

Learning lunch 5 november 2020

New fire book: Benelux rules the waves

Brandveiligheid en berekening van de brandwerendheid van staalconstructies voor gebouwen volgens Eurocode 3

Brand

A.F. Hamerlinck



Handboeken staalconstructies

Brandveiligheid

Brandveiligheid en berekening van de brandwerendheid van staalconstructies voor gebouwen volgens Eurocode 3

Joakim Gyg Capri, Rik Debruyckere, Jean-Marc Franssen



Guides de construction métallique

Sécurité incendie

Sécurité incendie et calcul de la résistance au feu des bâtiments en acier selon l'Eurocode 3

Joakim Gyg Capri, Rik Debruyckere, Jean-Marc Franssen



....naar nieuw

Fire safety and fire resistant design of steel structures for buildings according to Eurocode 3

Steel Design 2

Fire

A.F. Hamerlinck

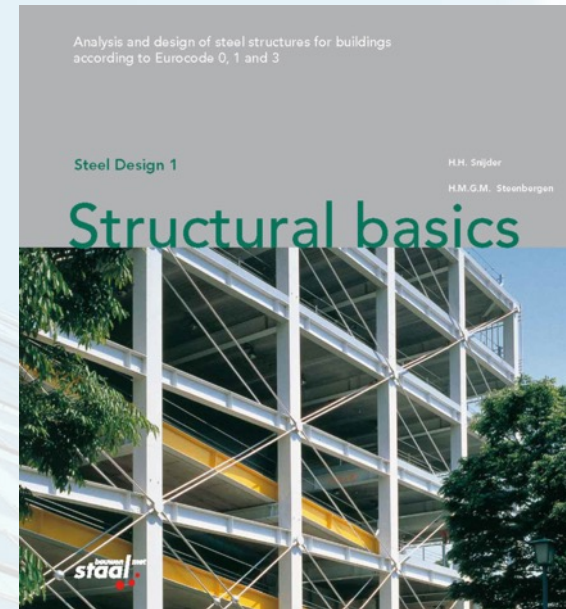


bouwen met
staal

bouwen met
staal

VEELZIJDIG • FLEXIBEL • DUURZAAM

- **Steel Design 1 Structural basics (2019)**
 - Analysis and design of steel structures for buildings according to Eurocode 0, 1 and 3
- **Steel Design 2 Fire (2021)**
 - Fire safety and fire resistant design of steel structures for buildings according to Eurocode 3
- **Steel Design 3 Connections**
 - Behaviour of connections in steel structures and design of mechanical fasteners and welds according to Eurocode 3
- **Steel Design 4 Composite structures**
 - Analysis and design of composite steel and concrete structures for buildings according to Eurocode 4
- **Steel Design 5 Joints**
 - Analysis and design of bolted and welded connections in steel frames and in tubular structures according to Eurocode 3



- universiteiten moeten in Engelse taal lesgeven
- elk land eigen studieboeken ≠ economisch
- Europese boeken om ontwikkelkosten te spreiden
- hoe omgaan met landspecifieke zaken (Nationale Bijlagen in Eurocodes)?
 - Engelstalig boek gebaseerd op de EN-versie van de Eurocode, met in kantlijn aangegeven waar de lezer wordt verwezen naar landspecifieke info,

In most European countries the required fire resistance of the main load bearing structure depends on the occupancy and the height of the building (e.g. fig. 1.24 as an example for the Dutch [and Belgian](#) building regulations).
 - als pdf te downloaden is bij de landelijke staalinfocenters.
- verspreidingsgebied voornamelijk Europa: actief doen nu mee: België, Luxemburg, Nederland en Zwitserland
- verkoop via de landelijke organisaties, maar ook via Worldsteel en als e-book via Wiley/Ernst & Sohn
- doelgroep: constructeurspraktijk en onderwijs

- concept vergelijkbaar met RFCS-disseminatie met centrale website en info over wettelijke context van regelgeving en toepassing van Eurocodes brand: <https://research.bauforumstahl.de/nl/fire-safety-1/locafi-temperature-assessment-of-a-vertical-member-subjected-to-localised-fire-10/>

Research

I01: LOCAFI+ Temperature assessment of a vertical member subjected to LOCALised Fire

- Design Guide_NL
- LOCAFI Juridische context_NL
- OZone V3 User Manual - OZone is a user-friendly software developed to calculate the thermal actions generated by a fire and the evolution of temperature in a steel structural element, using nominal fire curves or natural fire models based on physical and chemical parameters. This is the belonging user manual.
- Software OZone
- Seminar Presentations - Presentations on following Topics: Reason for the Projekt, Experimental tests and CFD calibration, Analytical method and validation, OZone Software, Synthesis Fire resistance and Worked examples.
- Legal Context_BE

LOCAFI+
Juridische Context

Temperatuurbepaling van een verticale stalen staaf blootgesteld aan een lokale brand - Valorisatie

bouwen met staal

LOCAFI+: Temperature assessment of a vertical member subjected to LOCALised Fire - Dissemination

