Seminar « BRIDGE DESIGN WITH EUROCODES »

JRC Ispra – 1 & 2 October 2012

Explaining National Calibration Period:

How to lay down the Nationally Determined Parameters and prepare the National Annexes

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Why NATIONAL ANNEXES ?

In a Eurocode Part (= EN standard), there are procedures, values, or classes recommendations, for which an agreement could not be reached within CEN TC250 sud-committees.

These are Nationally Determined Parameters (NDP)

For each of them, a NOTE in the EN standard :

- indicates that a National choice should be given in a NATIONAL ANNEX to this Eurocode Part and
- gives a recommendation for a National choice that provides an acceptable level of reliability.

NATIONAL ANNEXES to EUROCODE Parts

National Annexes may only contain information on those NDPs which are left open for national choice:

- **Values and/or classes where alternatives are given**
- **Values to be used where a symbol only is given**
- **Country specific data (geographical, climatic, etc.)**
- **Procedures to be used where alternatives are given**

Values and/or classes where alternatives are given

Example from EN 1991-1-1 “Imposed loads”:

Table 6.2 – Imposed loads on floors, balconies and stairs in buildings

Categories of loaded areas	q_k [kN/m^2]	Q_k [kN]
Category A		
- Floors	1,5 to 2,0	2,0 to 3,0
- Stairs	2,0 to 4,0	2,0 to 4,0
- Balconies	2,5 to 4,0	2,0 to 3,0
Category B	2,0 to 3,0	1, 5 to 4,5
Category C		
- C1	2,0 to 3,0	3,0 to 4,0
- C2	3,0 to 4,0	2,5 to 7,0 (4,0)
- C3	3,0 to 5,0	4,0 to 7,0
- C4	4,5 to 5,0	3,5 to 7,0
- C5	5,0 to 7,5	3,5 to 4,5
Category D		
-D1	4,0 to 5,0	3,5 to 7,0 (4,0)
-D2	4,0 to 5,0	3,5 to 7,0

NOTE: Where a range is given in this table, the value may be set by the National annex. The recommended values, intended for separate application, are underlined. q_k is intended for the determination of general effects and Q_k for local effects. The National annex may define different conditions of use of this Table.

Values to be used where a symbol only is given

Example from EN 1991-1-5 "Thermal actions":

6.1.5 Simultaneity of uniform and temperature difference components

(1) If it is necessary to take into account both the temperature difference $\Delta T_{M,heat}$ (or $\Delta T_{M,cool}$) and the maximum range of uniform bridge temperature component $\Delta T_{N,exp}$ (or $\Delta T_{N,con}$) assuming simultaneity (e.g. in case of frame structures) the following expression may be used (which should be interpreted as load combinations):

$$\Delta T_{M,heat} \text{ (or } \Delta T_{M,cool}) + \omega_N \ \Delta T_{N,exp} \text{ (or } \Delta T_{N,con}) \qquad (6.3)$$

or

$$\omega_M \ \Delta T_{M,heat} \text{ (or } \Delta T_{M,cool}) + \Delta T_{N,exp} \text{ (or } \Delta T_{N,con}) \qquad (6.4)$$

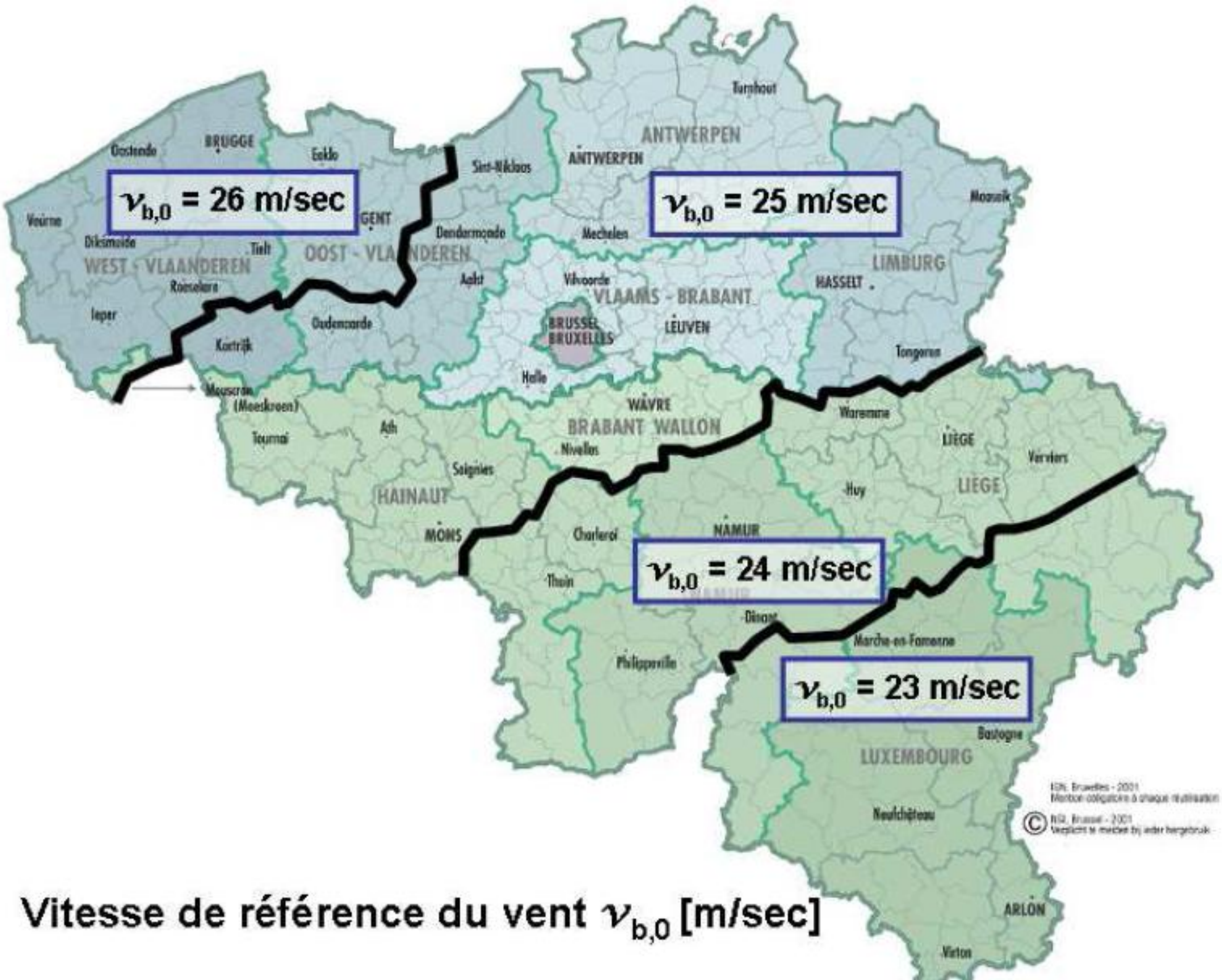
where the most adverse effect should be chosen.

