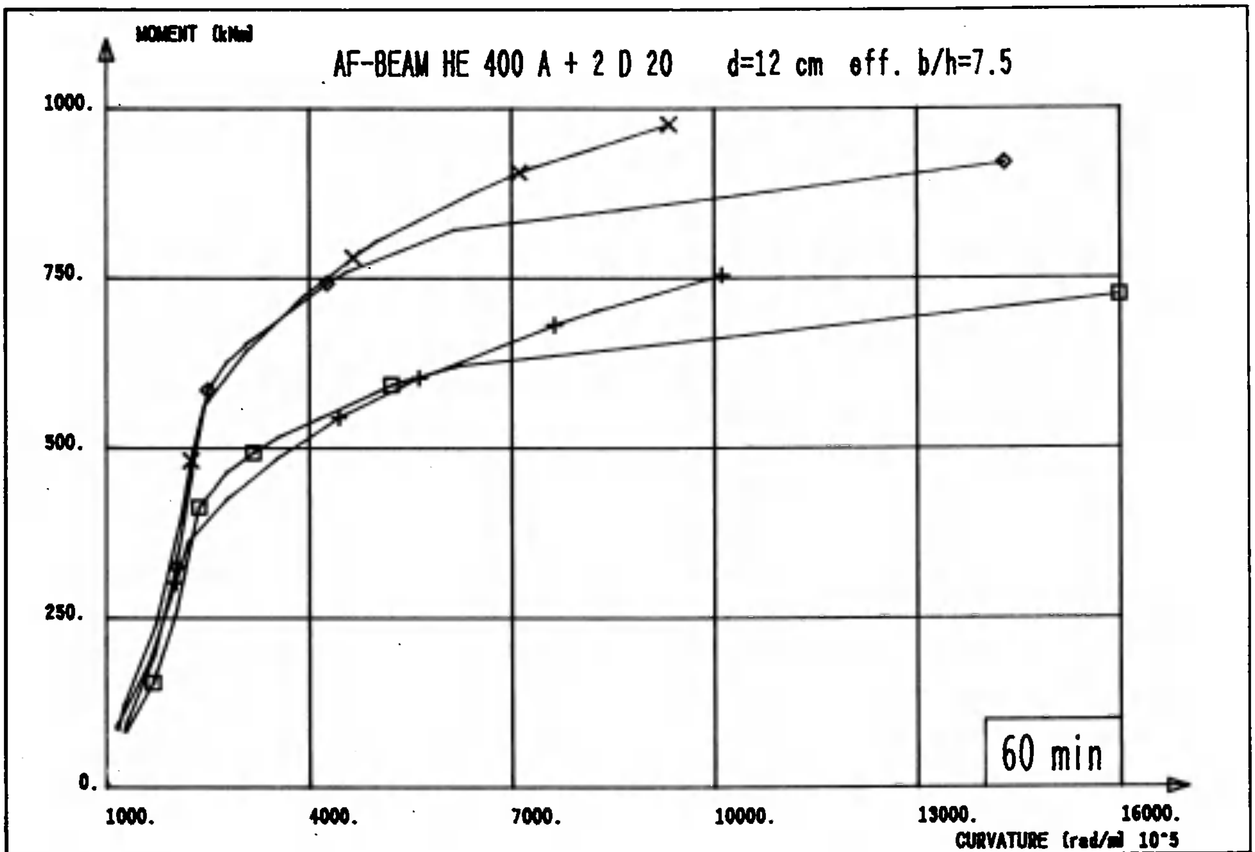


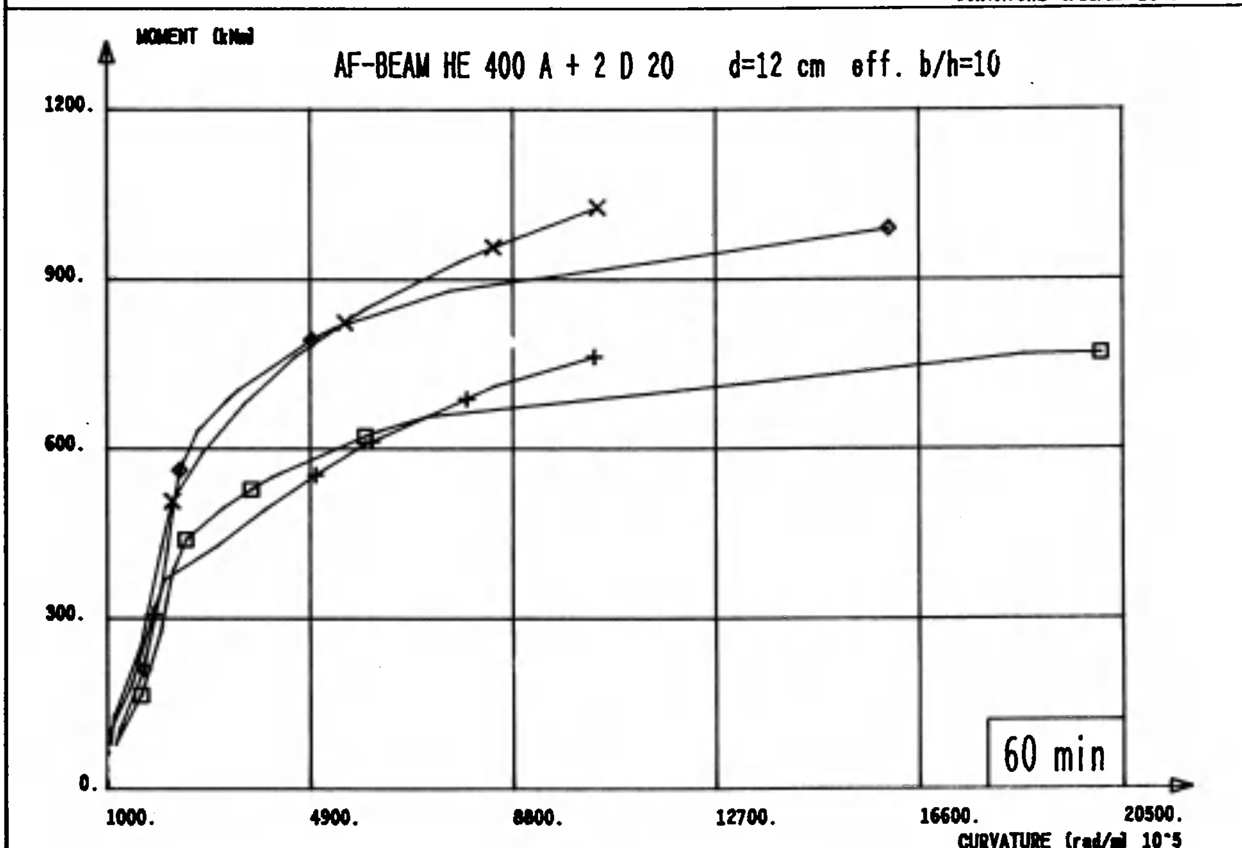
□ Fe 360 C20 ◇ Fe 510 C20	MOMENT-CURVATURE DIAGRAM
+ Fe 360 C50 × Fe 510 C50	ARBED RECHERCHES


MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=20 cm eff. b/h=7.5
2000.
1500.
1000.
500.
0.
1000.
1550.
2100.
2650.
3200.
3750.
CURVATURE (rad/m) 10^5
30 min
MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=20 cm eff. b/h=10
2000.
1500.
1000.
500.
0.
850.
1500.
2150.
2800.
3450.
4100.
CURVATURE (rad/m) 10^5
30 min
□ Fe 360 C20
◇ Fe 510 C20
+ Fe 360 C50
× Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES



MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=0
600.
450.
300.
150.
0.
1250.
4350.
7450.
10550.
13650.
16750.
CURVATURE (rad/m) 10^-5
60 min
MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=5
1200.
900.
600.
300.
0.
1250.
4650.
8050.
11450.
14850.
18250.
CURVATURE (rad/m) 10^-5
60 min
□ Fe 360 C20
◇ Fe 510 C20
+ Fe 360 C50
× Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES



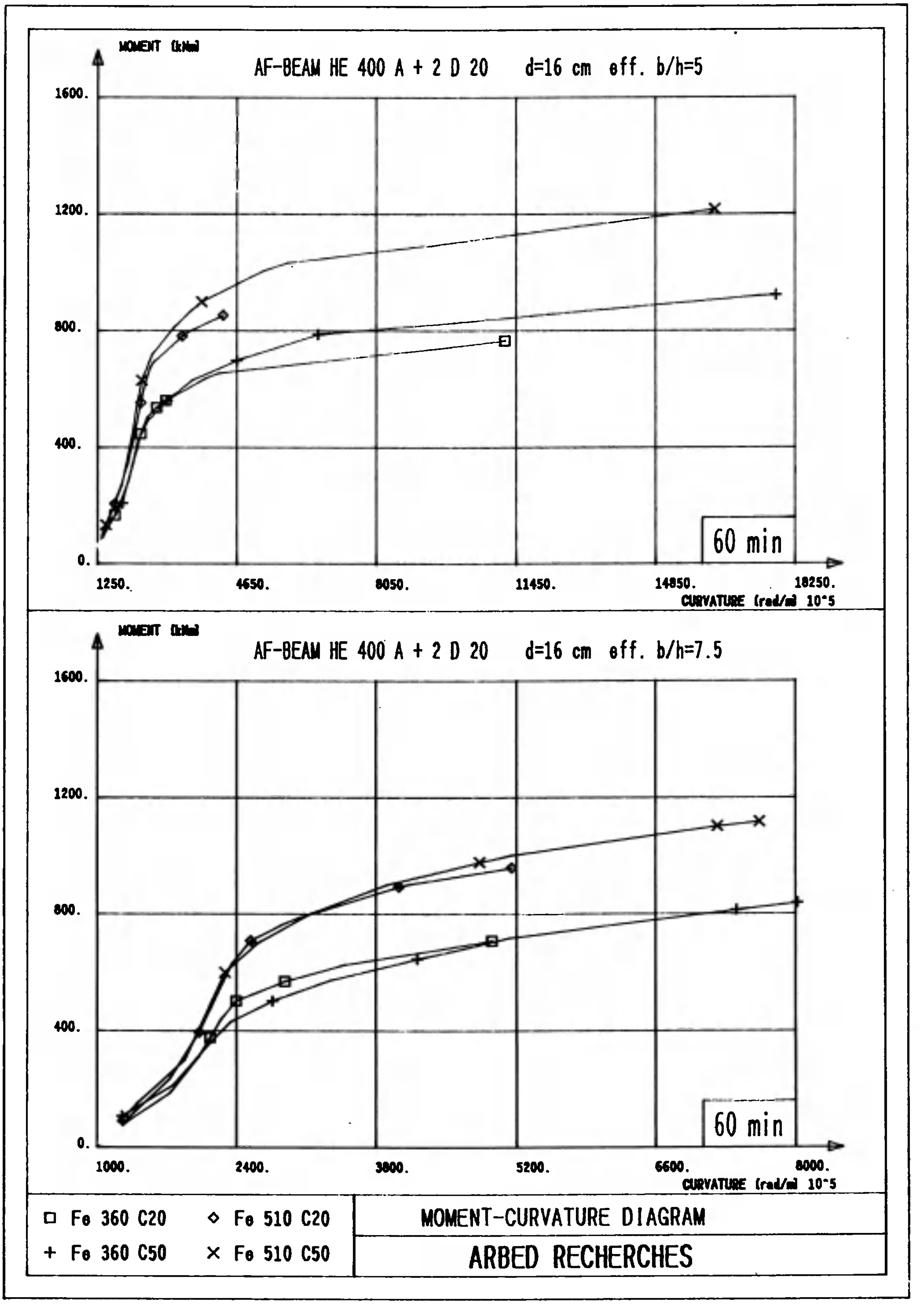


□ Fe 360 C20 ◇ Fe 510 C20

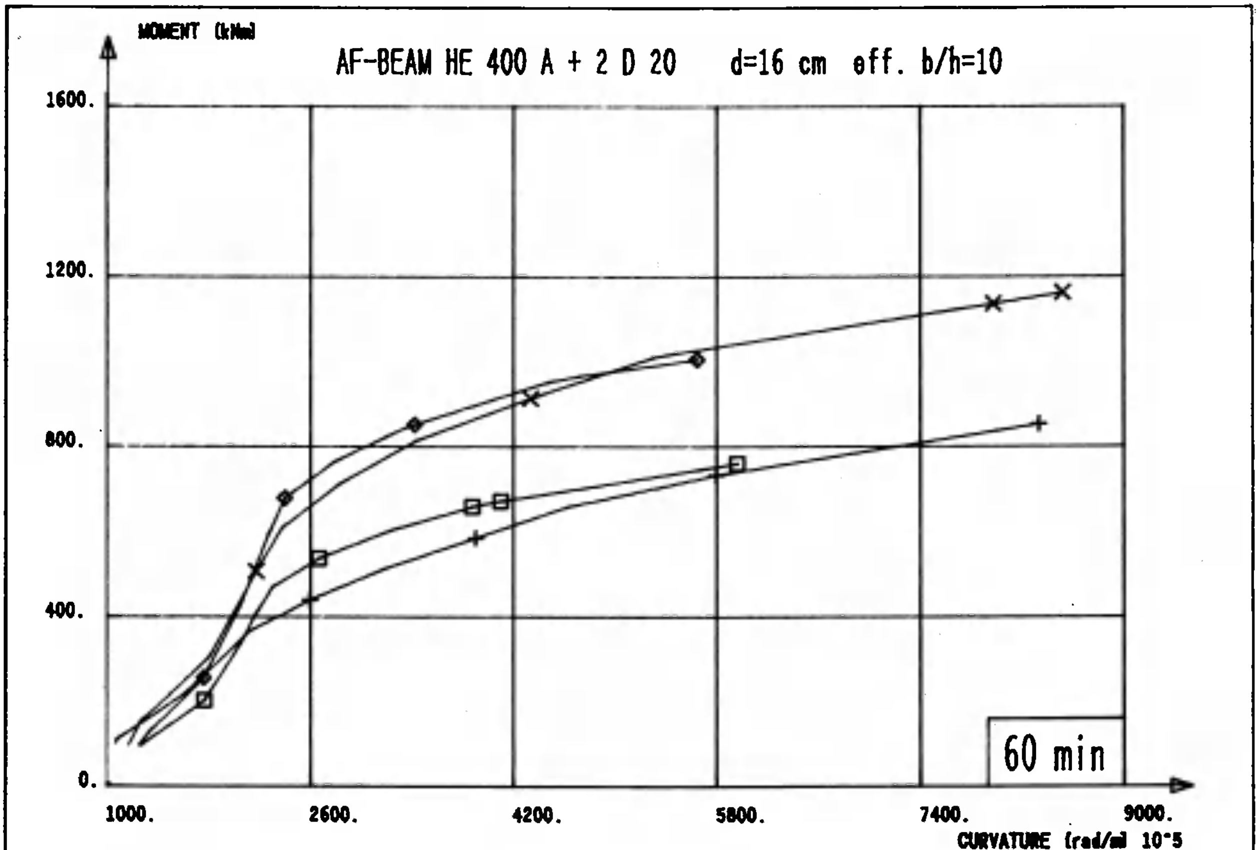
\+ Fe 360 C50 × Fe 510 C50

