Concrete Standards: a review of developments and refinements

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The Concrete Institute

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Outline

- Introduction
- The way it was….
- Structural Design Codes
- Construction Specifications
- Material Specifications
- Test Methods
- Implications
- Conclusions

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The way it was…

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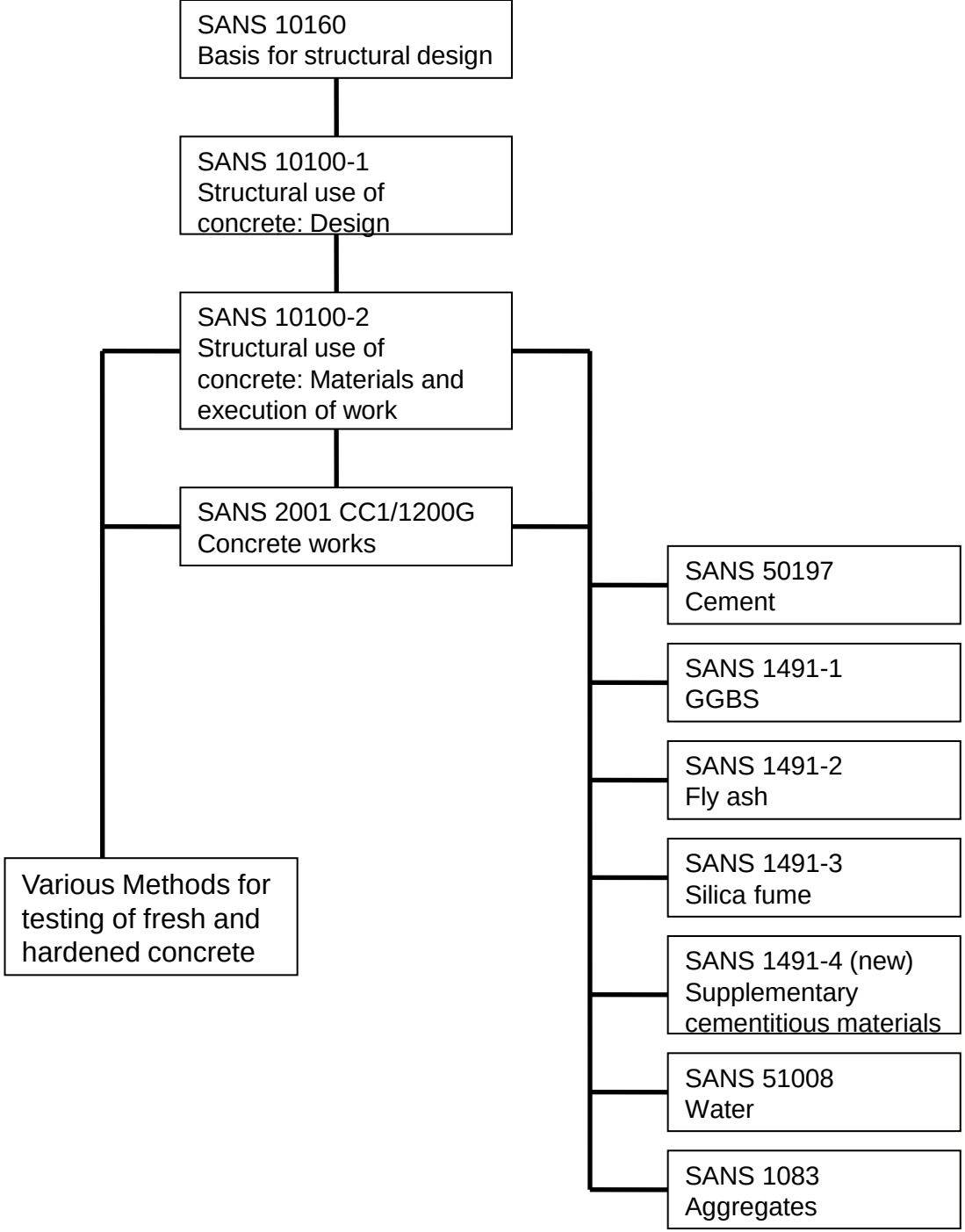
SANS 10160
Basis for structural design
SANS 10100-1
Structural use of concrete: Design
SANS 10100-2
Structural use of concrete: Materials and execution of work
SANS 2001 CC1/1200G
Concrete works
Various Methods for testing of fresh and hardened concrete
SANS 50197
Cement
SANS 1491-1
GGBS
SANS 1491-2
Fly ash
SANS 1491-3
Silica fume
SANS 1491-4 (new)
Supplementary cementitious materials
SANS 51008
Water
SANS 1083
Aggregates