Periode: 01/07/2017 – 31/12/2018

Fire safety engineering
Juridisch kader en referentiedocumenten in België

- concept vergelijkbaar met RFCS-disseminatie met centrale website en info over wettelijke context van regelgeving en toepassing van Eurocodes brand: <https://research.bauforumstahl.de/nl/fire-safety-1/locafi-temperature-assessment-of-a-vertical-member-subjected-to-localised-fire-10/>

bauforumstahl
ONLINE INFORMATION TOOL
FR

Research

I02: LOCAFI+ Temperature assessment of a vertical member subjected to LOCALised Fire

- OZone V3 User Manual_FR** - OZone is a user-friendly software developed to calculate the thermal actions generated by a fire and the evolution of temperature in a steel structural element, using nominal fire curves or natural fire models based on physical and chemical parameters. This is the belonging user manual.
- Seminar Presentations** - Presentations on following Topics: Reason for the Projekt, Experimental tests and CFD calibration, Analytical method and validation, OZone Software, Synthesis Fire resistance and Worked examples.
- Design Guide_FR**
- Legal Context_FR**
- Legal Context_LUX**
- Legal Context_BE**
- Software OZone**

LOCAFI+
Contexte Légal

Temperature assessment of a vertical steel member subjected to localized fire - Valorization

Ingénierie du Feu : Contexte légal et documents de référence au Luxembourg

ArcelorMittal

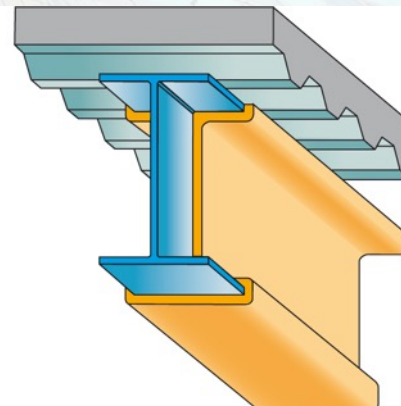
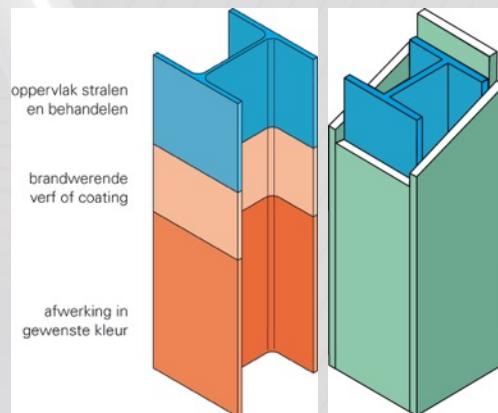
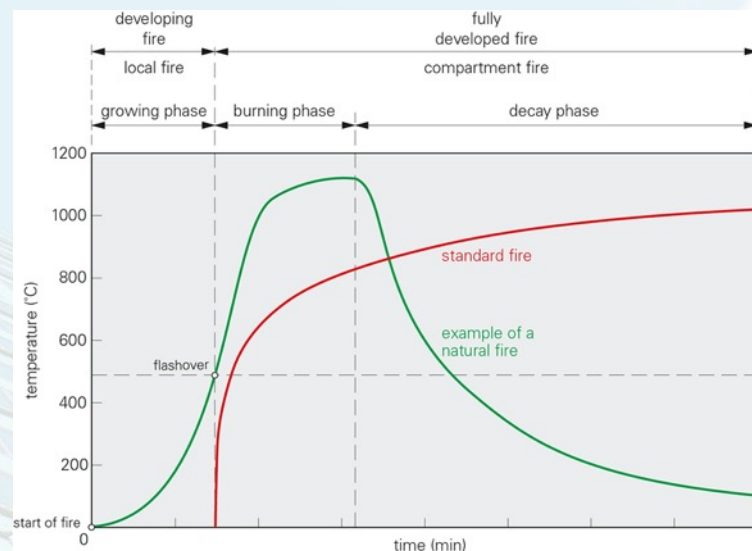
- uitgever Bouwen met Staal
- samenwerking met Worldsteel en Tata Steel Nederland als deelfinancier
- partners: België, Duitsland, Luxemburg, Nederland en Zwitserland
- aan 'Fire' werkten mee: Koen Michielsen, Infosteel (B), Graham Couchman, Steel Construction Institute (UK), Cor van Eldik en Ralph Hamerlinck, Bouwen met Staal (NL)



