General JCSS Presentation - History and Main Outputs

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JCSS
Joint Committee on Structural Safety

Structural Safety
past advancements and future challenges

Workshop dedicated to the 50th anniversary of the JCSS
22.-23. May 2024, Klokner Institute, CTU in Prague, Czech Republic

ELSEVIER

Structural Safety

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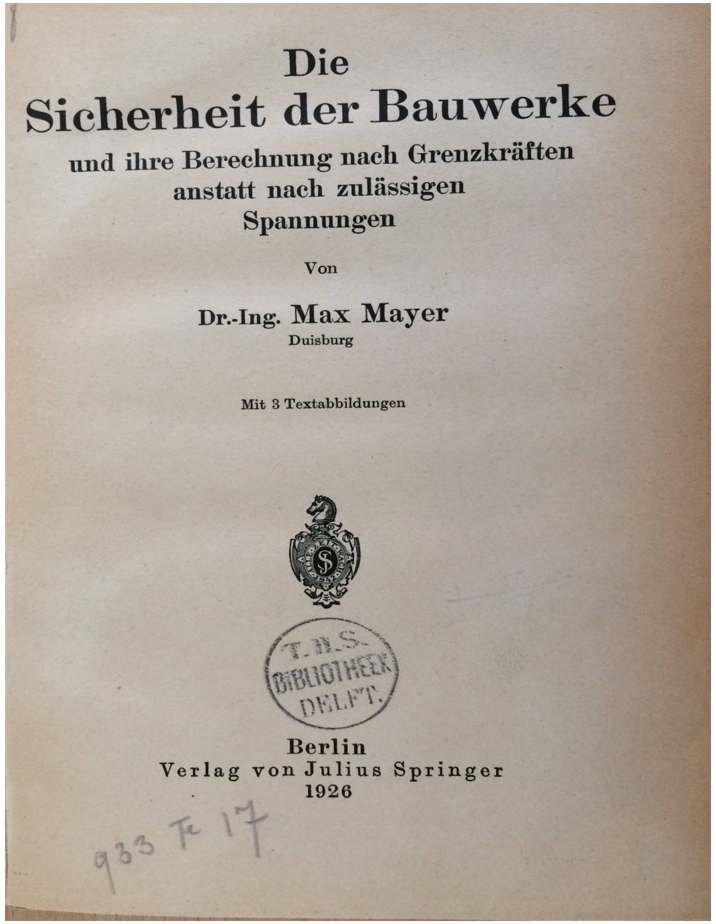
In Press, Journal Pre-proof ? What's this?

The JCSS – A major contributor to structural safety through half a century

Ton Vrouwenvelder [a], Michael Baker [b], Michael Havbro Faber [c]

Structural Safety

JCCS 50 Years Special Issue



Die Sicherheit der Bauwerke

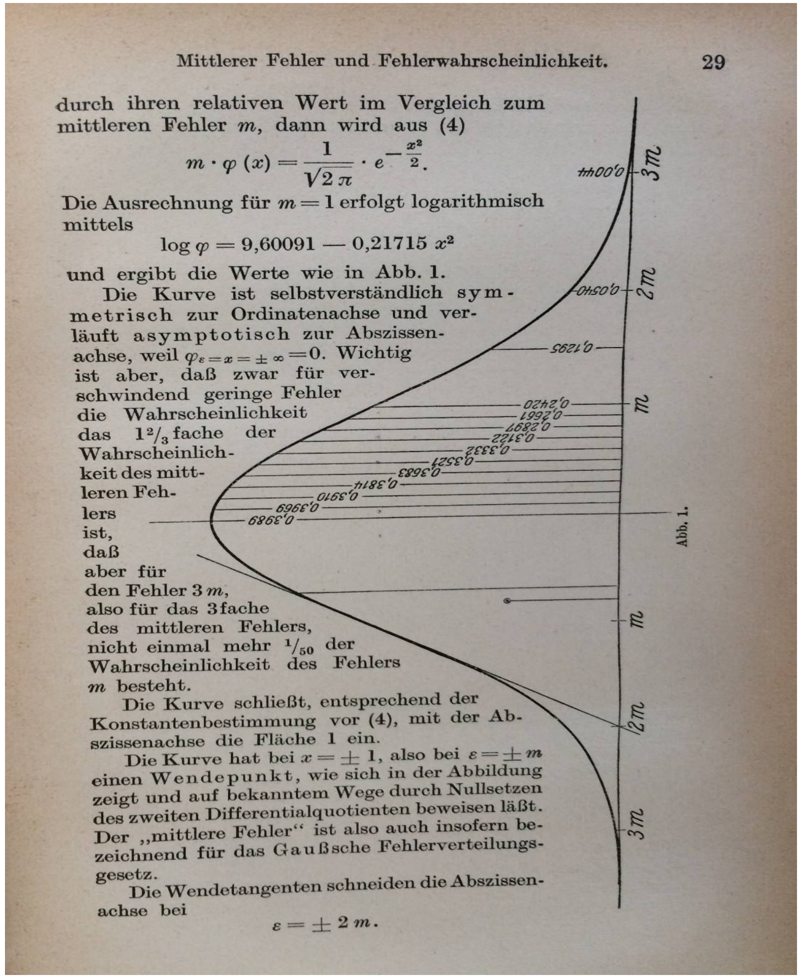
und ihre Berechnung nach Grenzkräften anstatt nach zulässigen Spannungen

