Krebs Ovesen's legacy to South Africa: a harmonized basis-of-design code
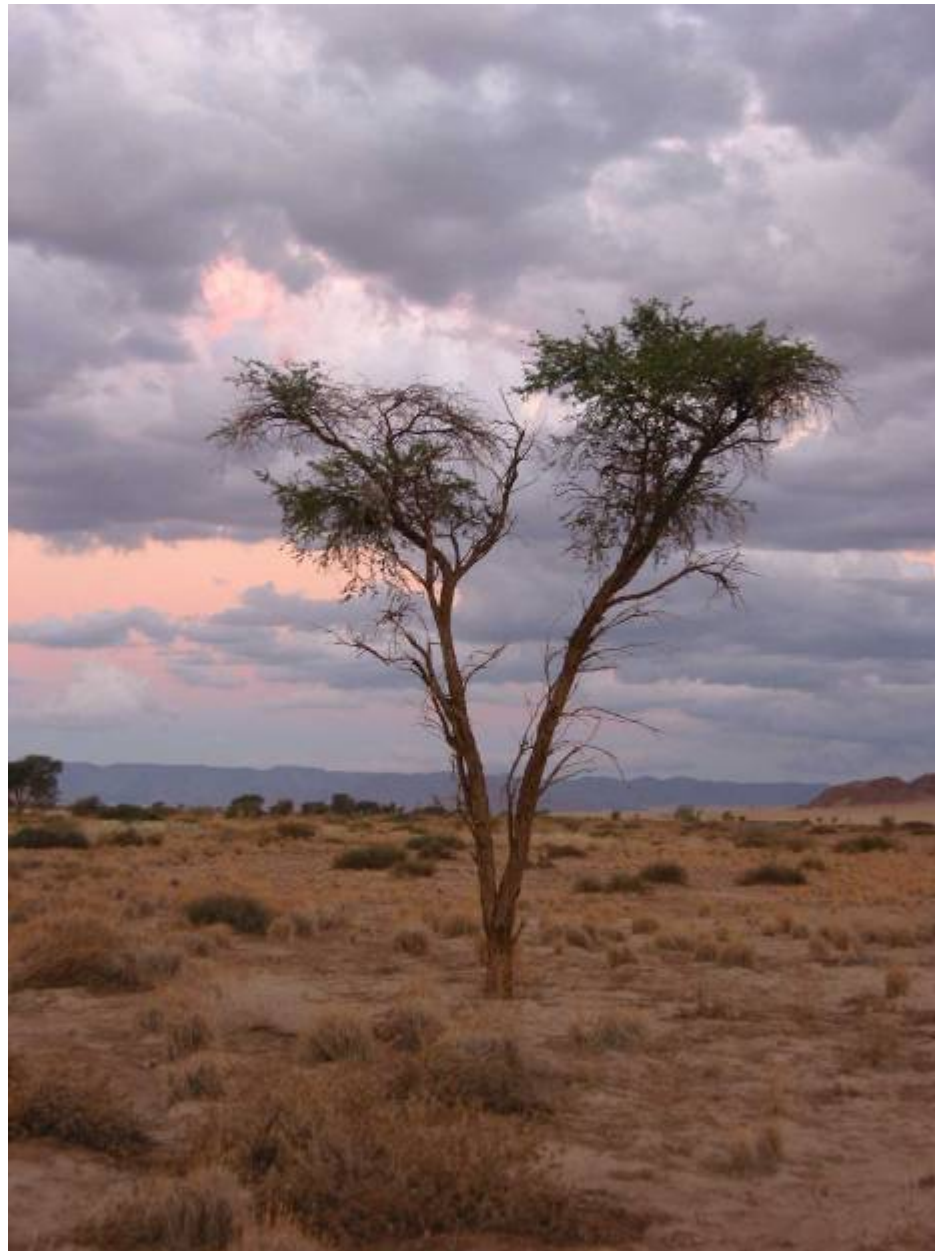
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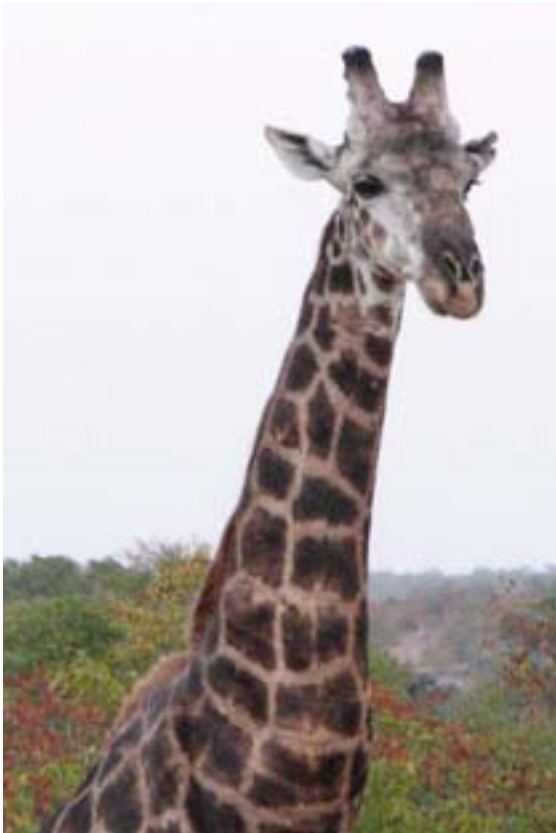Spirit of Krebs Ovesen