NOTE 1: The National annex may specify numerical values of ω_N and ω_M. If no other information is available, the recommended values for ω_N and ω_M are:

ω_N = 0,35

ω_M = 0,75.

Country specific data (geographical, climatic, etc.): Belgian National Annex to EN 1991-1-4 (wind)



Vitesse de référence du vent $v_{b,0}$ [m/sec]

Procedures to be used where alternatives are given

Example from EN 1991-1-2 "Actions on structures exposed to fire":

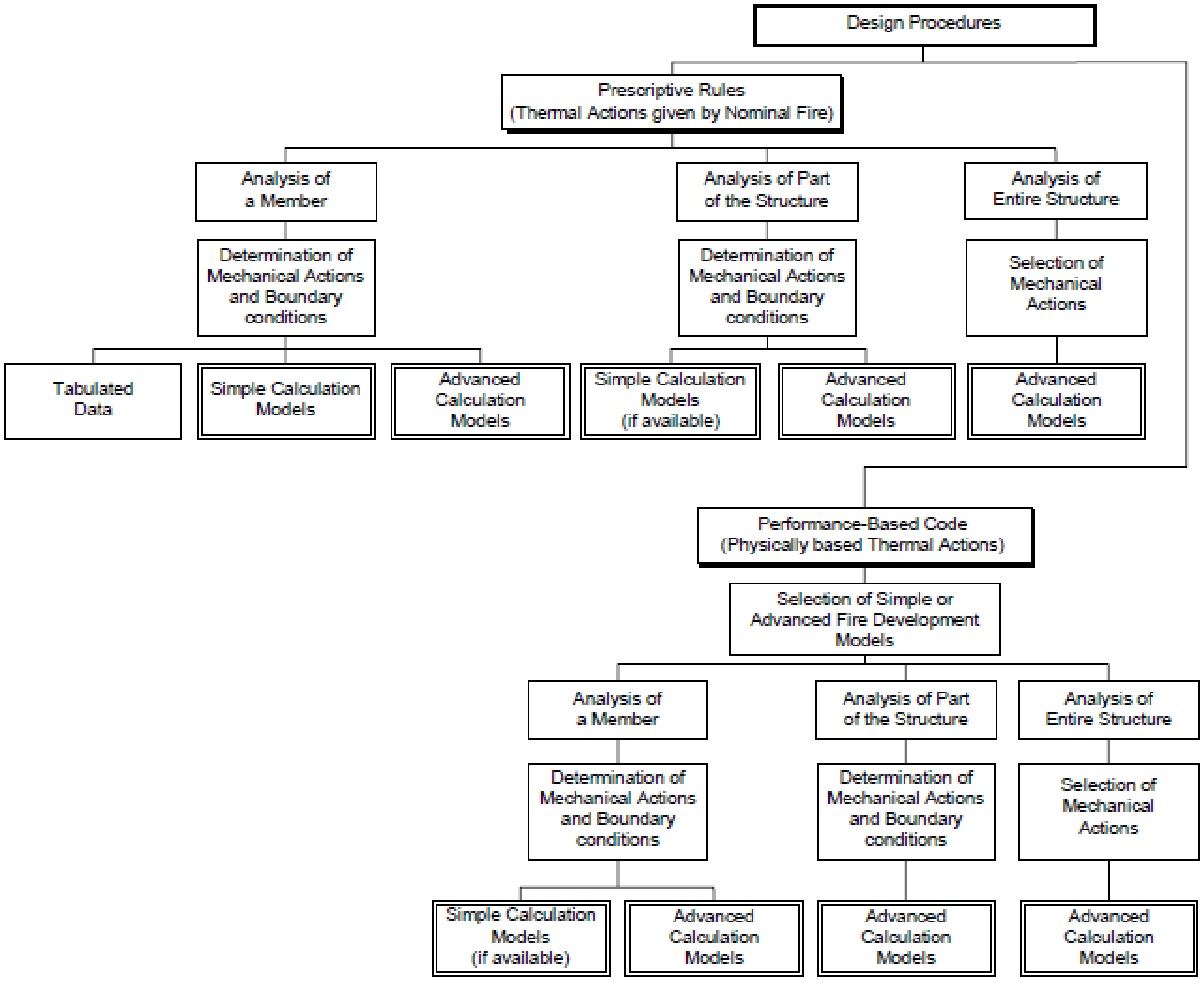


Figure 1 — Alternative design procedures

Belgian National Annexes (NBN)