Von

Dr.-Ing. **Max Mayer**
Duisburg

Mit 3 Textabbildungen

Berlin
Verlag von Julius Springer
1926



durch ihren relativen Wert im Vergleich zum mittleren Fehler m, dann wird aus (4)

$$m \cdot \varphi(x) = \frac{1}{\sqrt{2\pi}} \cdot e^{-\frac{x^2}{2}}.$$

Die Ausrechnung für $m = 1$ erfolgt logarithmisch mittels

$$\log \varphi = 9{,}60091 - 0{,}21715\, x^2$$

und ergibt die Werte wie in Abb. 1.

Die Kurve ist selbstverständlich symmetrisch zur Ordinatenachse und verläuft asymptotisch zur Abszissenachse, weil $\varphi_{\varepsilon = x = \pm\infty} = 0$. Wichtig ist aber, daß zwar für verschwindend geringe Fehler die Wahrscheinlichkeit das $1^2/_3$ fache der Wahrscheinlichkeit des mittleren Fehlers ist, daß aber für den Fehler $3\,m$, also für das 3fache des mittleren Fehlers, nicht einmal mehr $^1/_{50}$ der Wahrscheinlichkeit des Fehlers m besteht.

Die Kurve schließt, entsprechend der Konstantenbestimmung vor (4), mit der Abszissenachse die Fläche 1 ein.

Die Kurve hat bei $x = \pm 1$, also bei $\varepsilon = \pm m$ einen Wendepunkt, wie sich in der Abbildung zeigt und auf bekanntem Wege durch Nullsetzen des zweiten Differentialquotienten beweisen läßt. Der „mittlere Fehler" ist also auch insofern bezeichnend für das Gaußsche Fehlerverteilungsgesetz.

Die Wendetangenten schneiden die Abszissenachse bei

$$\varepsilon = \pm 2\,m.$$

Abb. 1.

First (?) SRA publication
Max Mayer, Berlin, 1926

One minute History

Pioneers (1926-…)

Mayer / Weibull / Gumbel / Khozialov/ Wierzbicki / Prot / Pugsley Rosenblueth / Torroja / Basler / Freudenthal / Ferry Borges / Bolotin /Cornell / Galambos / Ang and Tang ..

Start of the JCSS (1971/1972) (Rackwitz / Ditlevsen..)

Committees, conferences, codes (1972-….)

CEB bulletins
IABSE / Icossar / ICASP / ESREL …
ASCE - Steel code / ISO 2394 / Eurocodes / other regional/national codes

JCSS

Joint Committee
on Structural Safety

First meeting 1972

JCSS and associated Professional Associations

Professor Julio Ferry Borges,

first president of JCSS

(with courtesy of LNEC)

JCSS Early days
Editorial Group: Codes of practice

- Allowable stress design
- LFD (load factor design)
- LRFD (load and resistance factor design)
- Partial Factor Design

- Limit states
- Characteristic values for material properties
- Return periods for variable loads
- Tradition based safety margins
- Some ideas about target reliability and code calibration