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South Africa:

Traditionally followed British practice

Few South African geotechnical codes

No geotechnical design code

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Copenhagen, May 1993:

DGS Conference on Limit
States Design in
Geotechnical Engineering

DGS conference organizer

Chairman of TC23 1990 – 1997

Chairman TC250: SC7

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Copenhagen, May 1993:

DGS Conference on Limit
States Design in
Geotechnical Engineering

Seeds were sown for a seminar in
South Africa led by "NKO"

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Johannesburg, 1995:

SAICE Geotechnical Division Seminar on Limit States Design in Geotechnical Engineering

- **Niels Krebs Ovesen**
  - Background to LSD
  - Introduction to EC7

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Johannesburg, 1995:

SAICE Geotechnical Division Seminar on Limit States Design in Geotechnical Engineering

- **Niels Krebs Ovesen**
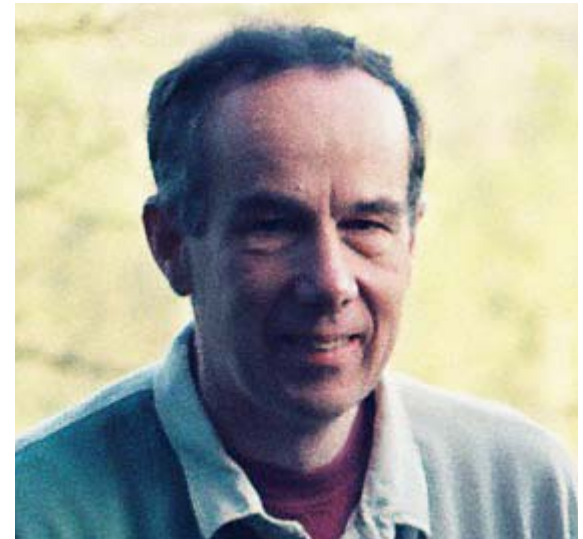 - Background to LSD
  - Introduction to EC7

- **Brian Simpson**
  - Retaining Structures
  - Selection of parameters

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1   Extracts from EC1 : Basis of design

2   Eurocode 7 : geotechnical design

3   Paper by N. Krebs Ovesen :
     Eurocode 7 for geotechnical Design

4   Paper by Brian Simpson :
     ground - Structure Interaction

5   Paper by Brian Simpson :
     Eurocode 7

6   Extracts from :
     Danish code of Practice for Foundation
     Engineering , DS 415

7   Extracts from a report on :
     Principles used in Denmark for the assessment of
     Partial Factors of Safety in geotechnical Engineering

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8.3.2.1 Ground surfaces

(1)P Design values for the geometrical data concerning the backfill behind the retaining structure shall take account of the variation in the actual field values. The design values shall also take account of anticipated excavation or possible scour in front of the retaining structure. [-] For ultimate limit state calculations in which

(2) ~~Where~~ the stability of a retaining wall depends on the passive resistance of the ground in front of the structure, the ground level of the passive soil should be lowered by an amount Δ_a ~~in ultimate limit state calculations~~. The value of Δ_a should be selected taking account of the degree of control to be exerted on site over the level of the surface. For situations with a normal degree of control, the following should be applied:

[-] Δa below the nominal, expected level

    a) for a cantilever wall, Δ_a should equal (10 %) of its height, limited to a maximum of [0.5] m.