NBN (Belgian Bureau of Standards) :

58 Working Groups to draft the Belgian National Annexes (ANB)

Projects in Flemish and French submitted to public enquiry (6 month)

National Annexes published as NBN standards (December 2011)

Luxemburg National Annexes (ILNAS)

Based on the Belgian National Annexes

One Working Group of 6 Experts to draft the 58 projects for Luxemburg (December 2009 – March 2010):

- 2 Belgians (reporters) from NBN/SECO
- 4 Experts from Luxemburg

Public enquiry (June 2010-March 2011)

Projects commented to be revised by working groups including the authors of comments (May-August 2011)

Publication as ILNAS standards (December 2011)

Luxemburg National Annexes (ILNAS)

The projects of Luxemburg National Annexes have been notified to the European Commission.

The 58 projects may be freely downloaded in the 22 languages of the European Union on :

http://ec.europa.eu/enterprise/tris/pisa/app/search/index.cfm?fuseaction=advanced&lang=en

Year : **2010**

Country : **Luxemburg**

Product type : **B00 : Construction**

Example of AN-LU : EN 1991-1-3 « Snow loads »

Paragraph	Parameters defined at the national level
1.1(2) NOTE 1	Not applicable: the various altitudes within Luxembourg do not exceed 600 m.
1.1(3) NOTE 2	Case A contained in table A.1 of Annex A shall apply. The loads are not differentiated based on the applicable site conditions.
1.1(4) NOTE 3	Annex B shall not apply.
2(3) NOTE	Exceptional snow loads shall not apply.
2(4) NOTE	Exceptional accumulations of snow shall not apply.
3.3(1) NOTE 2	None of the project locations requires the application of exceptional conditions.
3.3(3) NOTE 2	None of the project locations requires the application of exceptional conditions.
4.1(1) NOTE 1	The characteristic value s_k (in kN/m²) of the ground snow load is defined by the expression (4.2 AN-LU) which is based on altitude A (in m): $s_k = 0.41 + A/966$ [kN/m²] (4.2 AN-LU) ***NON-CONTRADICTORY COMPLEMENTARY INFORMATION:*** ***The characteristic value s_k corresponds to a probability of 0.02, i.e. a return period of 50 years.***