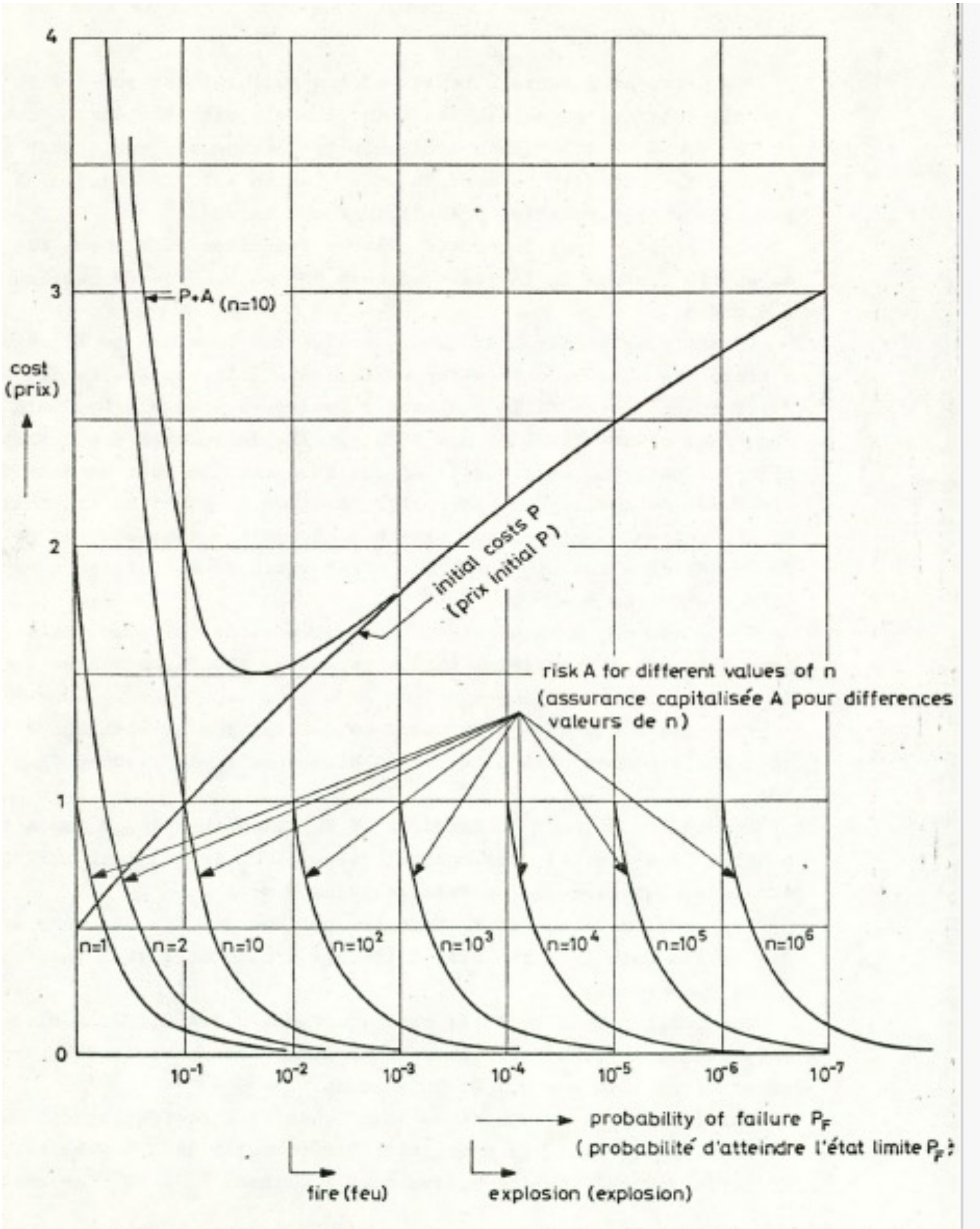
JCSS Early days

Subcommittee: First Order Reliabilty Concepts

- Level I, II, III
- Mean value level II approach
- Design point level II approach (Hasofer/Lind)
- Load combination
- Systems
- The concept of probability
- Optimization

F.K. Ligtenberg 1971
(JCSS Member)
Netherlands

How safe is safe enough ?