Δf =

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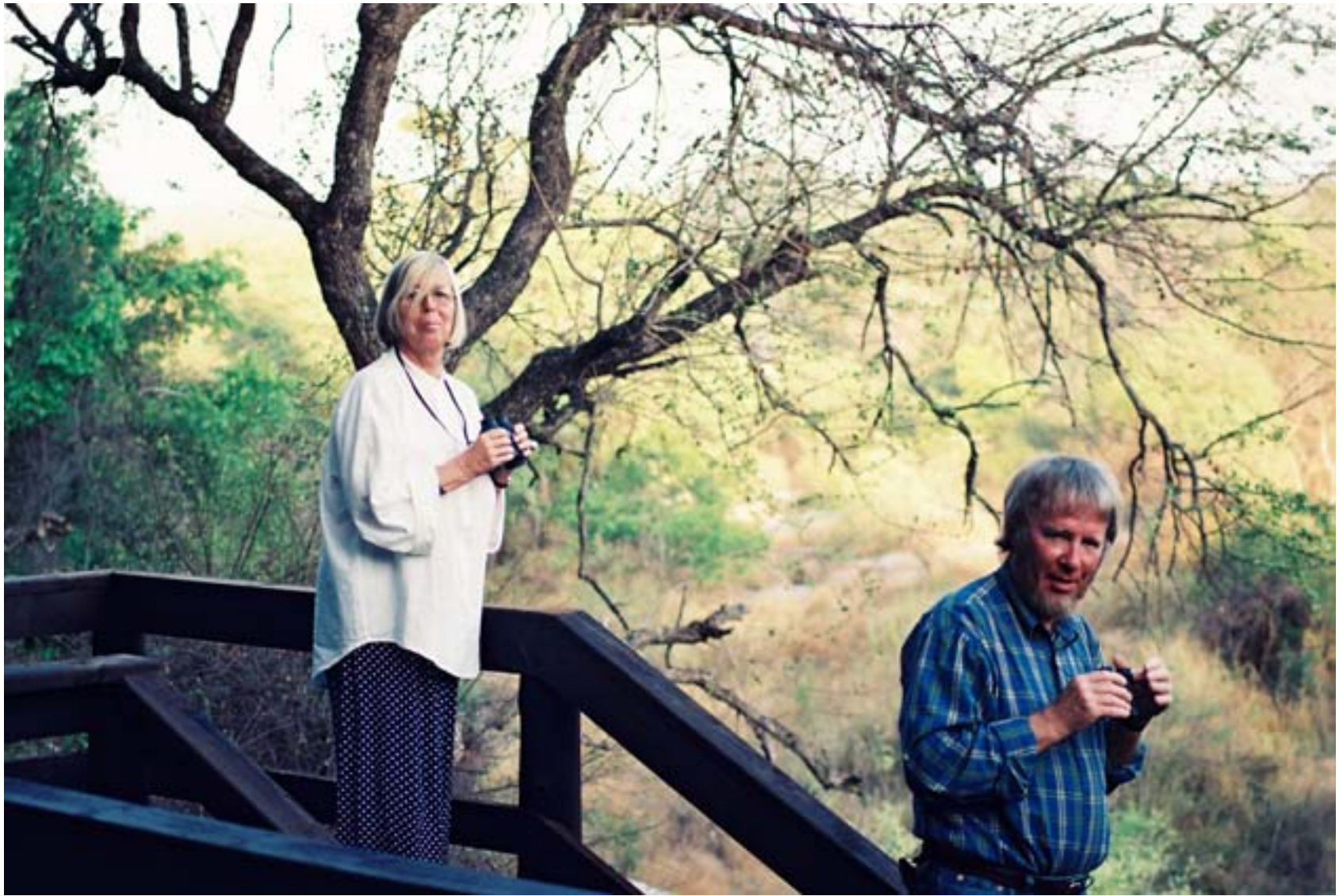