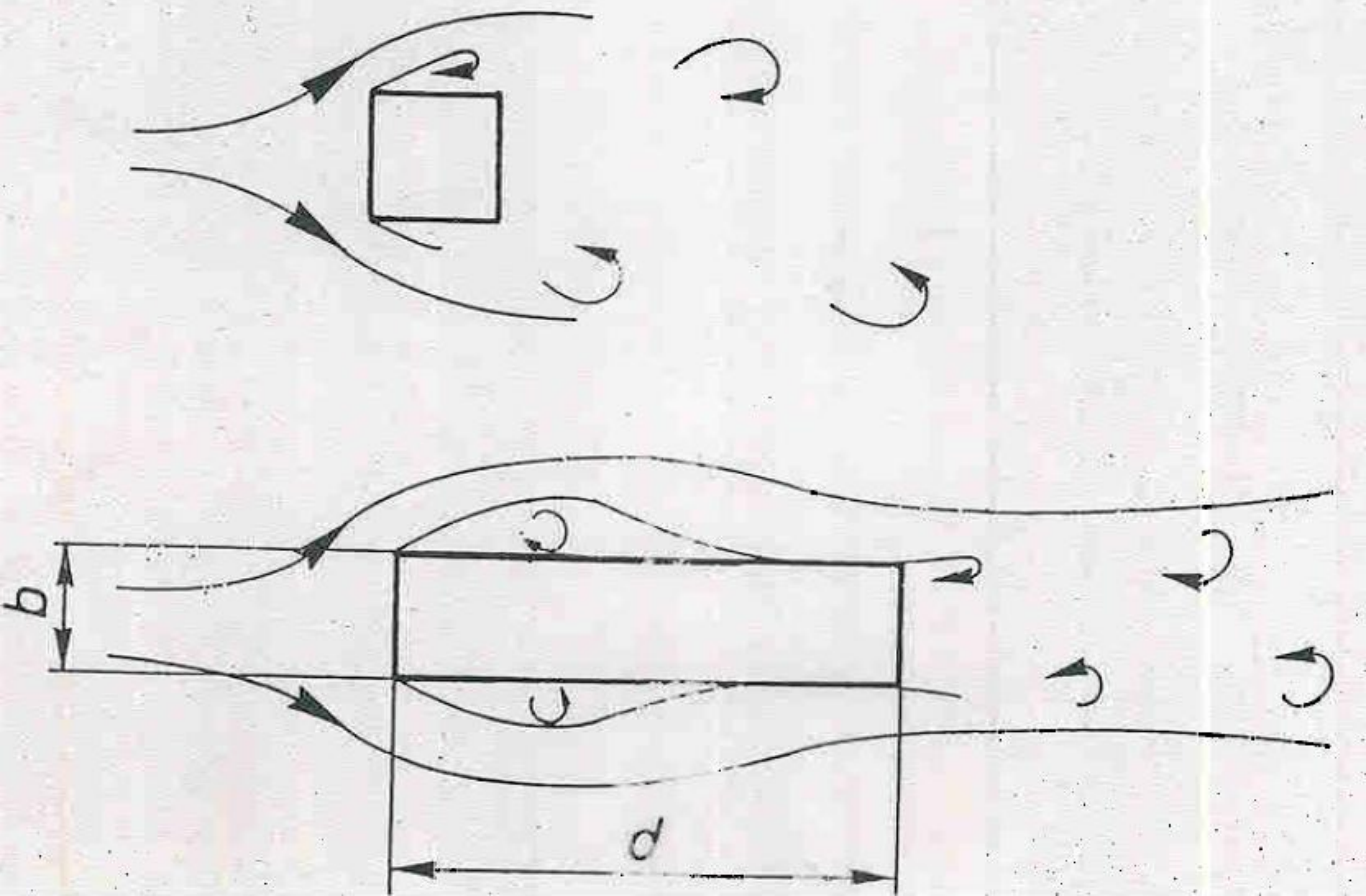
NATIONAL ANNEXES to EUROCODE Parts

National Annexes may also contain :

- **Decisions on the application of informative annexes of a Eurocode Part (to be normative, to remain informative or not to be applied)**

- **References to non-contradictory complementary information to assist the user to apply the Eurocode Part**

Annex E: Vortex shedding



Aeroelastic instabilities – critical velocities

E.2 Galloping

$$v_{CG} = \frac{2 \cdot Sc}{a_G} \cdot n_{1,y} \cdot b \qquad (E.18)$$

a_G is the factor of galloping instability (Table E.7)

E.4.4.4 AN-LU Instability of bridges under pure torsion

$$v_{CT} = n_{1,t} . d . \tau \qquad \textit{(E.32 AN-LU)}$$

τ *is the instability coefficient under torsion of the bridge*

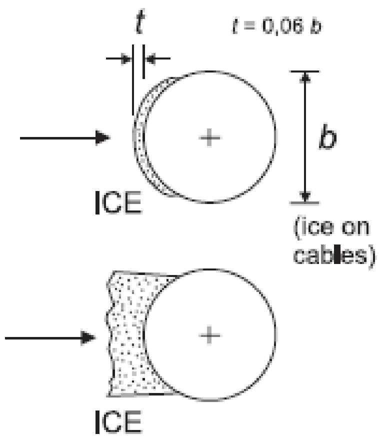
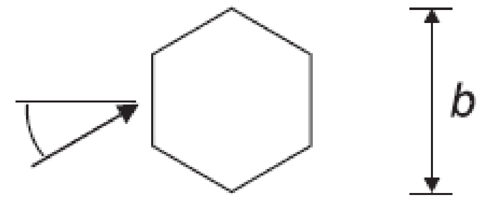
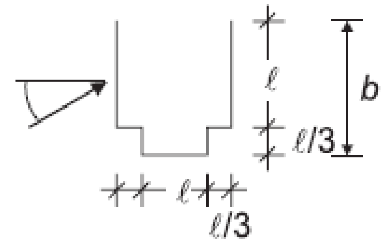
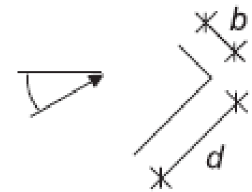
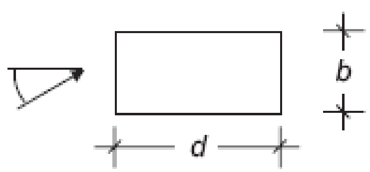
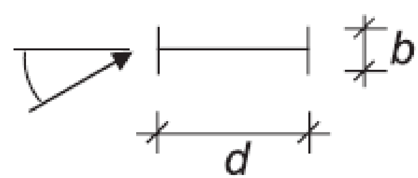
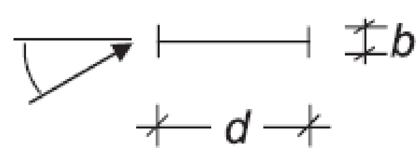
E.4.4.5 AN-LU Instability of bridges under both bending and torsion