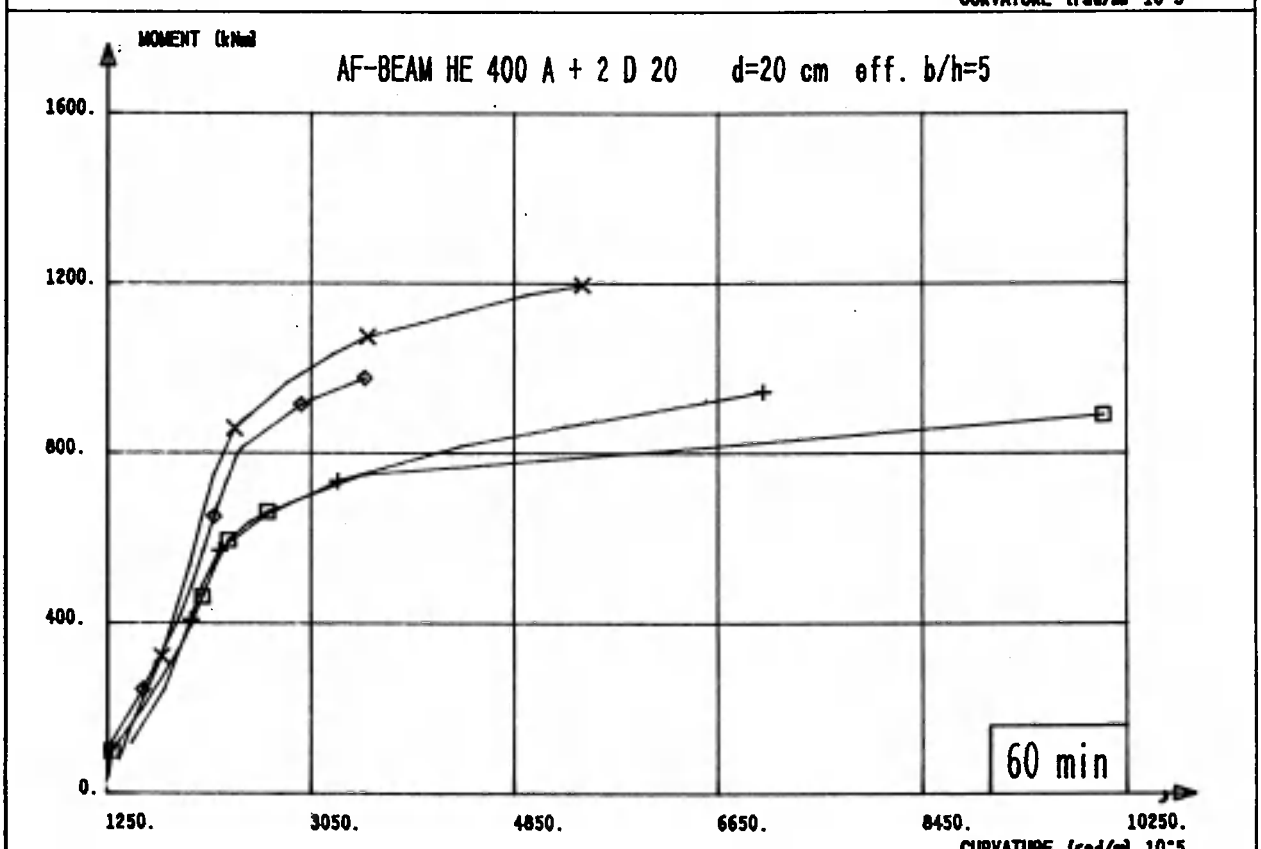
MOMENT-CURVATURE DIAGRAM

ARBED RECHERCHES



MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=16 cm eff. b/h=5
1600.
1200.
800.
400.
0.
60 min
1250.
4650.
8050.
11450.
14850.
18250.
CURVATURE (rad/m) 10^-5
MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=16 cm eff. b/h=7.5
1600.
1200.
800.
400.
0.
60 min
1000.
2400.
3800.
5200.
6600.
8000.
CURVATURE (rad/m) 10^-5
□ Fe 360 C20
◇ Fe 510 C20
+ Fe 360 C50
× Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES