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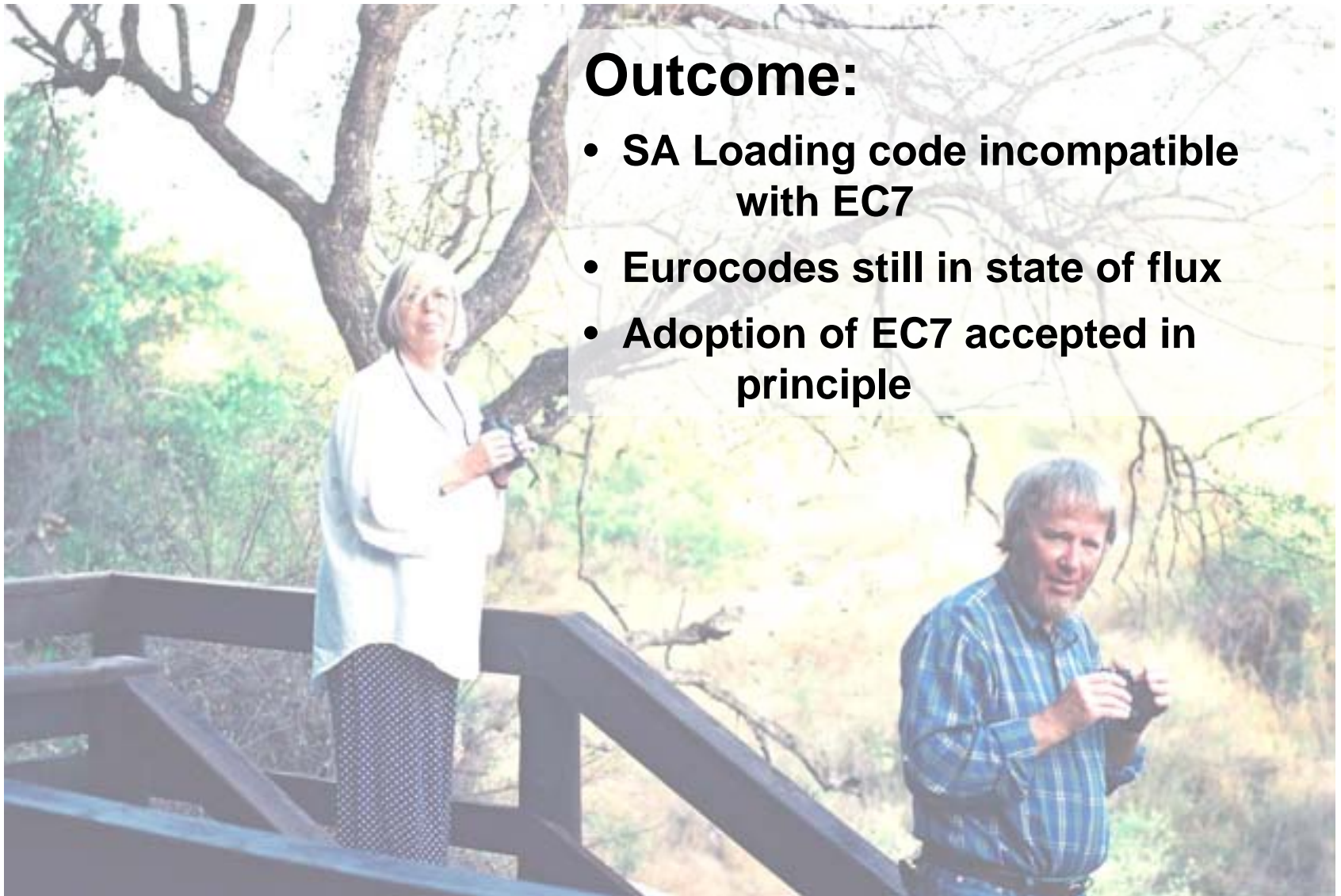Spirit of Krebs Ovesen