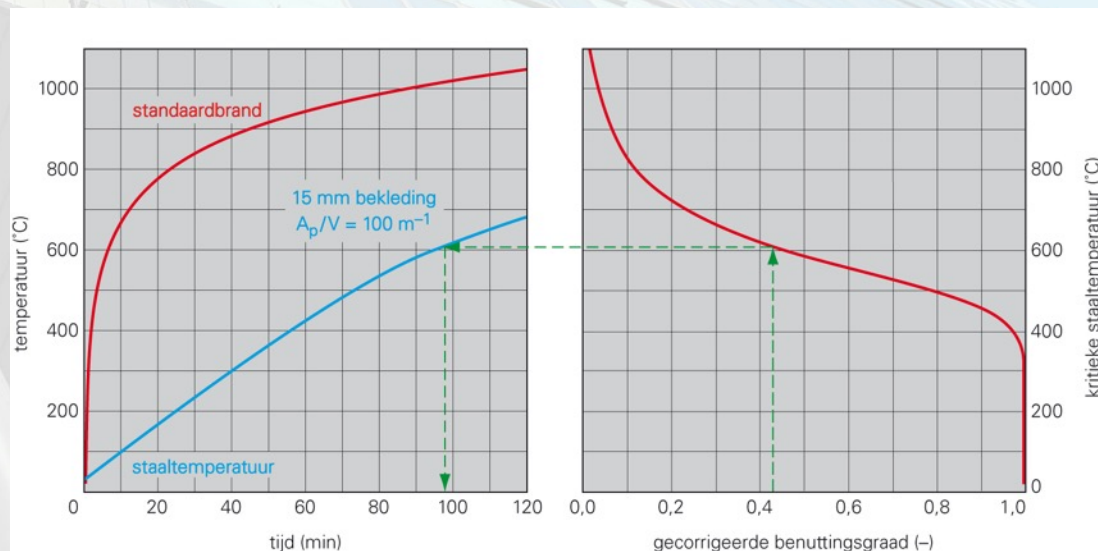
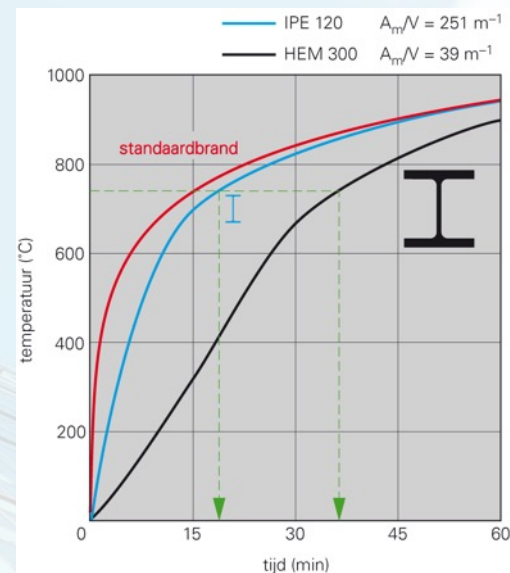
- hoofdstuk 1, 2, 4: klaar
- hoofdstuk 3: inhoudelijk klaar, nog redactionele bewerking
- eind 2020 boek gereed voor druk
- verschijnt begin 2021, met daarna de nationale teksten (pdf's te downloaden op websites van de staalinstituten)

- Chapter 1 Fire Safety
- Chapter 2 Calculation of the fire resistance
- Chapter 3 Fire safety engineering
- Chapter 4 Design tables

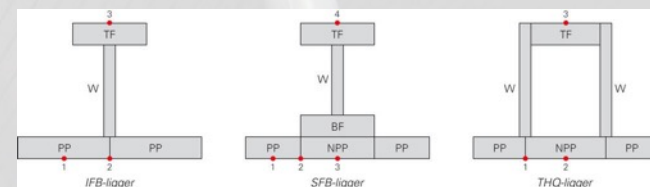
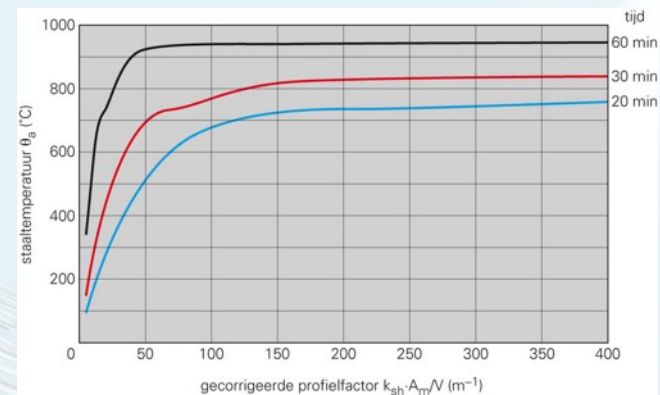
- Wat is brandveiligheid?
 - doelstellingen
 - maatregelen
- Ontwikkeling van brand
- Ontwerpen van brandveilige gebouwen
- Veiligheidseisen bij brand
- Belastingen bij brand
- Gedrag van staal bij brand