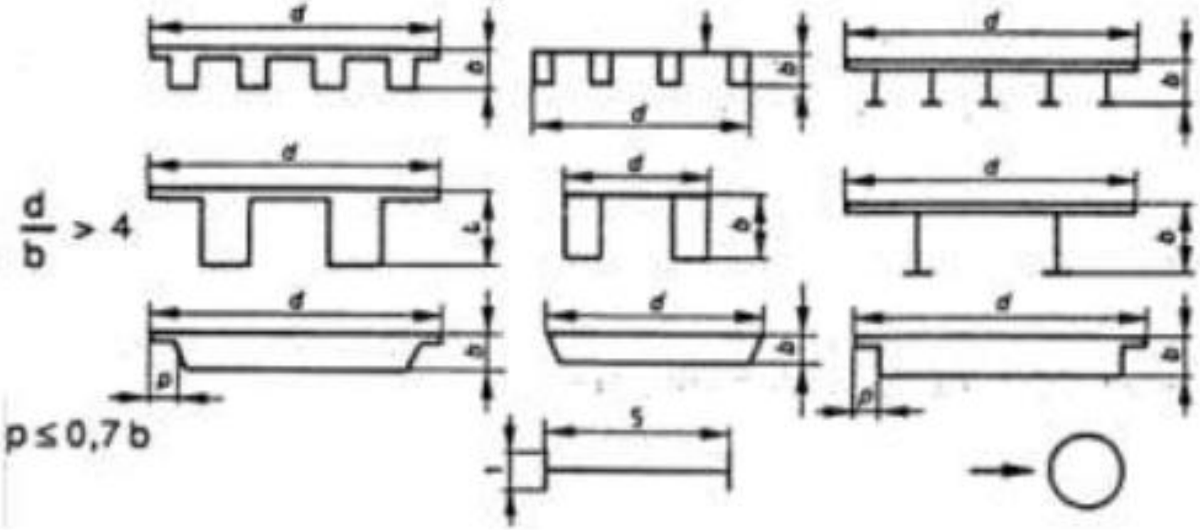
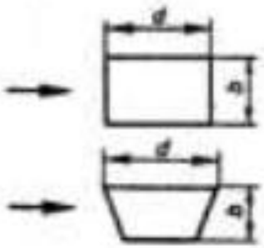
$$v_{C\varepsilon} = \pi . n_{r,f} . d . \beta . \eta \qquad \textit{(E.33 AN-LU)}$$

β *is the instability coefficient under both bending and torsion of a flat sheet parallel to the wind direction.*

η *is the ratio between the critical speed of the deck section and the critical speed of a plate which is parallel to the wind direction. It is given in figure E.15 AN-LU based on* $\varepsilon = n_{1,t} / n_{r,f}$ *as well as on the cross-section type of the bridge deck.*

Table E.7 — Factor of galloping instability a_G

Cross-section		Factor of galloping instability a_G	Cross-section		Factor of galloping instability a_G
		1,0			1,0
					4
	d/b=2	2		d/b=2	0,7
 linear interpolation	d/b=1,5	1,7		d/b=2,7	5
	d/b=1	1,2		d/b=5	7

<table>
<tr><th colspan="4">CROSS-SECTION</th><th colspan="3">a_G</th></tr>
<tr><td colspan="4" rowspan="3">open or closed

</td><td colspan="3">Turbulence intensity I_v</td></tr>
<tr><td>0</td><td>0,10</td><td>0,20</td></tr>
<tr><td>stable</td><td>stable</td><td>stable</td></tr>
<tr><td rowspan="7"></td><td rowspan="7">$p \leq 0.7\ b$

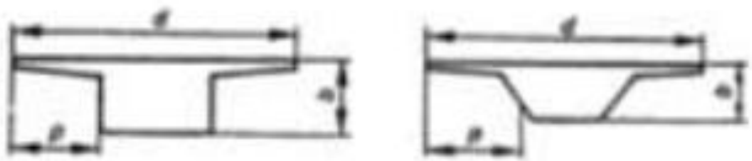
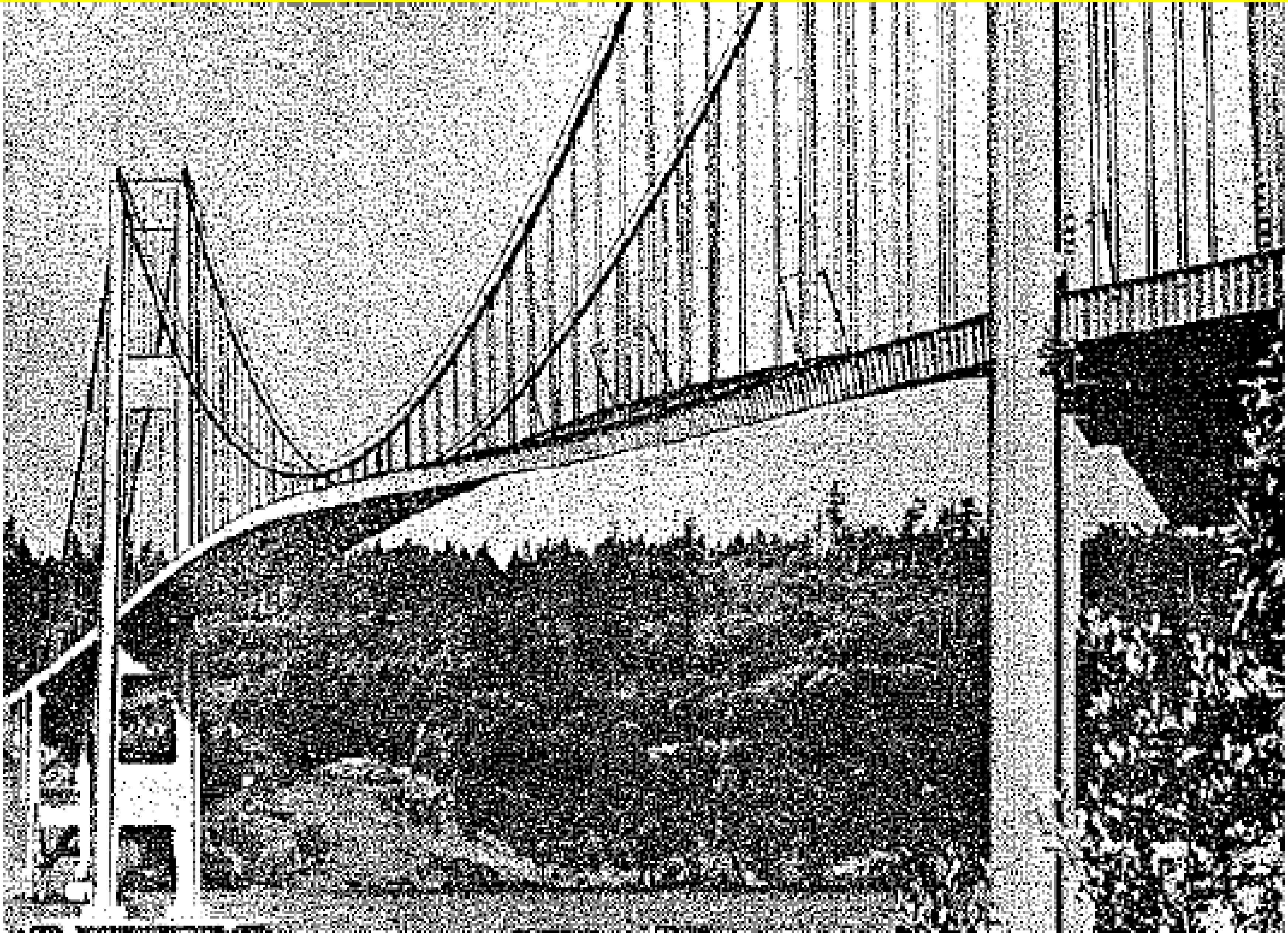
$\lambda \geq 12$
(Table 7.18 AN-LU)</td><td rowspan="7">d/b</td><td>≤ 0,33</td><td>stable</td><td>stable</td><td>stable</td></tr>
<tr><td>0,5</td><td>stable</td><td>0,5</td><td>1</td></tr>
<tr><td>0,7</td><td>stable</td><td>0,74</td><td>1</td></tr>
<tr><td>1</td><td>2,7</td><td>2,6</td><td>1,5</td></tr>
<tr><td>1,5</td><td>1,91</td><td>1,83</td><td>stable</td></tr>
<tr><td>2</td><td>2,8</td><td>stable</td><td>stable</td></tr>
<tr><td>≥ 3</td><td>stable</td><td>stable</td><td>stable</td></tr>
<tr><td colspan="3"></td><td>$p > 0.7\ b$
$d/b \leq 4$</td><td>2</td><td>2</td><td>2</td></tr>
</table>