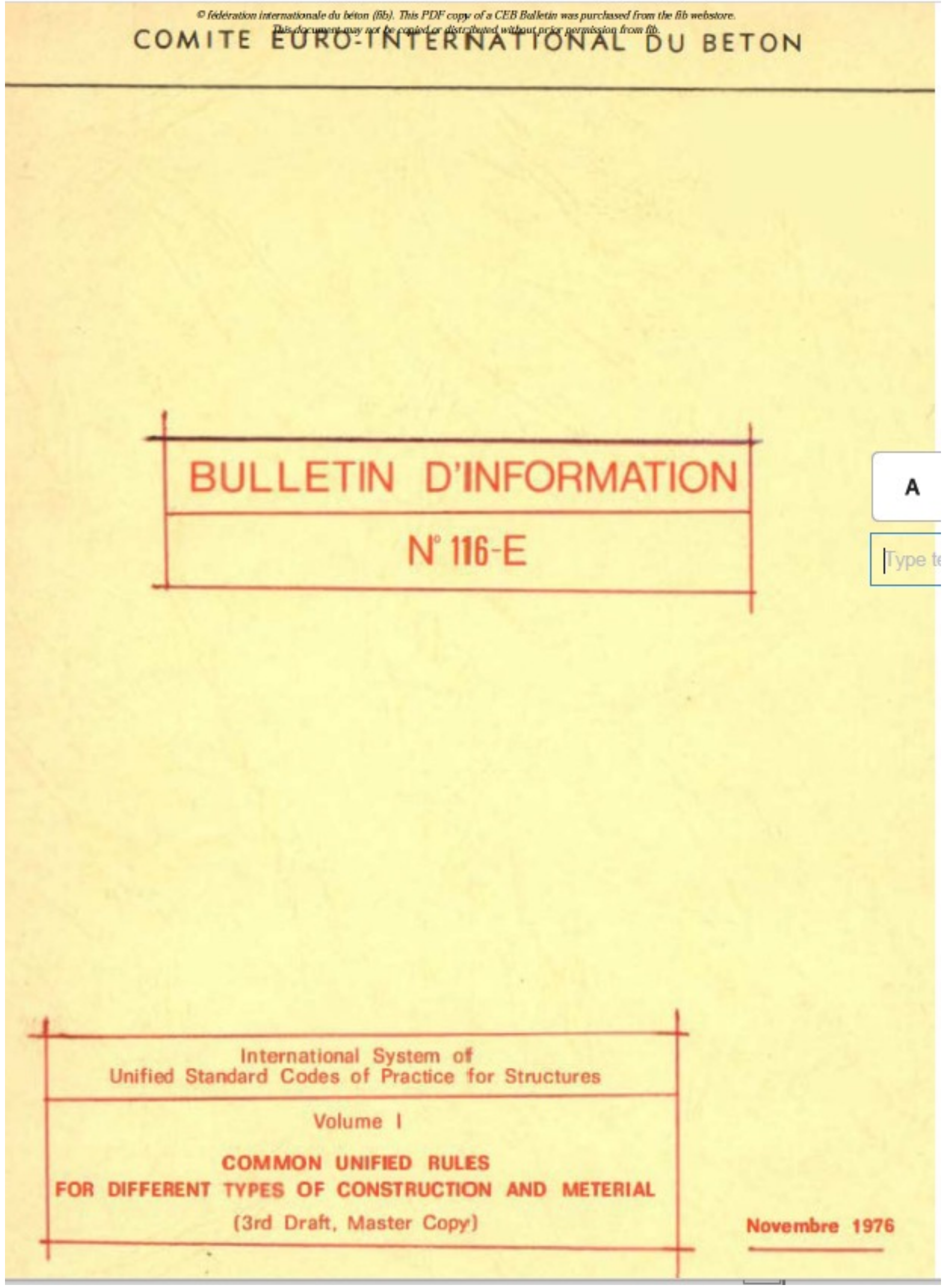


Determination of the most economical value for P_F
(Détermination du valeur de P_F le plus économique.)

First important output 1976:

CEB Bulletin 116E:

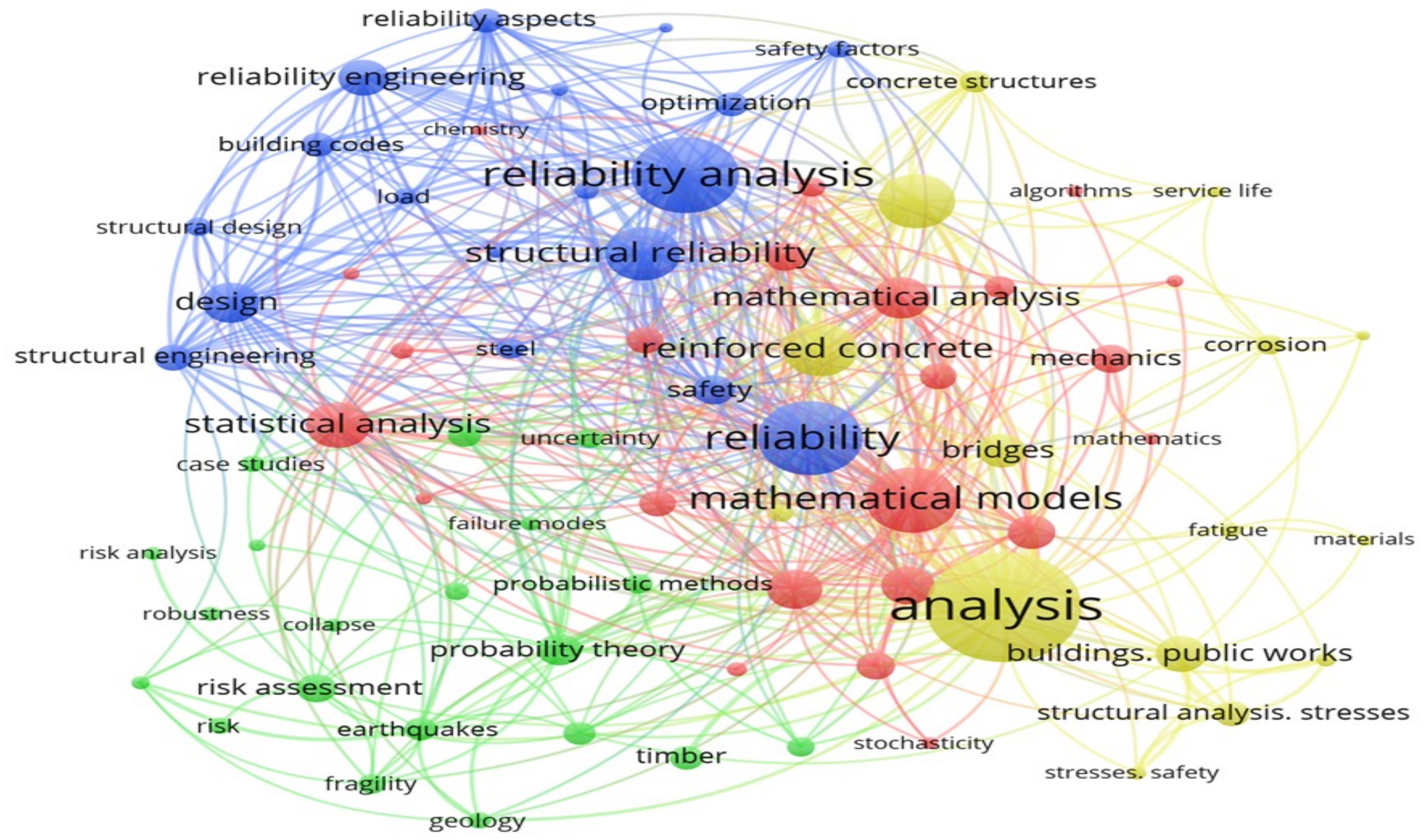
Common Unified Rules for different types of construction and materials