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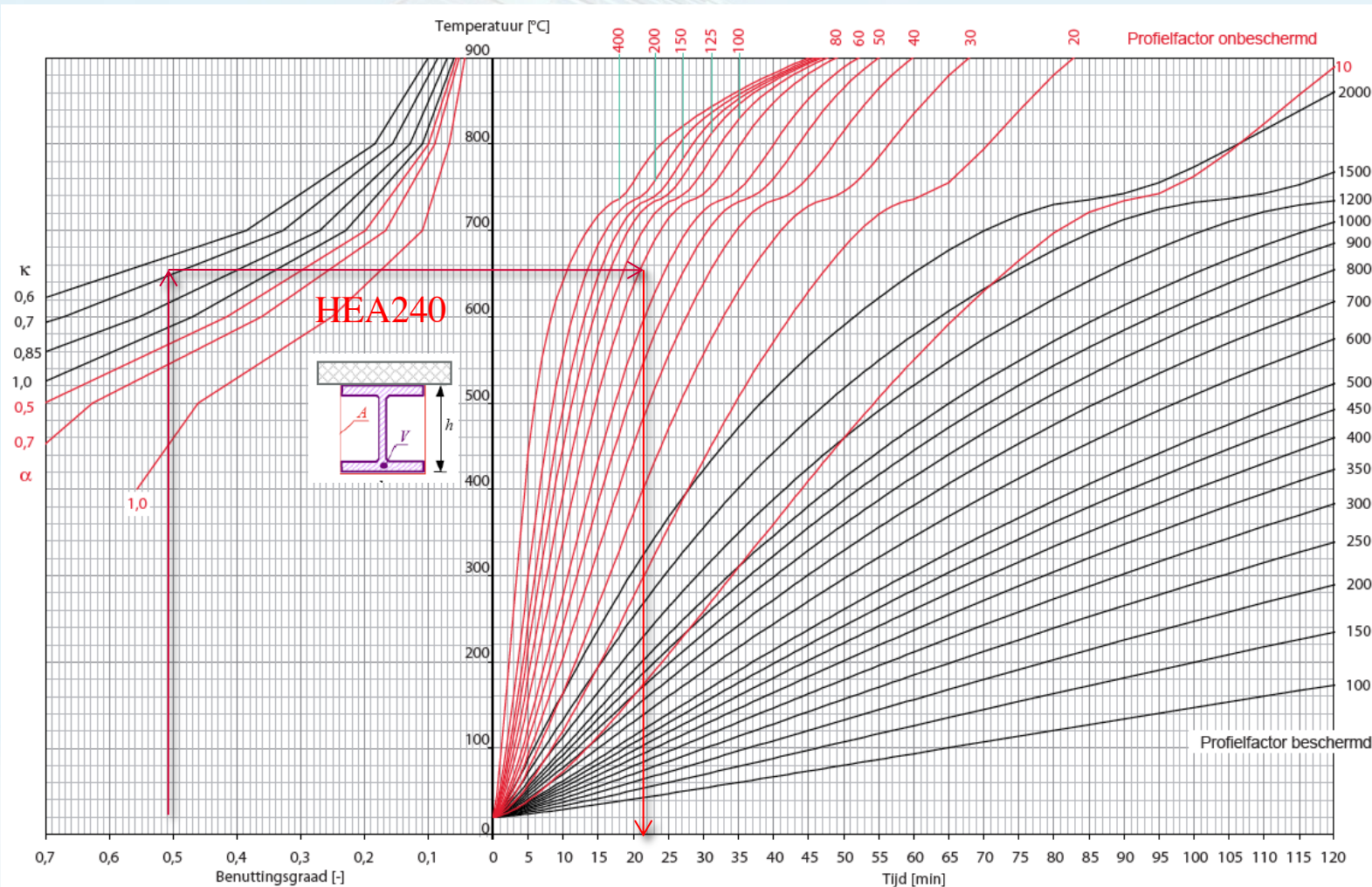


- Begrippen en randvoorwaarden
- Berekening van de thermische respons
 - achtergronden (on)beschermd profielen **NIEUW**
 - thermisch verzinkt staal **NIEUW**
- Berekening van de mechanische respons
 - verbindingen (met rekenvoorbeeld) **NIEUW**
 - trekstaven (met rekenvoorbeeld)
 - liggers met buiging zonder kip (met 2 rekenvoorbeelden)
 - kolom met druk (met rekenvoorbeeld)
 - liggers met kip (met rekenvoorbeeld)
- Geïntegreerde liggers
 - thermisch gedrag
 - rekenmethode onbeschermd liggers (met rekenvoorbeeld)
 - beschermd liggers