Figure E.11 AN-LU: Galloping instability coefficient a_G for bridges

Torsional vibrations of TACOMA bridge (1940)



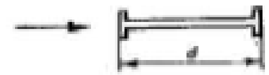
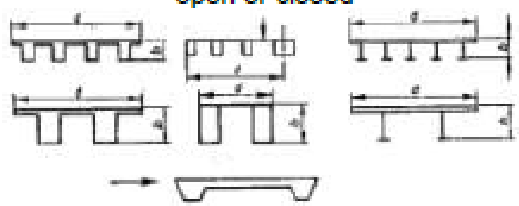
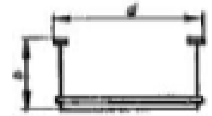
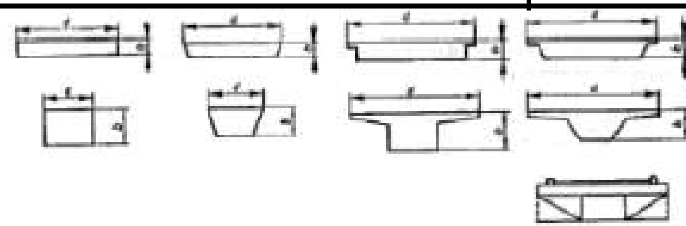
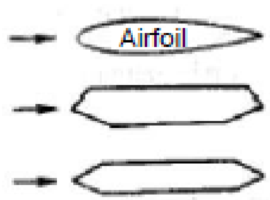
SECTION		t
Old Tacoma Narrows Bridge  12 m x 2.5 m	b = 0.2d 0.16d 	2 (*) 3,5(***)
open or closed 	full or meshed  b ≤ 0.275 d  20 m x 5 m	5(*)(**) (****)
 27.5 m x 7.5 m		5(**) if 2.4 b < d< 4b this value is replaced by $12\frac{b}{d}$ (**)
		9(*)
	 21.5 x 10.5 m	stable (*)

