Krebs Ovesen’s legacy to South Africa: a harmonized basis-of-design code
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South Africa: 10x the population of Denmark

7,000 Registered Civil Engineers

200 Geotechnical Practitioners
South Africa:
Traditionally followed British practice
Few South African geotechnical codes
No geotechnical design code
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Early 1990's:
• Geotechnical Division committee established
• Noted effort going into the Eurocodes
• Insufficient resources
• Adopt / adapt recognised international code
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”
Johannesburg, 1995:
SAICE Geotechnical Division
Seminar on Limit States
Design in Geotechnical Engineering

- Niels Krebs Ovesen
  - Background to LSD
  - Introduction to EC7
Johannesburg, 1995:
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Design in Geotechnical Engineering

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

- Brian Simpson
  - Retaining Structures
  - Selection of parameters
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) 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.

(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 \( \Delta_h \) in ultimate limit state calculations in which:

\[ \Delta_h = \text{hill below the nominal, expected level} \]

The value of \( \Delta_h \) 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:

\[ \Delta_h = 0.1 \times \text{height of wall}, \text{limited to a maximum of} \ 0.5 \text{m.} \]

as for a cantilever wall, \( \Delta_h \) should equal (10 %) of its height.
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Outcome:

- SA Loading code incompatible with EC7
- Eurocodes still in state of flux
- Adoption of EC7 accepted in principle
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 $\beta = 3.0$
Geotechnical Design

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

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<th>ACTIONS</th>
<th>EN1990</th>
<th>SANS 10160</th>
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<tbody>
<tr>
<td>Permanent</td>
<td>1,35/ 1,15 / 0,9</td>
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<tr>
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<tr>
<td>Friction</td>
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<tr>
<td>Cohesion</td>
<td>c'</td>
<td>1,25</td>
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<tr>
<td>Undrained</td>
<td>$c_u$</td>
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<tr>
<td>Density</td>
<td>$\gamma$</td>
<td>1,0</td>
</tr>
</tbody>
</table>
**EN1990**

\[
\sum_{j \geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} \psi_{0,1} Q_{k,1} \quad "+" \quad \sum_{i \geq 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i}
\]

6.10a

\[
\sum_{j \geq 1} \xi_j \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \quad "+" \quad \sum_{i \geq 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i}
\]

6.10b

**SANS 10160**

\[
\sum_{j \geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1}
\]

STR-P

\[
\sum_{j \geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \quad "+" \quad \sum_{i \geq 1} \gamma_{Q,i} \psi_{1,i} Q_{k,i}
\]

STR

Spirit of Krebs Ovesen
EN1990
\[ \sum_{j \geq 1} \gamma_{G,j} G_{k,j} ^{+} \gamma_{Q,1} \psi_{0,1} Q_{k,1} ^{+} \sum_{i \geq 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \]

6.10a

SANS 10160
\[ \sum_{j \geq 1} \xi_{j} \gamma_{G,j} G_{k,j} ^{+} \gamma_{Q,1} Q_{k,1} ^{+} \sum_{i \geq 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \]

STR-P

\[ \sum_{j \geq 1} \gamma_{G,j} G_{k,j} ^{+} \gamma_{Q,1} Q_{k,1} ^{+} \sum_{i \geq 1} \gamma_{Q,i} \psi_{1,i} Q_{k,i} \]

STR

Spirit of Krebs Ovesen
EN1990
\[
\sum_{j \geq 1} \gamma_{G,j} G_{k,j} + \gamma_{Q,1} \psi_{0,1} Q_{k,1} + \gamma_{Q,1} Q_{k,1} + \sum_{i > 1} \sum_{j \geq 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i}
\]

SANS 10160
\[
\sum_{j \geq 1} \gamma_{G,j} G_{k,j} + \gamma_{Q,1} Q_{k,1} + \sum_{i > 1} \sum_{j \geq 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i}
\]
EN1990
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SANS 10160
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\[ \sum_{j \geq 1} \gamma_{G,j} G_{k,j} \quad "+" \quad \gamma_{Q,1} Q_{k,1} \quad "+" \quad \sum_{i > 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \] 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