JCSS / DEVELOPMENTS IN COURSE OF TIME

PFM	time variant	existing structures	systems / robustness
Level II	deterioration/fatigue	jcss model code	accidental / terrorist
	risk	LQI	resilience
	reliability target	inspection/SHM	sustainability
	code calibration	NL-FEM	

1972 ---present/future


reliability aspects
safety factors
reliability engineering
concrete structures
optimization
chemistry
building codes
reliability analysis
load
algorithms
service life
structural design
structural reliability
design
mathematical analysis
structural engineering
steel
reinforced concrete
mechanics
corrosion
safety
statistical analysis
uncertainty
reliability
bridges
mathematics
case studies
mathematical models
failure modes
fatigue
materials
risk analysis
probabilistic methods
analysis
robustness
collapse
probability theory
buildings. public works
risk assessment
risk
earthquakes
structural analysis. stresses
timber
stochasticity
stresses. safety
fragility
geology

JCSS Message in a nutshell

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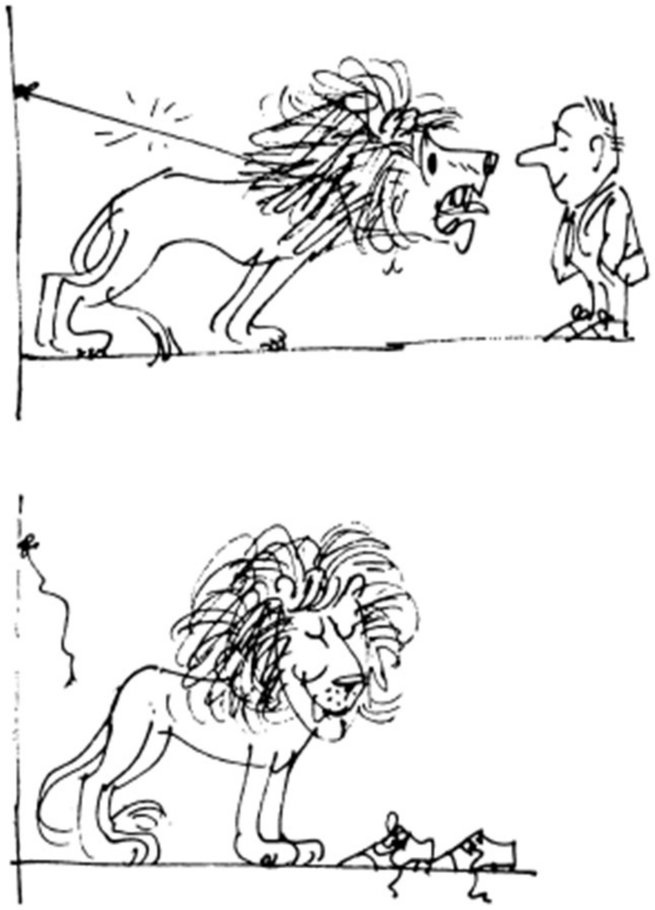


Cartoon by courtesy of *Dicke, 1975*

JCSS Message in a nutshell

Design / assessment $=$ finding optimal decisions under uncertainty

Objectives and models should be formulated

Uncertainties are dealt with using the Theory of Probability

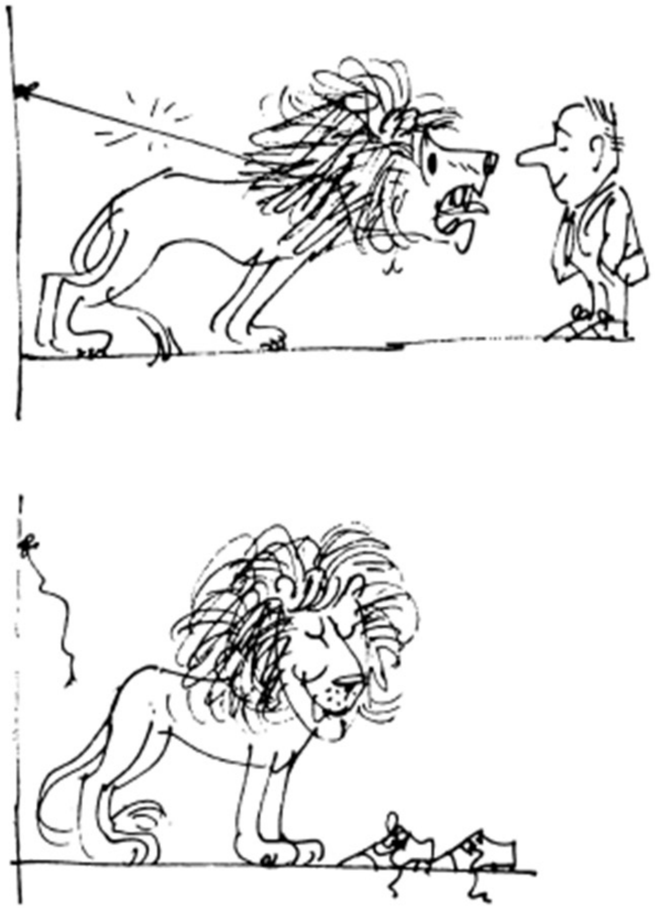
Aleatory and epistemic uncertainties should be treated in a similar way