Figure E.12 AN-LU : Instability coefficient under torsion τ for bridges

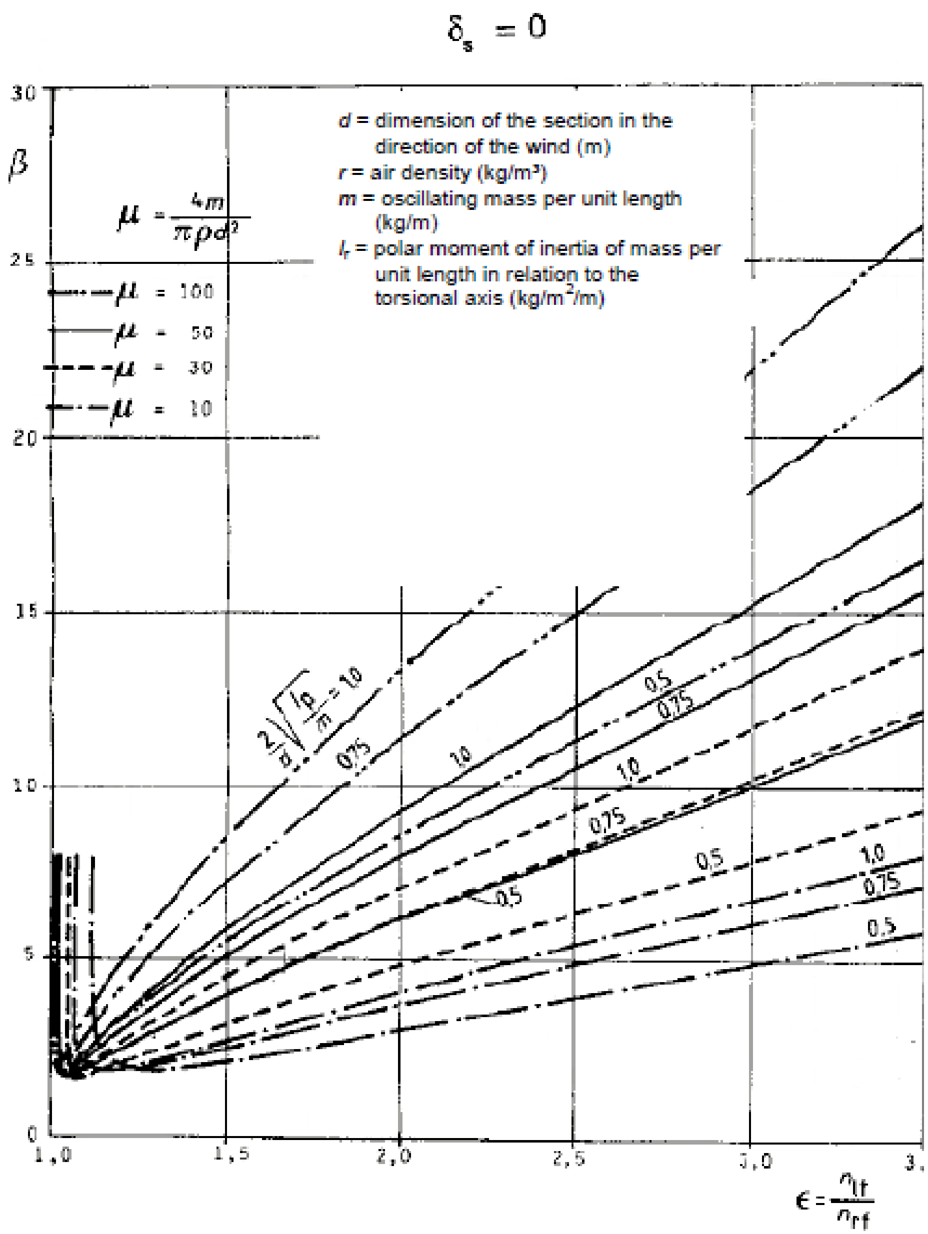


Figure E.13 AN-LU: Instability coefficient β under both twisting and torsion of a flat sheet parallel to the direction of the wind for $\delta_s = 0$

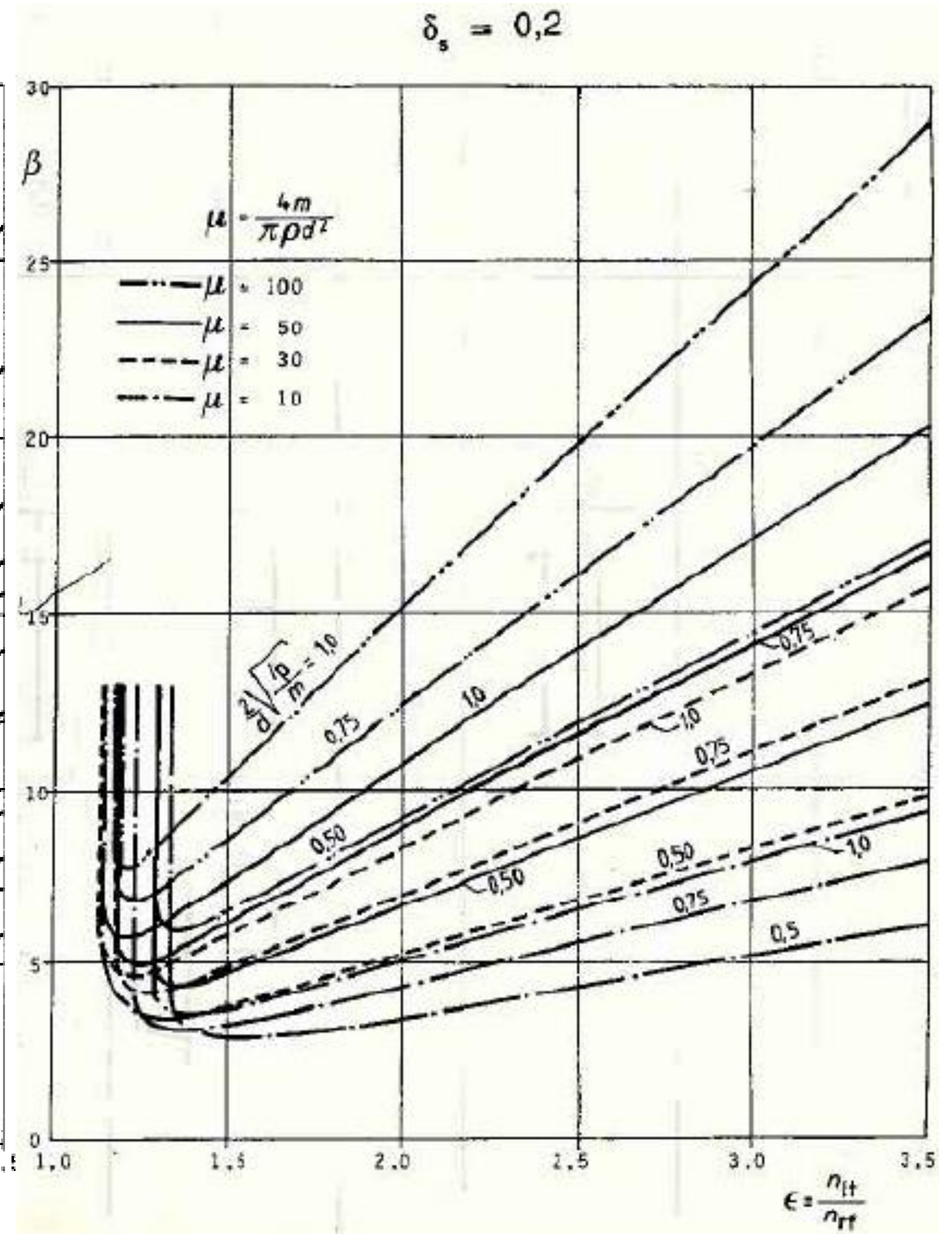
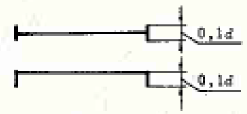
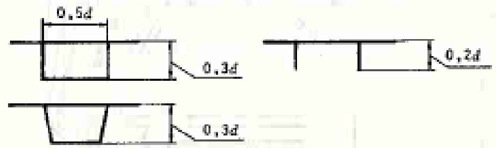
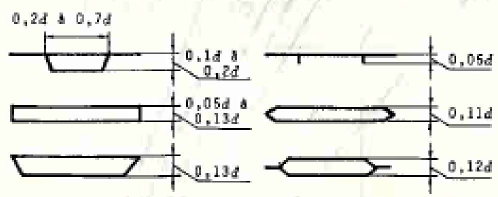