In Europe…

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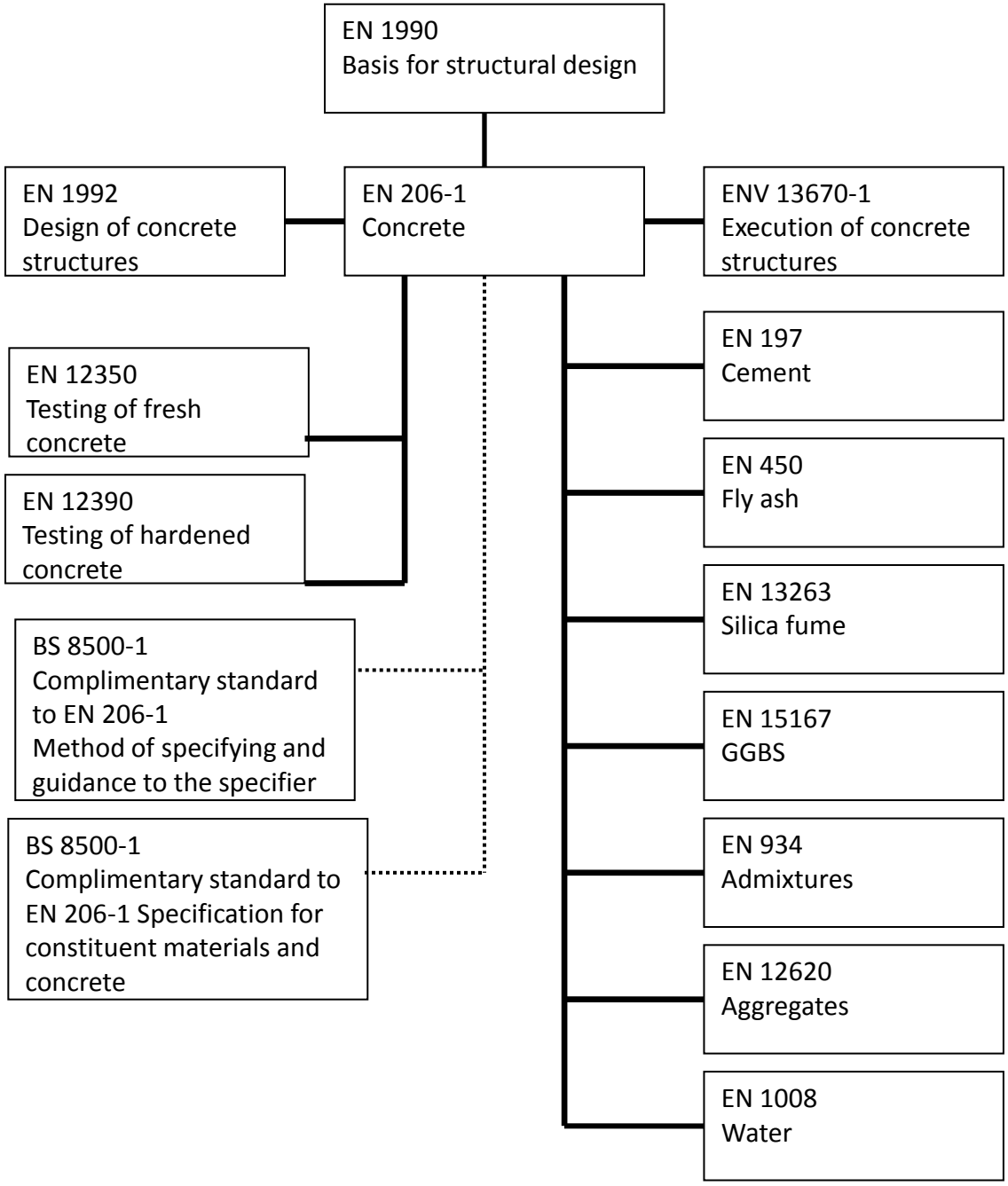