Balanced interpretation of probability: classical, frequentist, Bayesian, notional

Codes reflects opinion of groups of experts

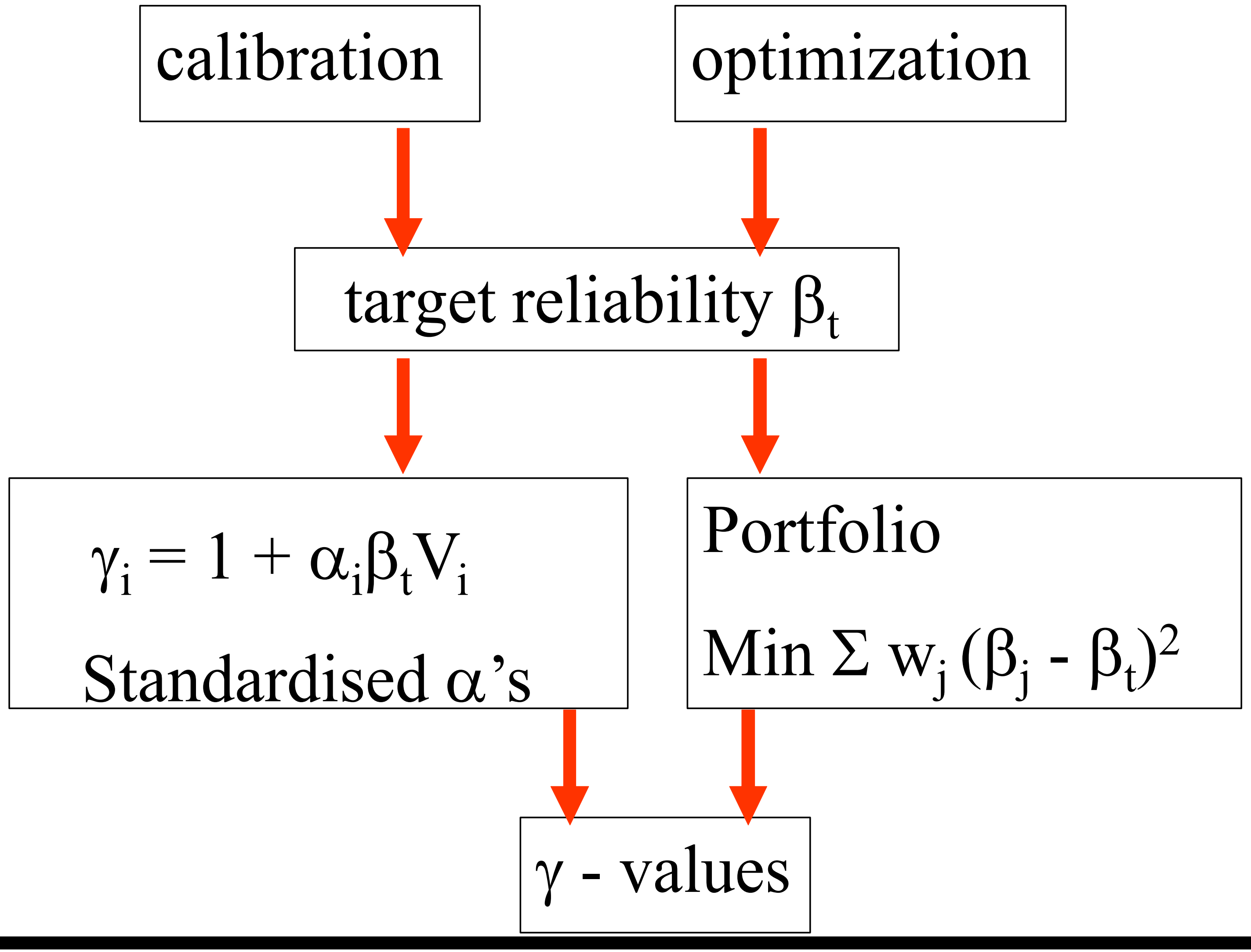
Operational levels: Risk informed, Reliability based and (Calibrated) Semi-probabilistic