Chapter 2 Calculation of the fire resistance

- Tool: onbeklede statisch bepaalde ligger \wedge — \wedge



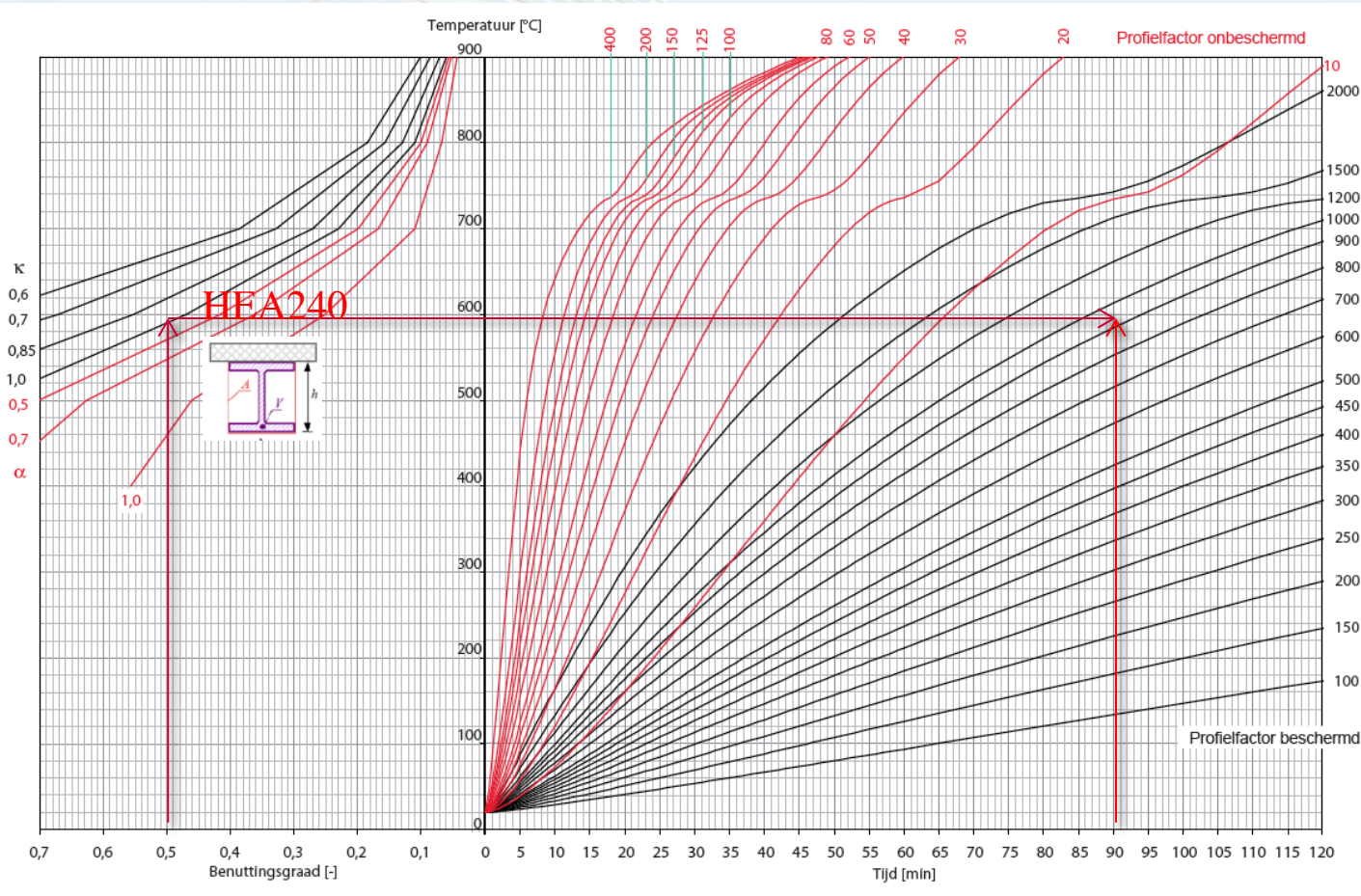
Afb. 2.12

Chapter 2 Calculation of the fire resistance

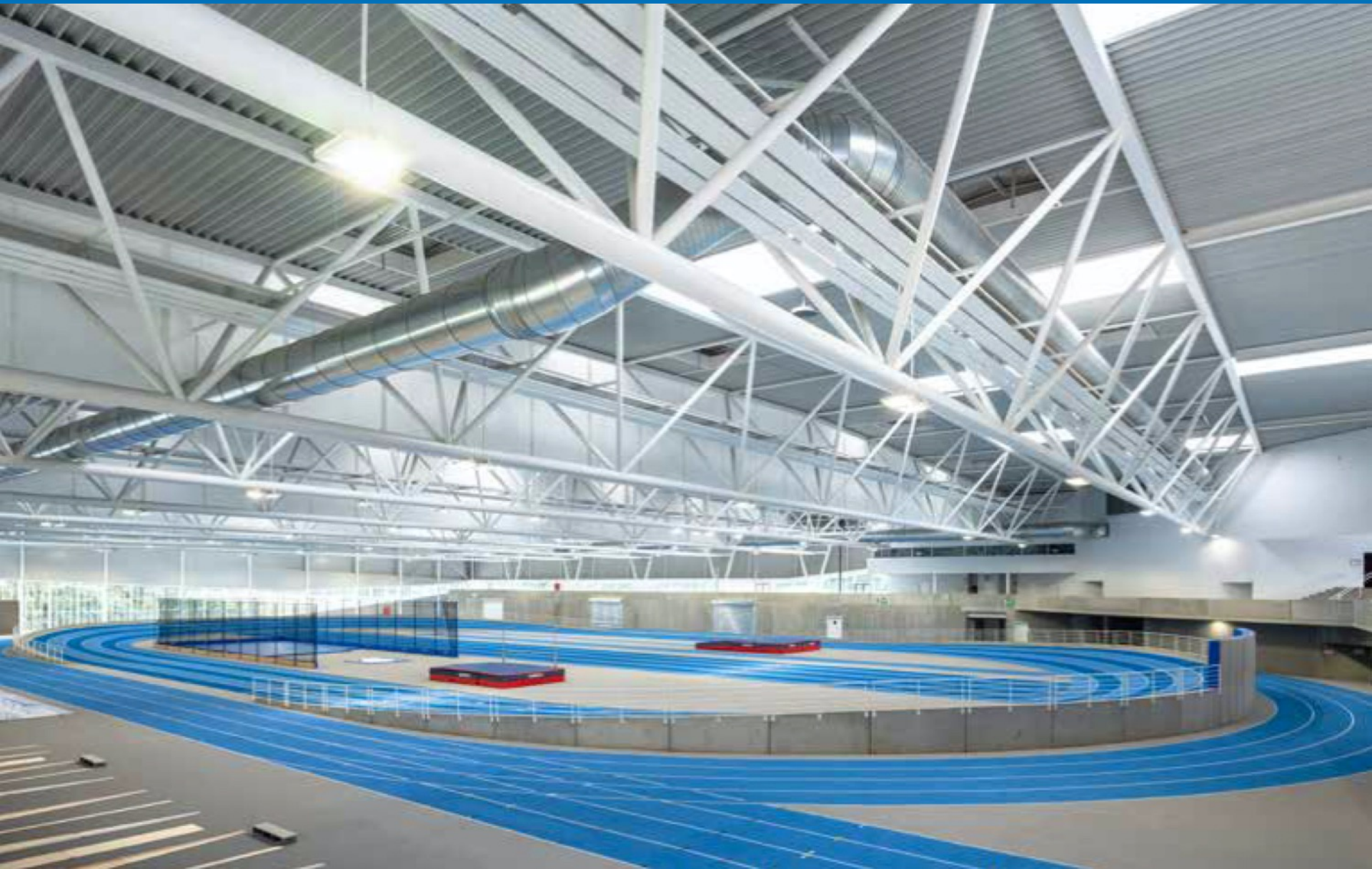
- Tool: beklede ligger 




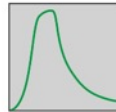

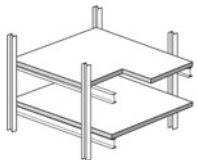