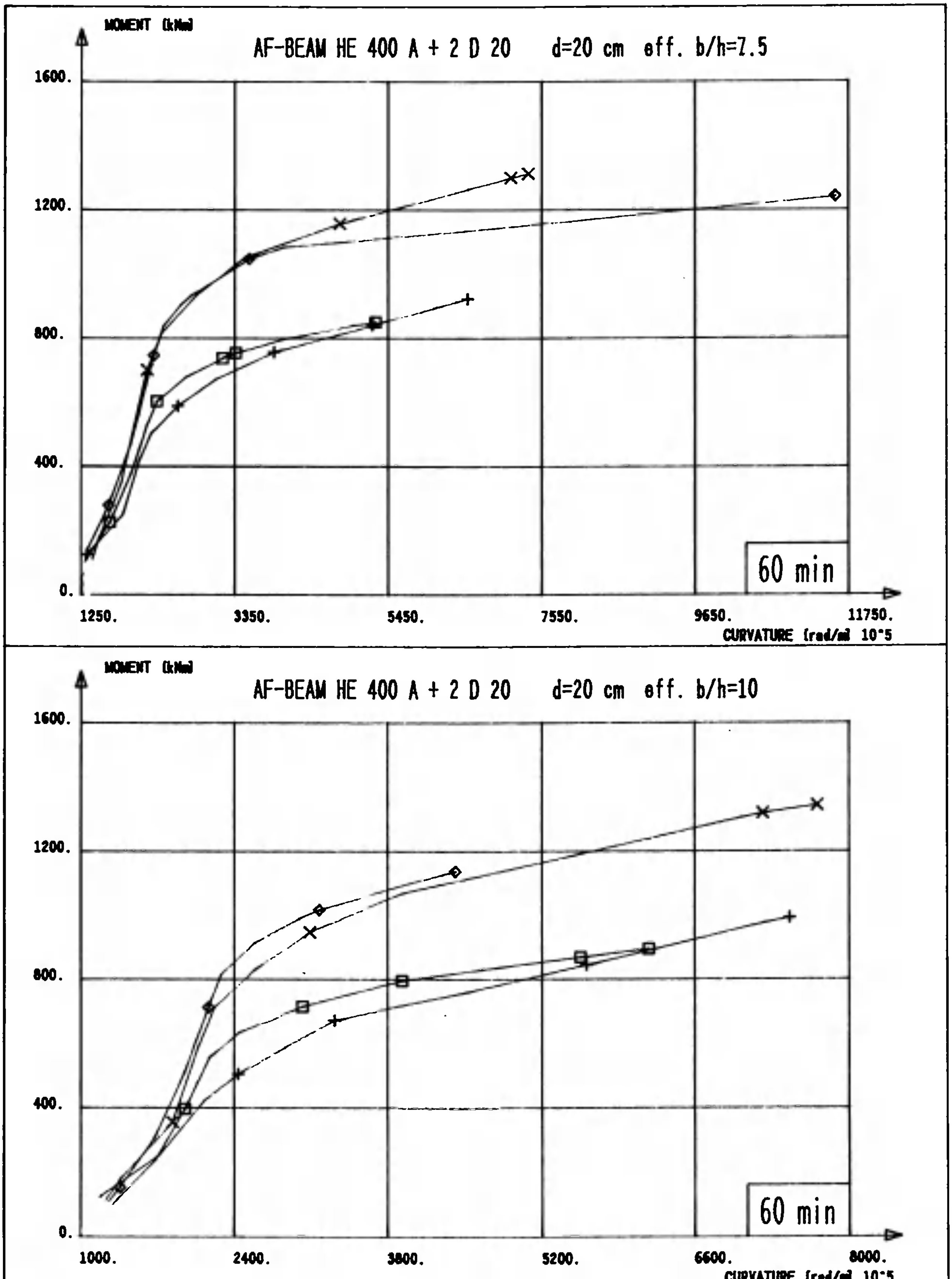


□ Fe 360 C20 ◇ Fe 510 C20

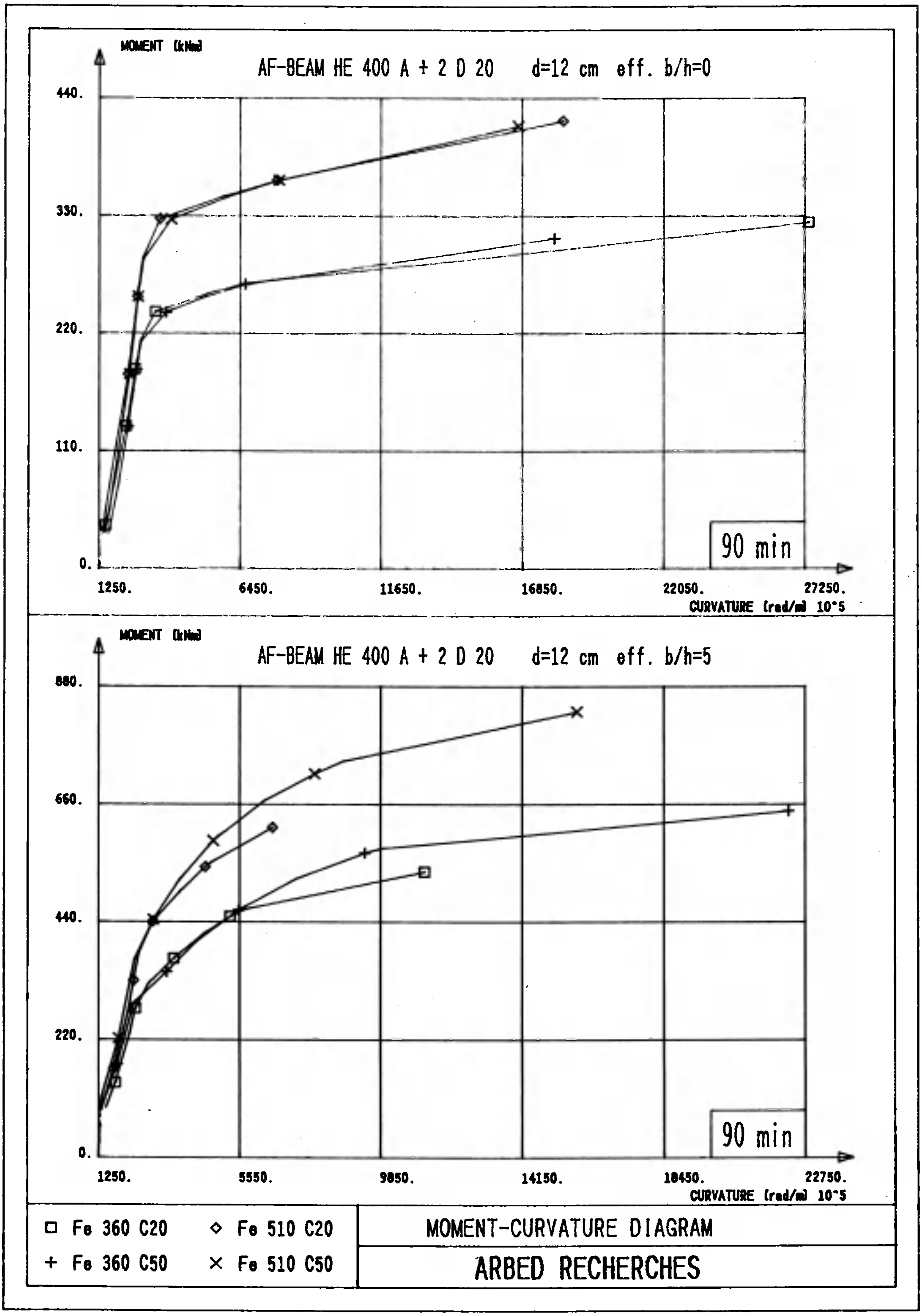
+ Fe 360 C50 × Fe 510 C50

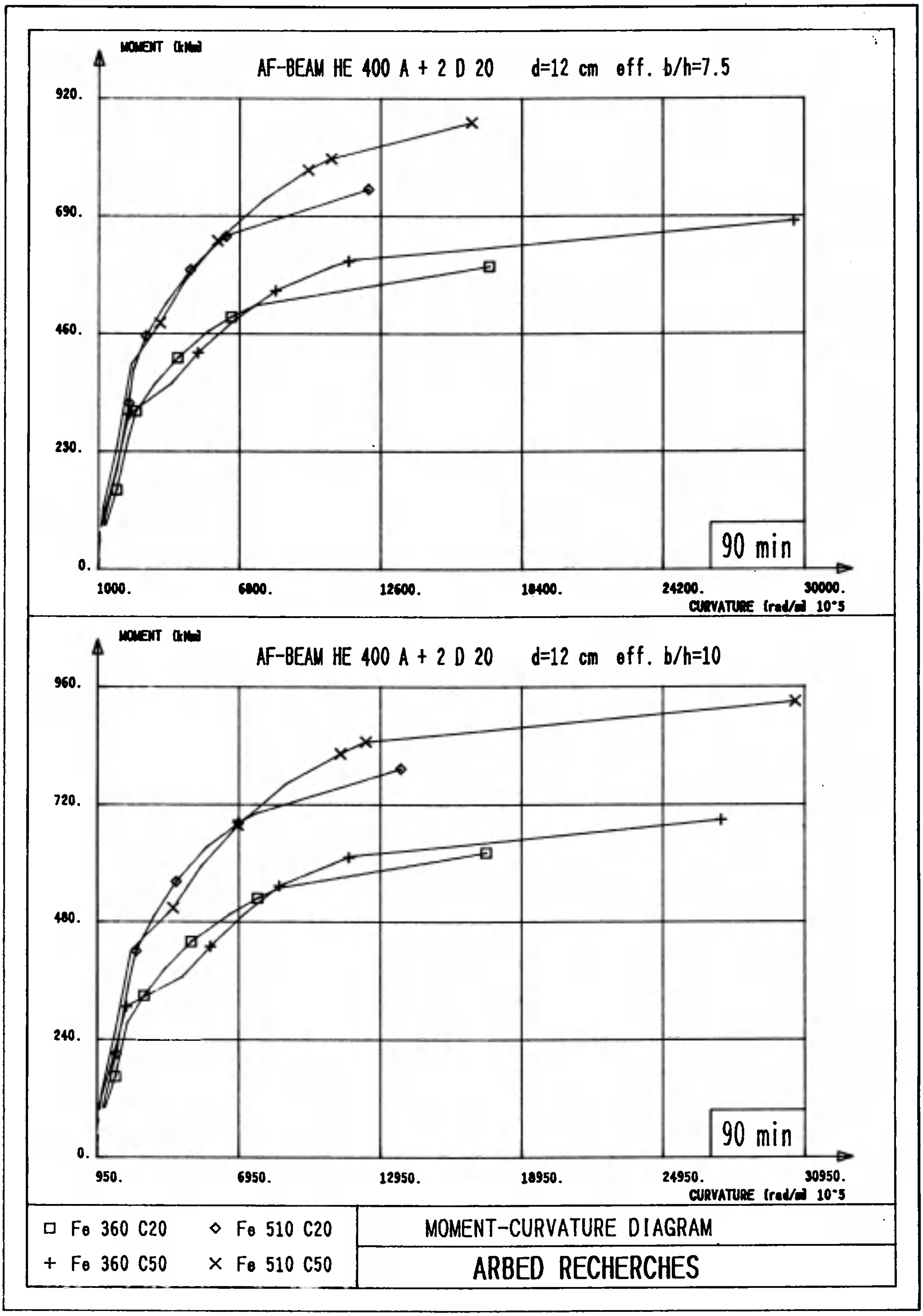
MOMENT-CURVATURE DIAGRAM

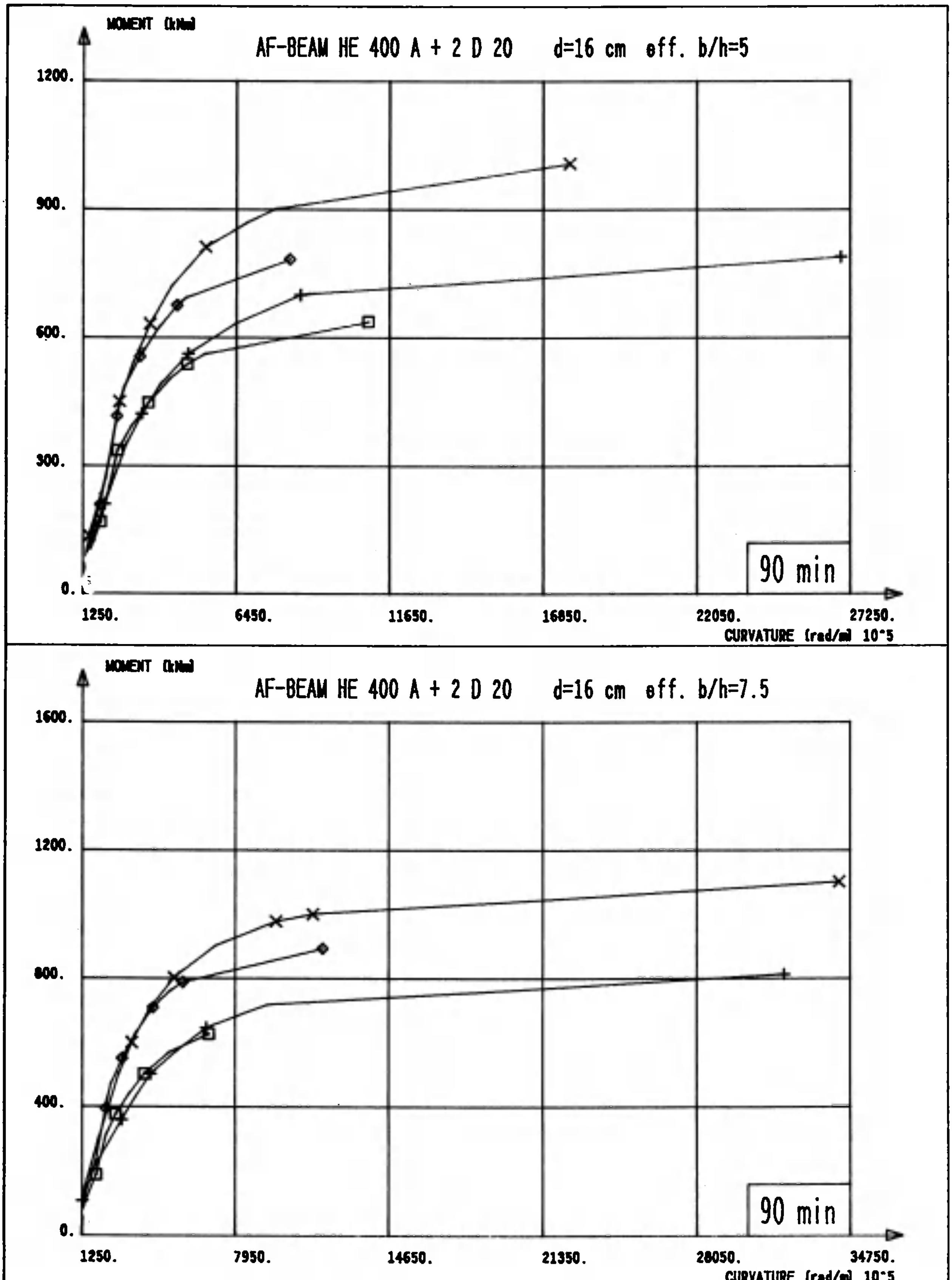
ARBED RECHERCHES



□ Fe 360 C20	◇ Fe 510 C20	MOMENT-CURVATURE DIAGRAM
+ Fe 360 C50	× Fe 510 C50	ARBED RECHERCHES

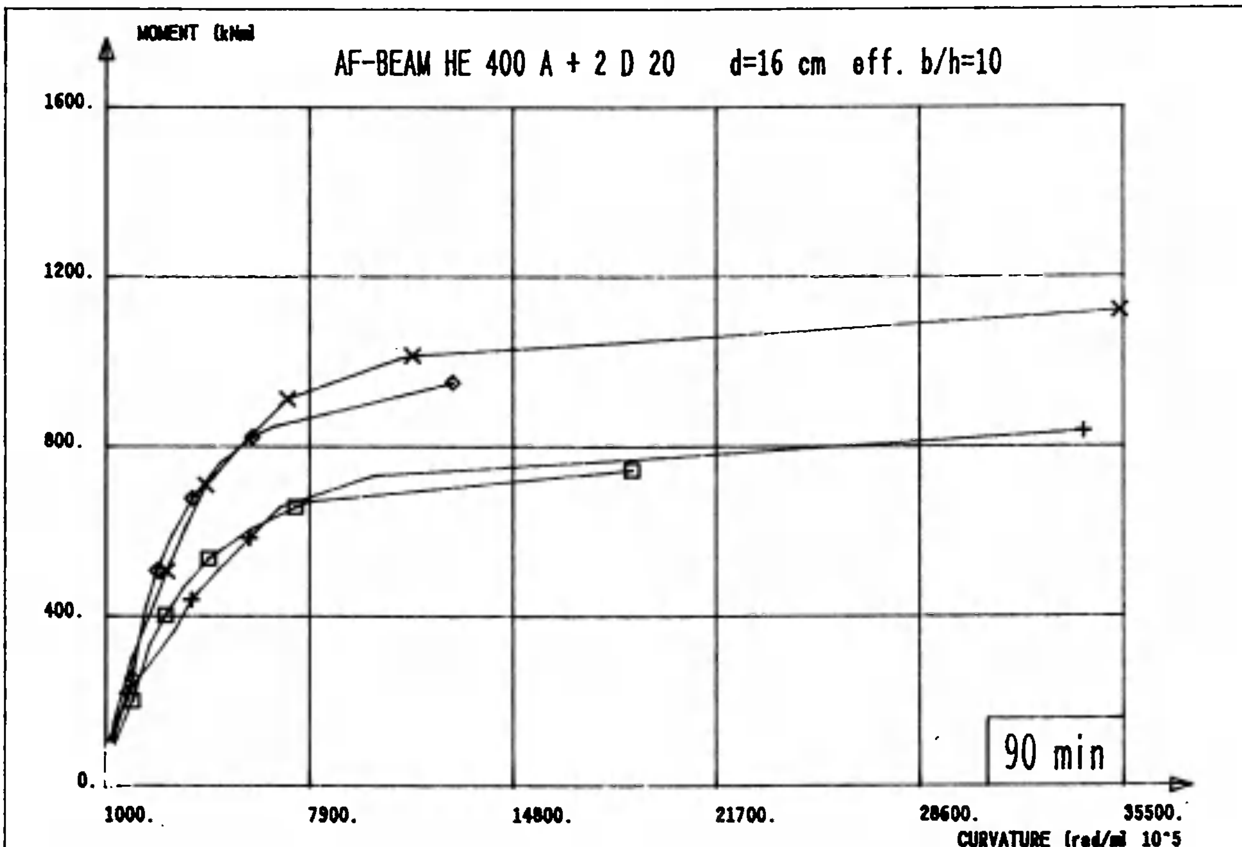

MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=0
440.
330.
220.
110.
0.
1250.
6450.
11650.
16850.
22050.
27250.
CURVATURE (rad/m) 10^5
90 min
MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=5
880.
660.
440.
220.
0.
1250.
5550.
9850.
14150.
18450.
22750.
CURVATURE (rad/m) 10^5
90 min
□ Fe 360 C20
◇ Fe 510 C20
+ Fe 360 C50
× Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES

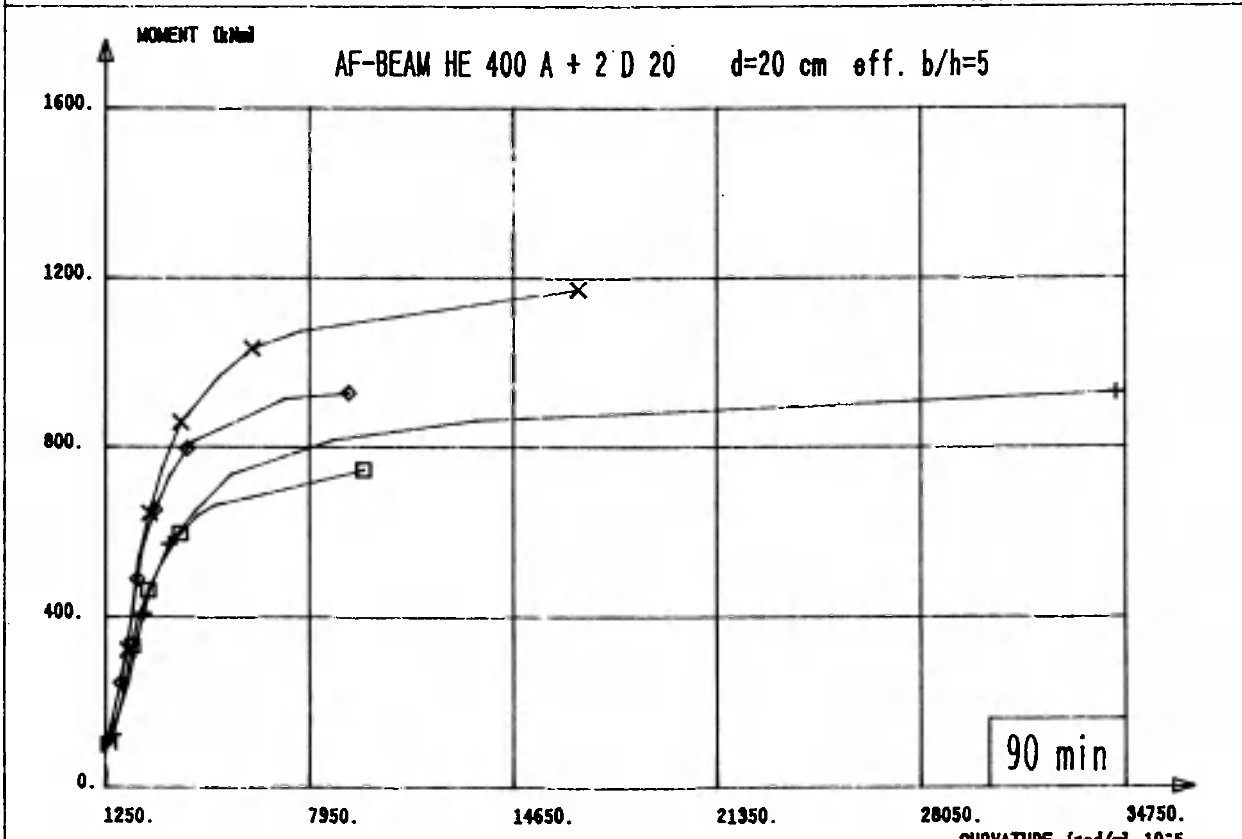

MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=7.5
920.
690.
460.
230.
0.
90 min
1000.
6800.
12600.
18400.
24200.
30000.
CURVATURE (rad/m) 10^5
MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=10
960.
720.
480.
240.
0.
90 min
950.
6950.
12950.
18950.
24950.
30950.
CURVATURE (rad/m) 10^5
Fe 360 C20
Fe 510 C20
Fe 360 C50
Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES



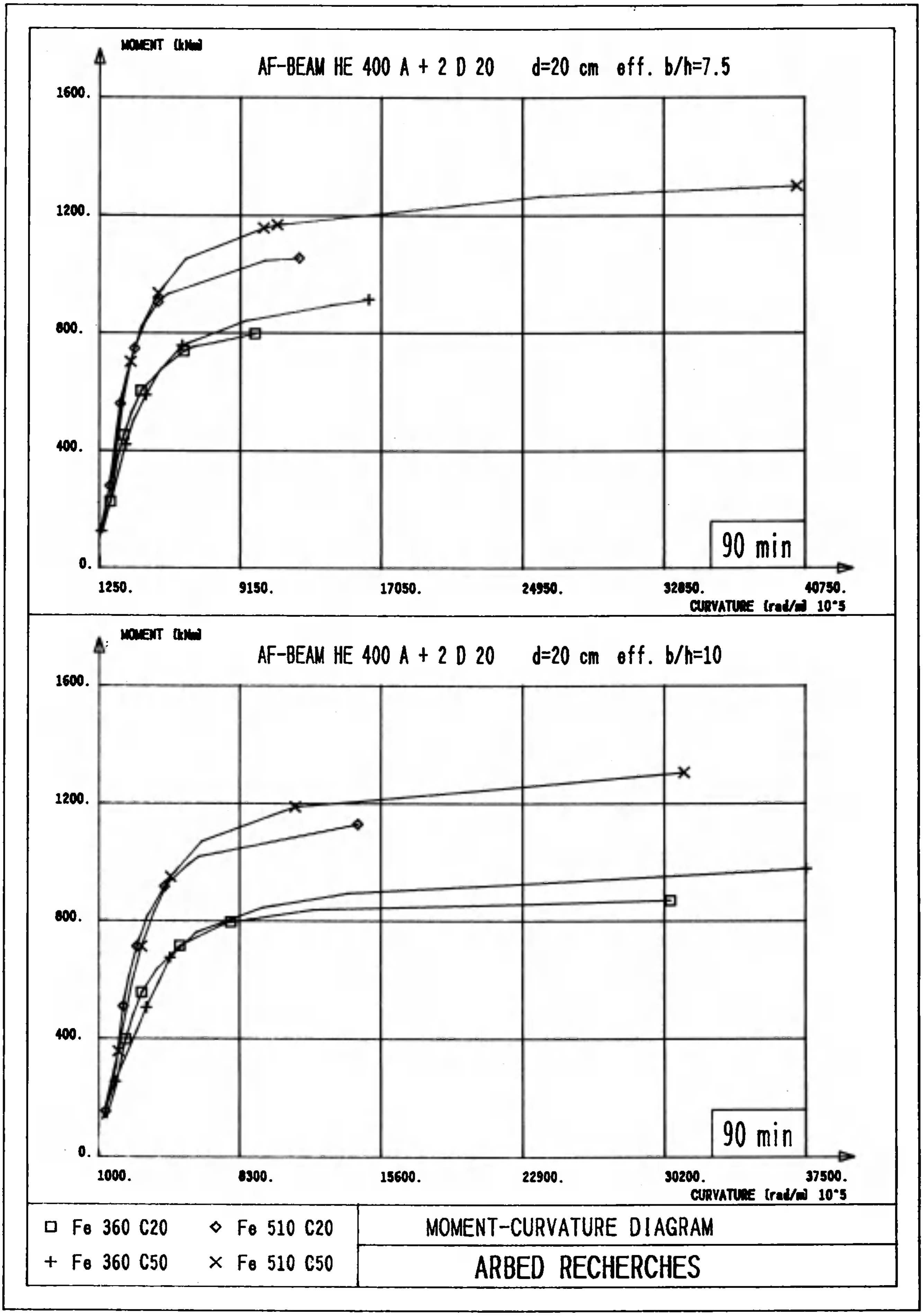
MOMENT-CURVATURE DIAGRAM

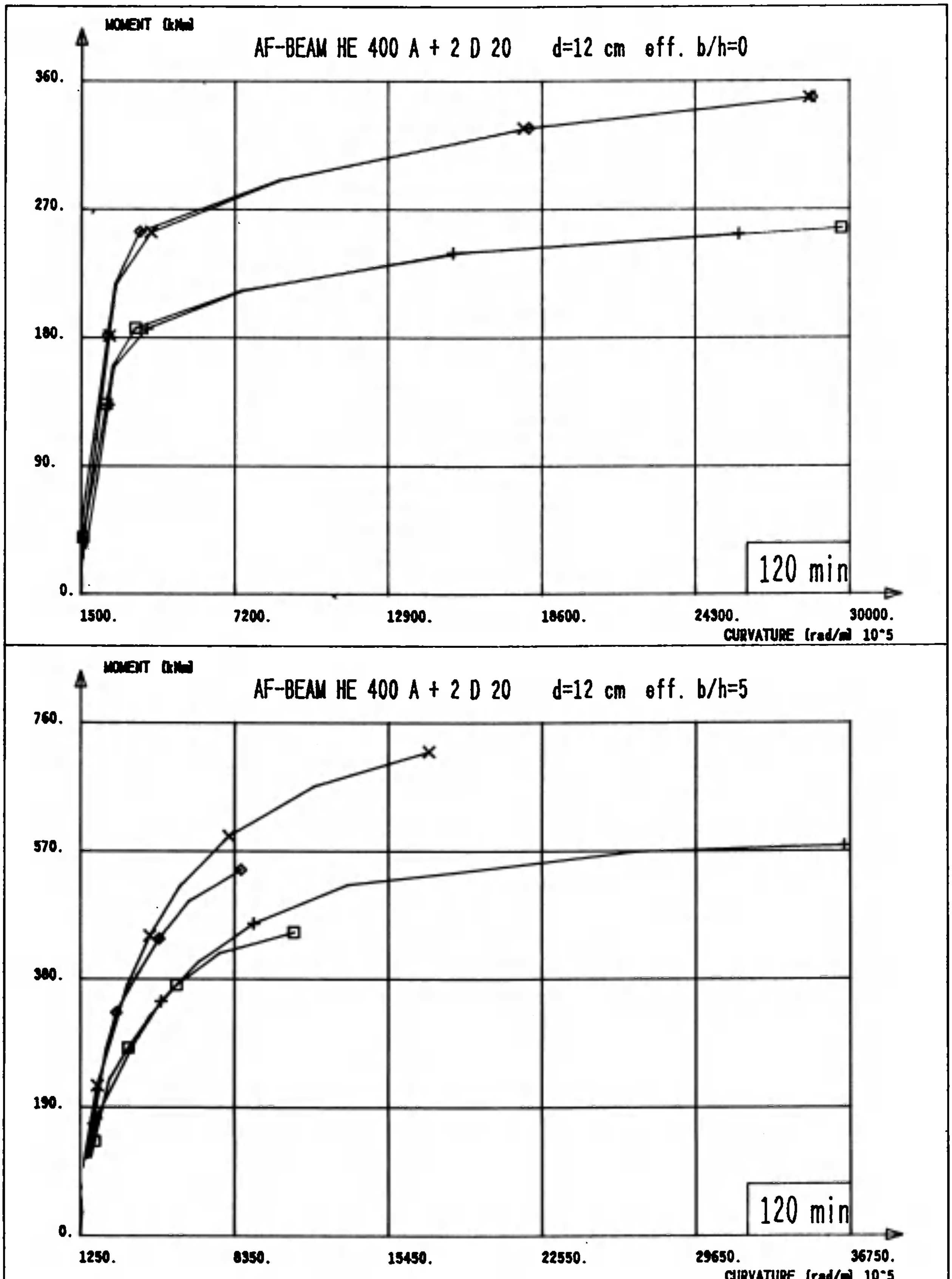
ARBED RECHERCHES



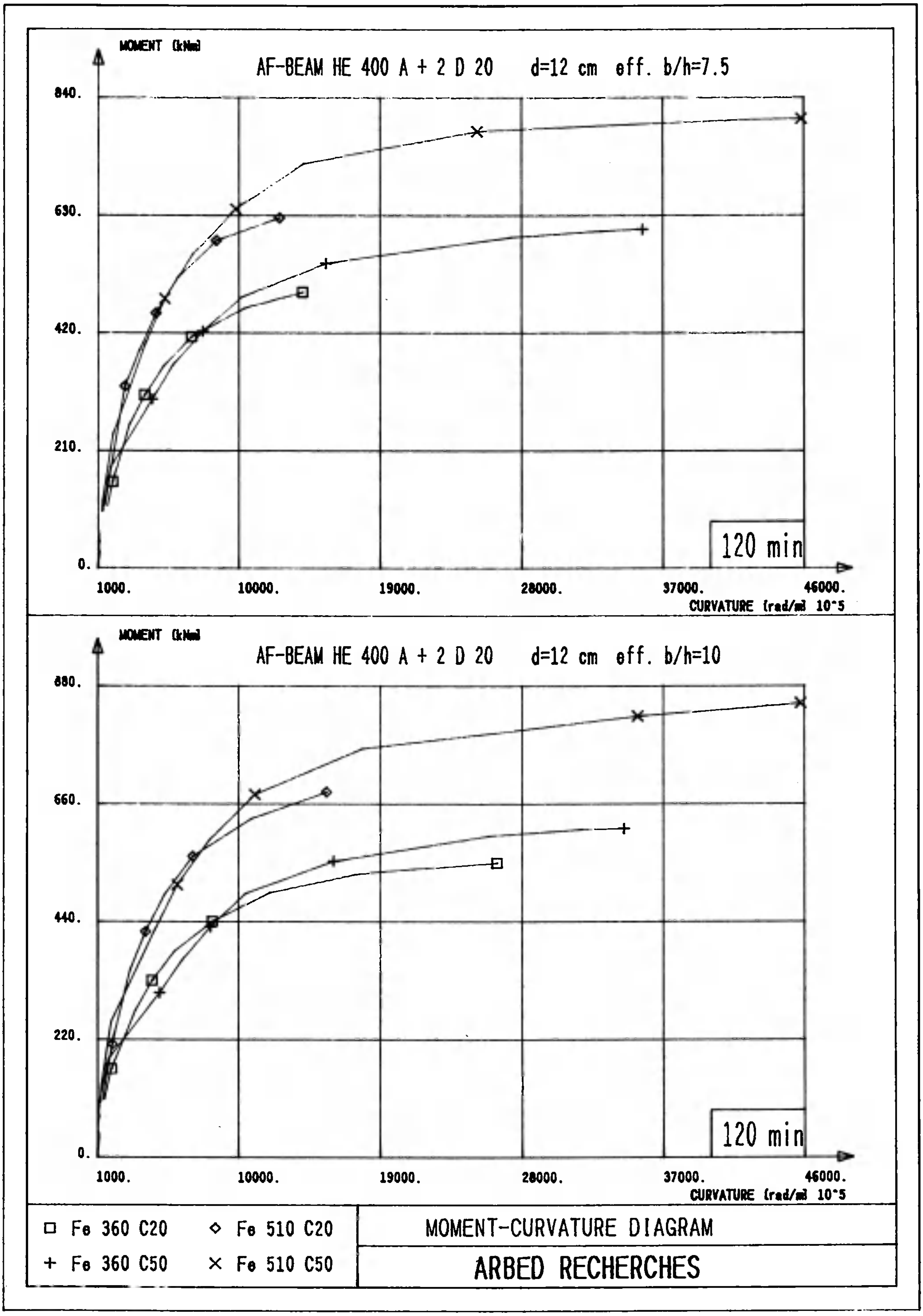


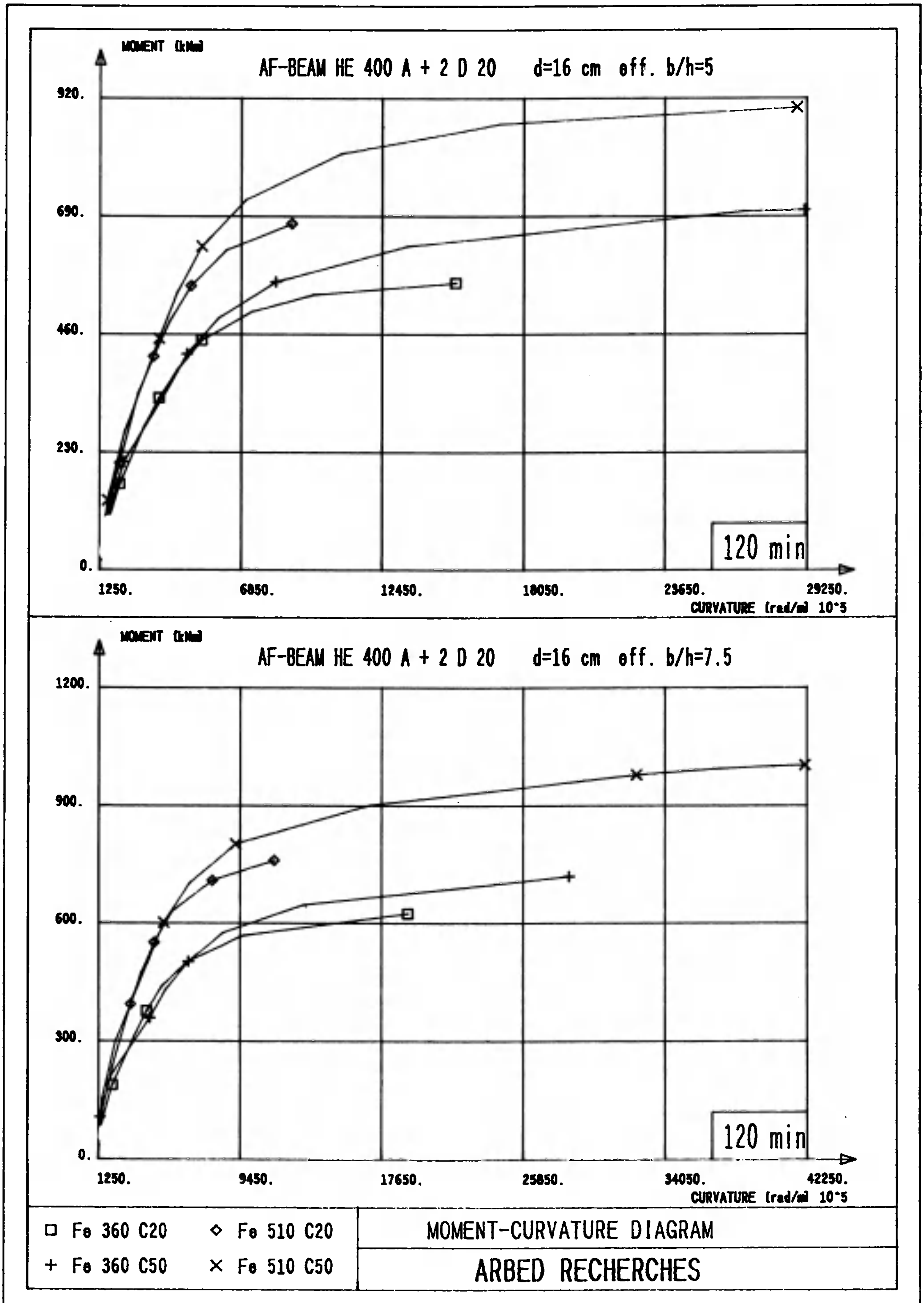
□ Fe 360 C20	◇ Fe 510 C20	MOMENT-CURVATURE DIAGRAM
+ Fe 360 C50	× Fe 510 C50	ARBED RECHERCHES


AF-BEAM HE 400 A + 2 D 20 d=20 cm eff. b/h=7.5
MOMENT (kNm)
1600.
1200.
800.
400.
0.
1250.
9150.
17050.
24950.
32850.
40750.
CURVATURE (rad/m) 10^5
90 min
AF-BEAM HE 400 A + 2 D 20 d=20 cm eff. b/h=10
MOMENT (kNm)
1600.
1200.
800.
400.
0.
1000.
8300.
15600.
22900.
30200.
37500.
CURVATURE (rad/m) 10^5
90 min
□ Fe 360 C20
◇ Fe 510 C20
+ Fe 360 C50
× Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES



□ Fe 360 C20 ◇ Fe 510 C20	MOMENT-CURVATURE DIAGRAM
+ Fe 360 C50 × Fe 510 C50	ARBED RECHERCHES


MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=7.5
840.
630.
420.
210.
0.
1000.
10000.
19000.
28000.
37000.
46000.
CURVATURE (rad/m) 10^-5
120 min
MOMENT (kNm)
AF-BEAM HE 400 A + 2 D 20 d=12 cm eff. b/h=10
880.
660.
440.
220.
0.
1000.
10000.
19000.
28000.
37000.
46000.
CURVATURE (rad/m) 10^-5
120 min
□ Fe 360 C20
◇ Fe 510 C20
+ Fe 360 C50
× Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES


MOMENT [kNm]
AF-BEAM HE 400 A + 2 D 20 d=16 cm eff. b/h=5
920.
690.
460.
230.
0.
120 min
1250.
6850.
12450.
18050.
23650.
29250.
CURVATURE [rad/m] 10^5
MOMENT [kNm]
AF-BEAM HE 400 A + 2 D 20 d=16 cm eff. b/h=7.5
1200.
900.
600.
300.
0.
120 min
1250.
9450.
17650.
25850.
34050.
42250.
CURVATURE [rad/m] 10^5
□ Fe 360 C20
◇ Fe 510 C20
+ Fe 360 C50
× Fe 510 C50
MOMENT-CURVATURE DIAGRAM
ARBED RECHERCHES