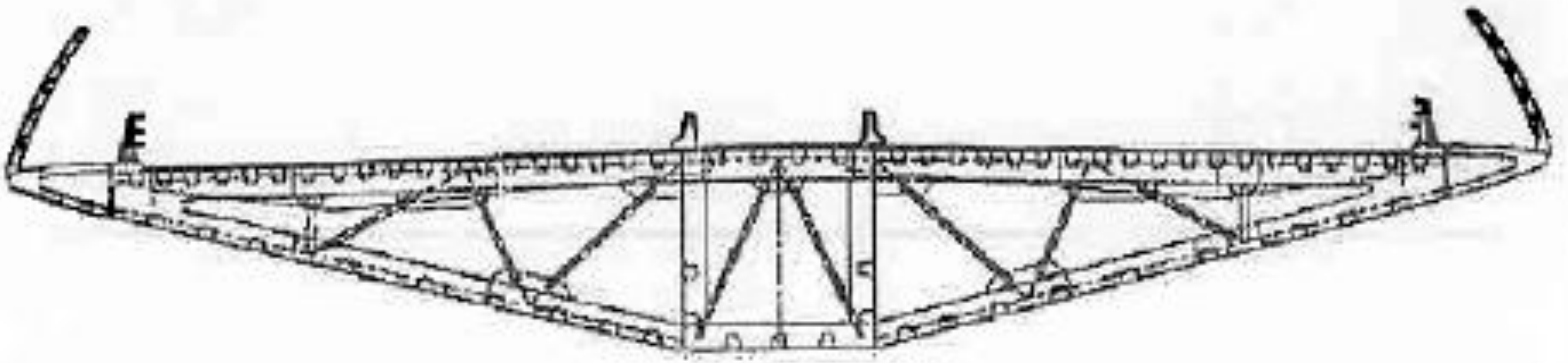
Figure E.14 AN-LU: Instability coefficient β under both twisting and torsion of a flat sheet parallel to the direction of the wind for $\delta_s = 0.2$

SECTION	η: $\varepsilon_1 \leq 1{,}5$	η: $\varepsilon_1 \geq 3$
	0,12	0,10
	0,18	0,15
	0,25	0,15
	0,3	0,2
	0,5	0,3
	0,6	0,4
	0,7	0,6
	1	1

$$\varepsilon_1 = \frac{n_{1t}}{n_{r1}}$$

Figure E.15 AN-LU: Ratio η between the critical speed of the deck section and the critical speed of a sheet parallel to the direction of the wind

Cross-section of the MILLAU bridge deck



National Calibration Period (summary)

1990-1999 : drafting of pre-standards (ENV)

2002-2007 : publication of the 58 Eurocode Parts (EN)

2007-2011 : drafting of the NATIONAL ANNEXES
by the National Standardization Bodies

- *Comparison with National Standards & Regulations*
- *Examples of applications: buildings, bridges, etc.*
- *Non-contradictory complementary information for items not covered by the Eurocodes*

2013 : five year review & starting of revision of the ENs

2018 : second generation of Eurocodes available

Thank's for your attention

EUROPEAN COMMITTEE
FOR STANDARDIZATION

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SECO

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