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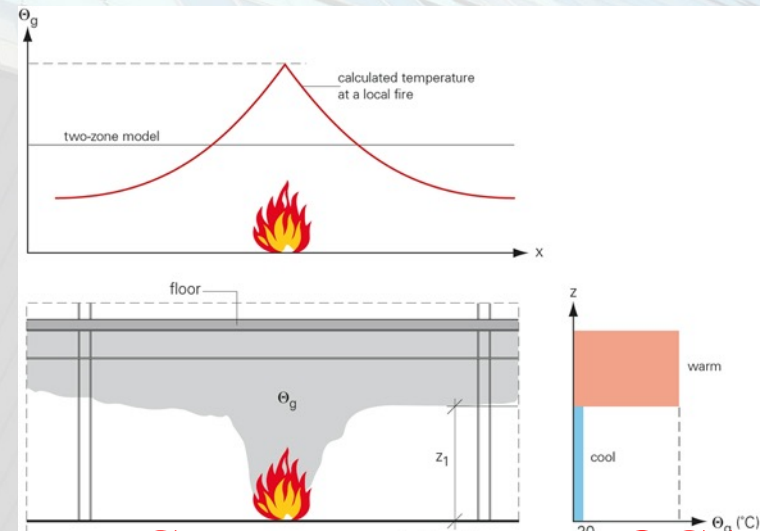
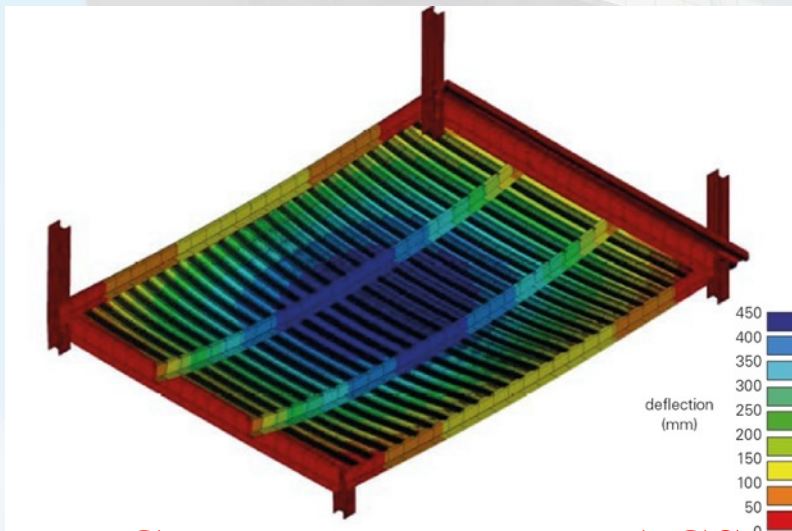
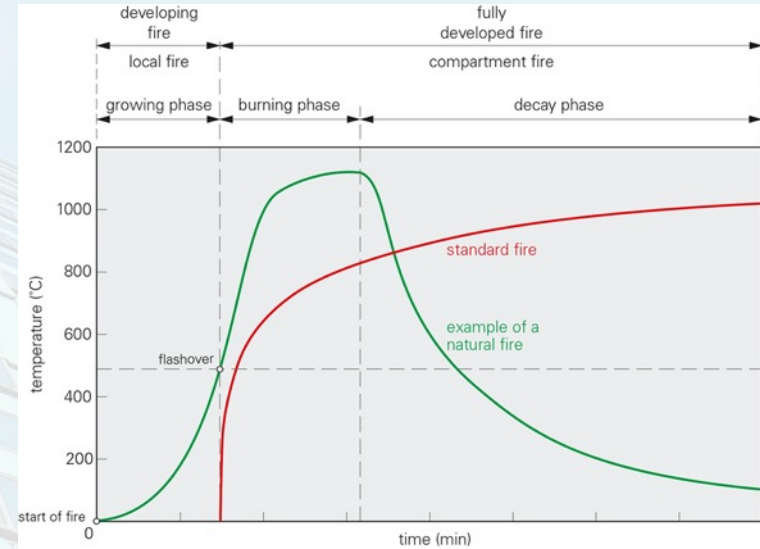


schatting bekledingsdikte



Chapter 3 Fire safety engineering

	 standard fire	 natural fire
 structural component	classification	fire safety engineering
 structural system	fire safety engineering	fire safety engineering