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Outcome:

- **SA Loading code incompatible with EC7**
- **Eurocodes still in state of flux**
- **Adoption of EC7 accepted in principle**

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Johannesburg, Sept. 1998:

SA National Conference on Loading

Joint geotechnical / structural effort

- Dr John Menzies   (EN1990)
- Dr Brian Simpson   (EN1997)
- Dr Lam Pham   (CSIRO)
- Dr Laurie Kennedy   (Canada)

Johannesburg, Sept. 1998:

SAICE National Conference on Loading

- Basis of design code to be revised
- Provision to be made for geotechnical design
- Increased cooperation with CEN and ISO through SABS
- Technical Committees to review materials codes

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SANS 10160:   Basis of design and actions for buildings and industrial structures

- Joint structural / geotechnical effort
- Representative of all disciplines
- Nearing finalisation after 8 years

General Principles

- Eurocodes used as reference codes

- Actions combinations according to 6.10a and 6.10b

- Turkstra-type action combination scheme

- Target reliability $\beta = 3{,}0$

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Geotechnical Design

- Design Approach 1
- Material factors from Annex A of EN1997
- Scope limited to buildings and industrial structures
- Fully compatible with EN1997

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Typical partial factors

ACTIONS:		EN1990	SANS 10160
Permanent		1,35/ 1,15 / 0,9	1,35 / 1,2 / 0,9
Variable		1,50 / 1,3 / 0,0	1,60 / 1,3 / 0,0

MATERIALS:			
Friction	$\tan \phi'$	1,25	1,25
Cohesion	c'	1,25	1,25
Undrained	c_u	1,4	1,4
Density	γ	1,0	1,0

EN1990

$$\sum_{j\geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} \psi_{0,1} Q_{k,1} \quad "+" \quad \sum_{i>1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \qquad \text{6.10a}$$

$$\sum_{j\geq 1} \xi_j \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \quad "+" \quad \sum_{i>1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \qquad \text{6.10b}$$

SANS 10160

$$\sum_{j\geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \qquad \text{STR-P}$$

$$\sum_{j\geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \quad "+" \quad \sum_{i>1} \gamma_{Q,i} \psi_i Q_{k,i} \qquad \text{STR}$$

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EN1990

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j} \quad "+" \quad \gamma_{Q,1}\psi_{0,1}Q_{k,1} \quad "+" \quad \sum_{i \succ 1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \qquad \text{6.10a}$$

$$\sum_{j\geq 1}\xi_{j}\gamma_{G,j}G_{k,j} \quad "+" \quad \gamma_{Q,1}Q_{k,1} \quad "+" \quad \sum_{i \succ 1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \qquad \text{6.10b}$$

SANS 10160

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j} \quad "+" \quad \gamma_{Q,1}Q_{k,1} \qquad \boxed{X} \qquad \text{STR-P}$$

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j} \quad "+" \quad \gamma_{Q,1}Q_{k,1} \quad "+" \quad \sum_{i \succ 1}\gamma_{Q,i}\psi_{i}Q_{k,i} \qquad \text{STR}$$

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EN1990

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j} \quad "+" \quad \gamma_{Q,1}\psi_{0,1}Q_{k,1} \quad "+" \quad \sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \qquad 6.10a$$

$$\sum_{j\geq 1}\xi_j\gamma_{G,j}G_{k,j} \quad "+" \quad \gamma_{Q,1}Q_{k,1} \quad "+" \quad \sum_{i>1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \qquad 6.10b$$

SANS 10160

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j} \quad "+" \quad \gamma_{Q,1}Q_{k,1} \qquad\qquad\qquad STR\text{-}P$$

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j} \quad "+" \quad \gamma_{Q,1}Q_{k,1} \quad "+" \quad \sum_{i>1}\gamma_{Q,i}\psi_i Q_{k,i} \qquad STR$$

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EN1990

$$\sum_{j \geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} \psi_{0,1} Q_{k,1} \quad "+" \quad \sum_{i \succ 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \qquad \text{6.10a}$$

$$\sum_{j \geq 1} \xi_j \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \quad "+" \quad \sum_{i \succ 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \qquad \text{6.10b}$$

SANS 10160

$$\sum_{j \geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \qquad\qquad\qquad \text{STR-P}$$

$$\sum_{j \geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \quad "+" \quad \sum_{i \succ 1} \gamma_{Q,i} \psi_i Q_{k,i} \qquad \text{STR}$$

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Outcome

- SANS10160 compatible with Structural Eurocodes

- Will take the place of EN1990 in SA.

- Comparable to a S.African NAD

- Door now open to use of Eurocodes in South Africa

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