Safety is based on: SRA + QA (Material / human errors) + System (Robustness / consequences)



Cartoon by courtesy of *Dicke, 1975*

Code calibration



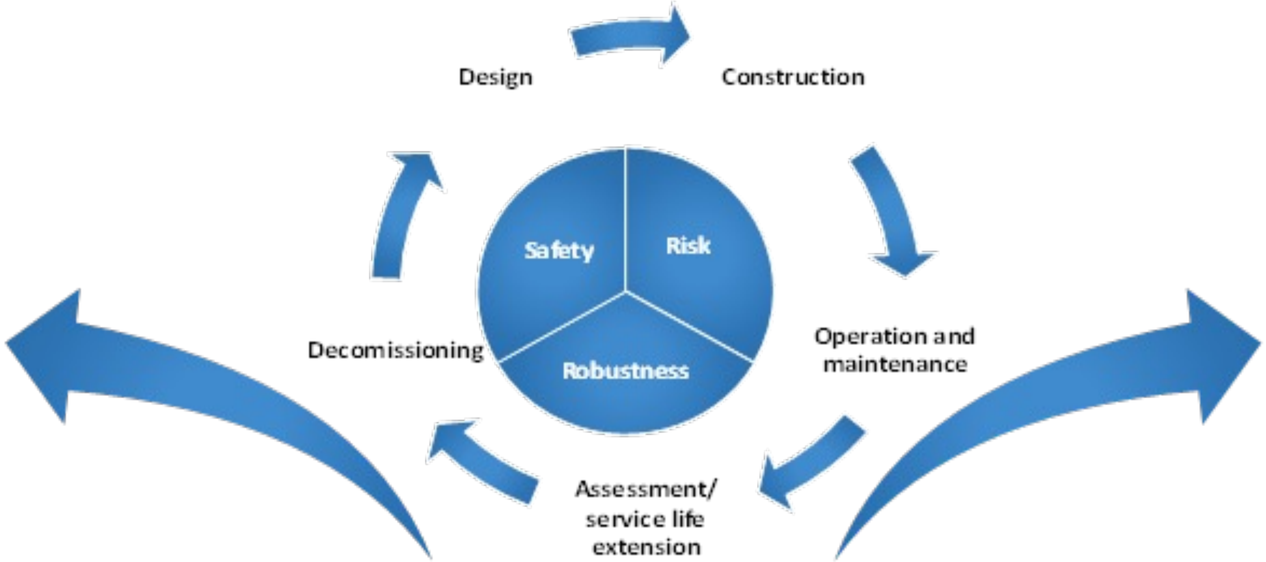
JCSS Output

Reliability based design

Probabilistic Model Code

Code safety format calibration

Contributions to general body of knowledge



Workshops and conference sessions

Education and training

Webinars

Code committee work

Joint Committee on Structural Safety

Liaison Committee

cib · ECCS CECM EKS · fib CEB-FIP · IABSE · rilem

Industry, researchers, educators, committees, working parties, model codes, conferences - with 5000+ members representing more than 150 nation states

MAIN JCSS PUBLICATIONS

CEB-Bulletins 116… (1978)

IABSE Working documents (1989)

JCCS Publication 94, March 1996, background EC 1 Basis of design:

Papers Structural Safety, no. 3, 1997

The JCSS probabilistic model code, 2000

Icossar 2004

JCSS INTERNET PUBLICATIONS (see website)

Basis of Design, official new Eurocode EN 1990 Background

Reflection

The JCSS, directly as a pre-normative organization and indirectly via its members in code committees, has contributed to the development of semi probabilistic codes and standards. This approach also opens doors for a consistent integration of:

- combined analysis of structural and non-structural safety measures
- effects of deterioration (fatigues, corrosion, wear) in ULS analysis
- optimal use of recourses
- reliability and sustainability