UITGEBREID MET MACS+ UITGEBREID MET LOCAFI



Fire

4 Design tables

dr.ir. A.F. Hamerlinck

Bouwen met Staal and Adviesbureau Hamerlinck

4.1

Reduction factor $k_{y,\theta}$ defined as the ratio between the (effective) yield strength $f_{y,\theta}$ at a steel temperature θ_a and the yield strength f_y at 20 °C, according to equation (2.2) in Fire 2 (Calculation of the fire resistance).

θ_a	$k_{y,\theta}$	θ_a	$k_{y,\theta}$	θ_a	$k_{y,\theta}$	θ_a	$k_{y,\theta}$	θ_a	$k_{y,\theta}$
350	1,000	384	0,988	418	0,963	452	0,913	486	0,830
351	1,000	385	0,988	419	0,962	453	0,911	487	0,827
352	0,999	386	0,987	420	0,961	454	0,909	488	0,825
353	0,999	387	0,987	421	0,960	455	0,907	489	0,822
354	0,999	388	0,986	422	0,958	456	0,905	490	0,819
355	0,999	389	0,986	423	0,957	457	0,903	491	0,816

NA 4.3 (continued)

Reduction factor for the design load level in the fire situation h_{fi} as a function of the ratio between the permanent load G_k and the variable load Q_k for different occupancies and load factors $\gamma_G = 1,2$ and $\gamma_Q = 1,5$, according to equation (2.3) of Fire 2 (Calculation of the fire resistance). Every member state specifies in its National Annex whether Ψ_1 or Ψ_2 has to be applied.

G_k/Q_k	$\Psi_1 = 0,0$ (roofs)	$\Psi_1 = 0,2$ (wind actions)	$\Psi_1 = 0,5$ (office, residential)	$\Psi_1 = 0,6$ (shopping, congregations)	$\Psi_1 = 0,9$ (storage)			
	$\Psi_2 = 0,0$ (roofs, wind actions)	$\Psi_2 = 0,3$ (office, residential)	$\Psi_2 = 0,6$ (shopping, congregations)	$\Psi_2 = 0,8$ (storage)				
1,35	0,433	0,497	0,529	0,593	0,625	0,657	0,689	0,721
1,40	0,440	0,503	0,535	0,597	0,629	0,660	0,692	0,723
1,45	0,448	0,509	0,540	0,602	0,633	0,664	0,694	0,725

NIEUW

4.4 (continued)

Steel temperature θ_a (°C) of an unprotected I-section exposed to the standard fire curve as a function of the section factor corrected to allow for the shadow factor $k_{sh} \cdot A_m / V$ (m⁻¹), for both non-galvanized and galvanized steel.

With $k_{sh} = 1$ the table can also be used for other types of unprotected sections, such as hollow sections and angles.

$k_{sh} \cdot A_m / V$ (m ⁻¹)	fire exposure time (minutes)											
	non-galvanized steel						galvanized steel					
	15	20	30	60	90	120	15	20	30	60	90	120
76	497	622	738	935	1001	1046	382	500	726	935	1001	1046
77	501	625	739	936	1001	1046	385	504	728	936	1001	1046
78	504	628	740	936	1001	1046	388	510	729	936	1001	1046
79	508	631	741	936	1001	1046	391	516	731	936	1001	1046
80	511	634	742	936	1001	1046	395	522	732	936	1001	1046

NIEUW





Fire

Design tables

4.5 (continued)

Section factor A/V (m^{-1}) for IPE, HEA, HEB and HEM sections, exposed to the standard fire curve. Values given for unprotected sections include the correction factor to allow for the shadow effect k_{sh} .

section	unprotected		contour encasement		hollow encasement	
	four-sided heating	three-sided heating	four-sided heating	three-sided heating	four-sided heating	three-sided heating
	HEB 600	60	50	86	75	67
HEB 650	60	50	85	74	66	56
HEB 700	59	50	82	72	65	55

4.6 (continued)

Steel temperature θ_a ($^{\circ}C$) of unprotected IPE and HE sections after 30 minutes exposure to the standard fire curve (based on values from table 4.5 and table 4.4), for both non-galvanized and galvanized steel.

profiel	non-galvanized steel		galvanized steel		profiel	non-galvanized steel		galvanized steel	
	four-sided heating	three-sided heating	four-sided heating	three-sided heating		four-sided heating	three-sided heating	four-sided heating	three-sided heating
	HEB 160	777	741	760		731	HEM 100	739	719
HEB 180	767	737	750	723	HEM 120	736	710	718	637
HEB 200	757	734	741	709	HEM 140	733	700	707	616

NIEUW

NIEUW



Fire

Design tables

4.7

Steel temperature $\theta_{a,ext}$ (°C) of an unprotected I-section exposed to the external fire curve as a function of the section factor $k_{sh}A_m/V$ (m^{-1}) corrected to allow for the shadow factor.