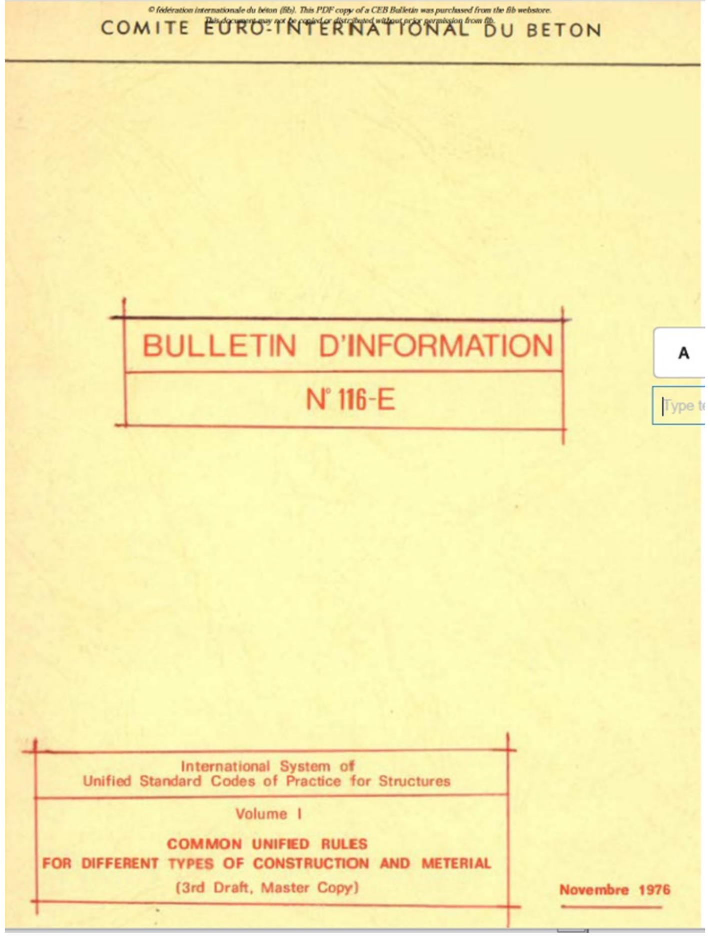
Code committees are often dominated by experts having a primarily deterministic mind setting, a preference for traditional approaches, non-probabilistic estimates of partial factors and market related effects.

Basic points of external criticism: difficult formulas and concepts, precision of numerical values, effect of human errors.

To do list

- further development of PMC
- durability models
- inspection (shm) and repair
- systems
- full probabilistic verification
- risk analysis
- resilience
- human safety engineering
- elication of expert opinions
- sustainability

<u>To do list</u>



COMITE EURO-INTERNATIONAL DU BETON

BULLETIN D'INFORMATION

N° 116-E

International System of
Unified Standard Codes of Practice for Structures

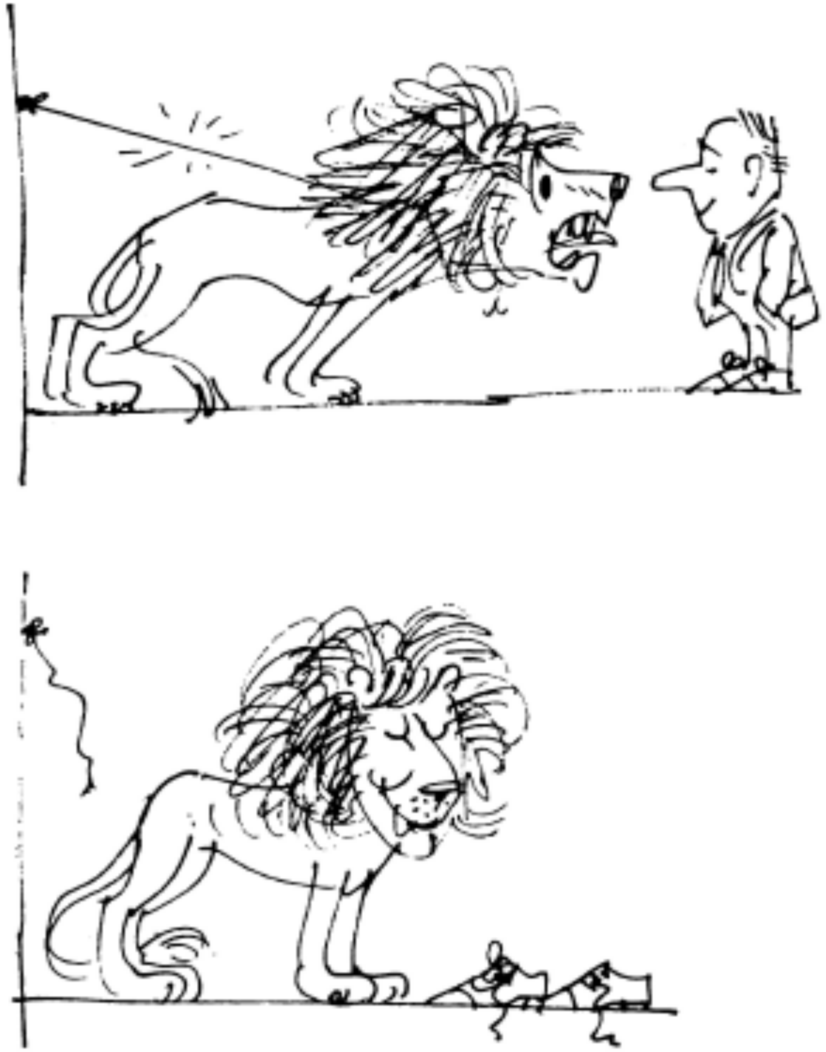
Volume I

COMMON UNIFIED RULES
FOR DIFFERENT TYPES OF CONSTRUCTION AND METERIAL
(3rd Draft, Master Copy)

Novembre 1976

- **Education**
- **Protocol**
- **Communication**
- **User friendly calculation tools**
- **..**
- **Common unified rules …**

Second part by Michael Faber



Cartoon by courtesy of *Dicke, 1975*