With $k_{sh} = 1$ the table can also be used for other types of unprotected sections, such as hollow sections and angles.

$k_{sh} \cdot A_m / V$ (m^{-1})	fire exposure time (minutes)				$k_{sh} \cdot A_m / V$ (m^{-1})	fire exposure time (minutes)			
	30	60	90	120		30	60	90	120
5	122	219	301	372	105	667	679	679	679
10	208	364	474	547	110	669	679	679	679
15	284	469	571	623	115	671	679	679	679
20	349	541	622	655	120	672	679	679	679

NIEUW

4.12

Critical steel temperature $\theta_{a,cr}$ (°C) for centrally loaded compression members in grade **S460** steel.

NIEUW

relative slenderness $\bar{\lambda}$	plastic degree of utilization μ_{pl}															
	0,05	0,06	0,07	0,08	0,09	0,10	0,11	0,12	0,13	0,14	0,15	0,16	0,17	0,18	0,19	0,20
0,00	950	900	880	860	840	820	800	792	783	775	767	758	750	742	733	725
0,04	946	898	877	857	836	816	798	790	781	772	764	755	747	738	730	721
0,08	941	896	875	854	833	812	796	787	779	770	761	752	743	734	726	717
0,12	937	893	872	851	829	808	794	785	776	767	758	749	740	731	722	712
0,16	932	891	869	847	825	803	792	783	773	764	755	745	736	727	717	708
0,20	927	889	866	844	821	799	790	780	770	761	751	742	732	722	713	703

4.13 (continued)

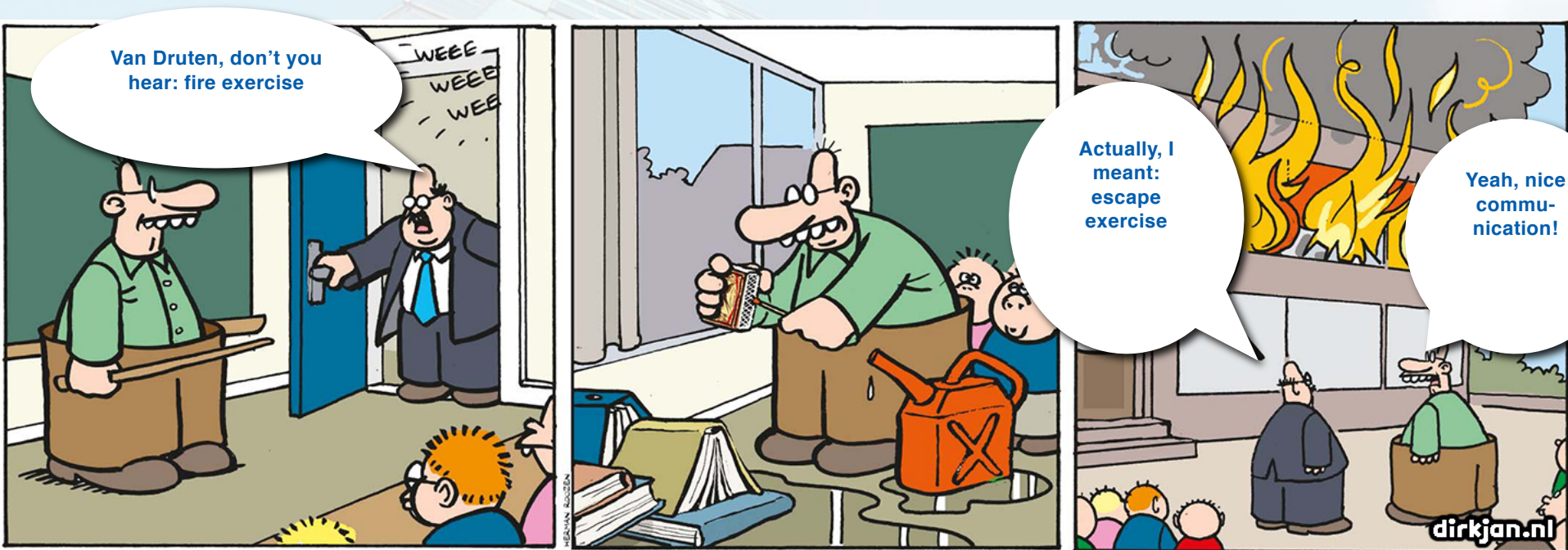
Cross-section class of IPE, HEA, HEB and HEM sections in bending and compression at room temperature and in the fire situation for grades **S235**, **S355**, **S420** and **S460** steel.

section	room temperature								fire							
	bending				compression				bending				compression			
	S235	S355	S420	S460	S235	S355	S420	S460	S235	S355	S420	S460	S235	S355	S420	S460
HEB 600	1	1	1	1	1	3	3	4	1	1	1	1	2	4	4	4
HEB 650	1	1	1	1	2	3	4	4	1	1	1	1	3	4	4	4
HEB 700	1	1	1	1	2	4	4	4	1	1	1	1	3	4	4	4

Fire

Design tables

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Bouwen met Staal en Houtbouw Nederland



- dat het nieuwe boek moge bijdragen aan betere communicatie over staal en brand en aan een hoger kennisniveau