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Structural Design Codes

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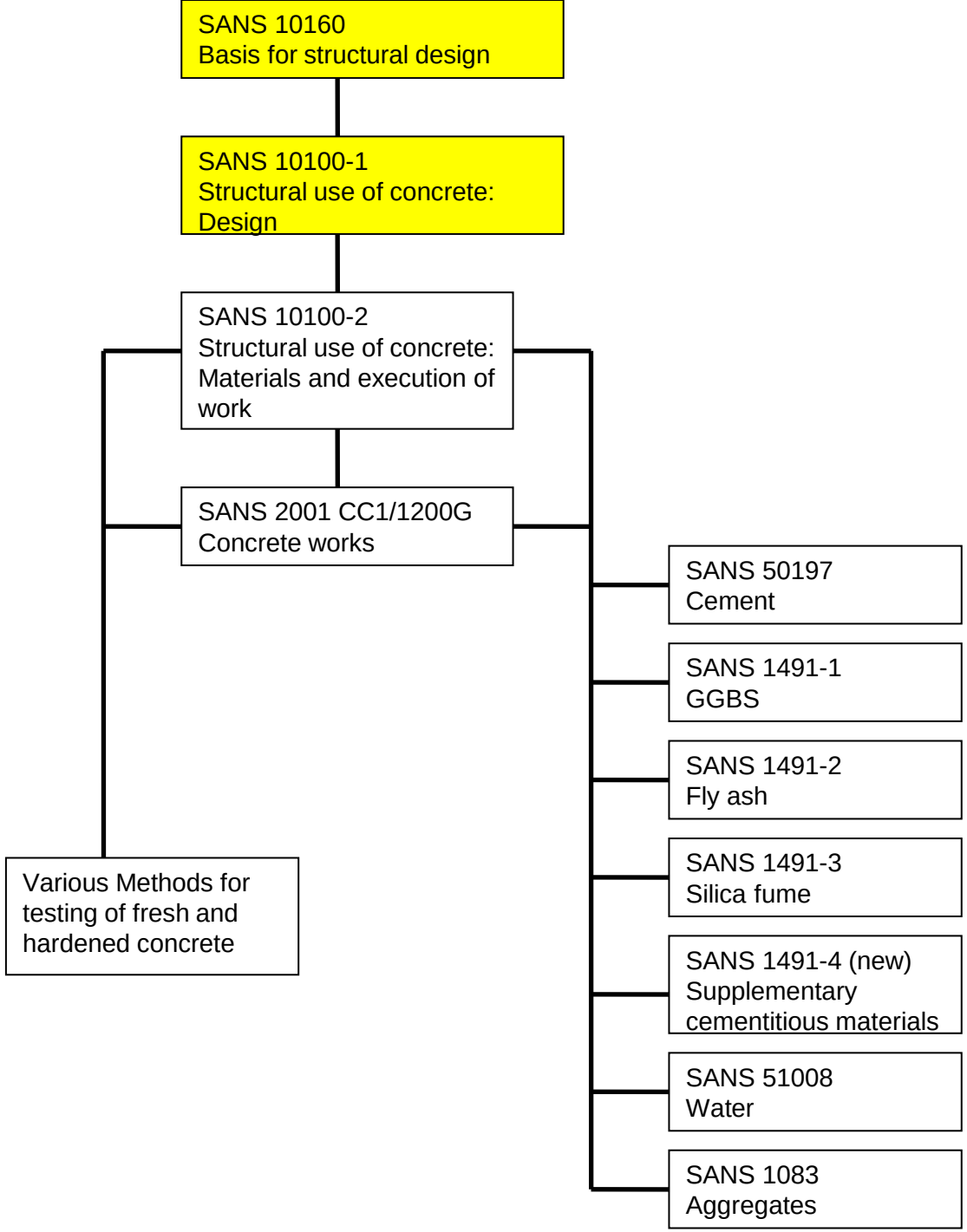

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Current Revision Status

- Loading code and basis of design (2010)
- Concrete water retaining standard
- Concrete design standard

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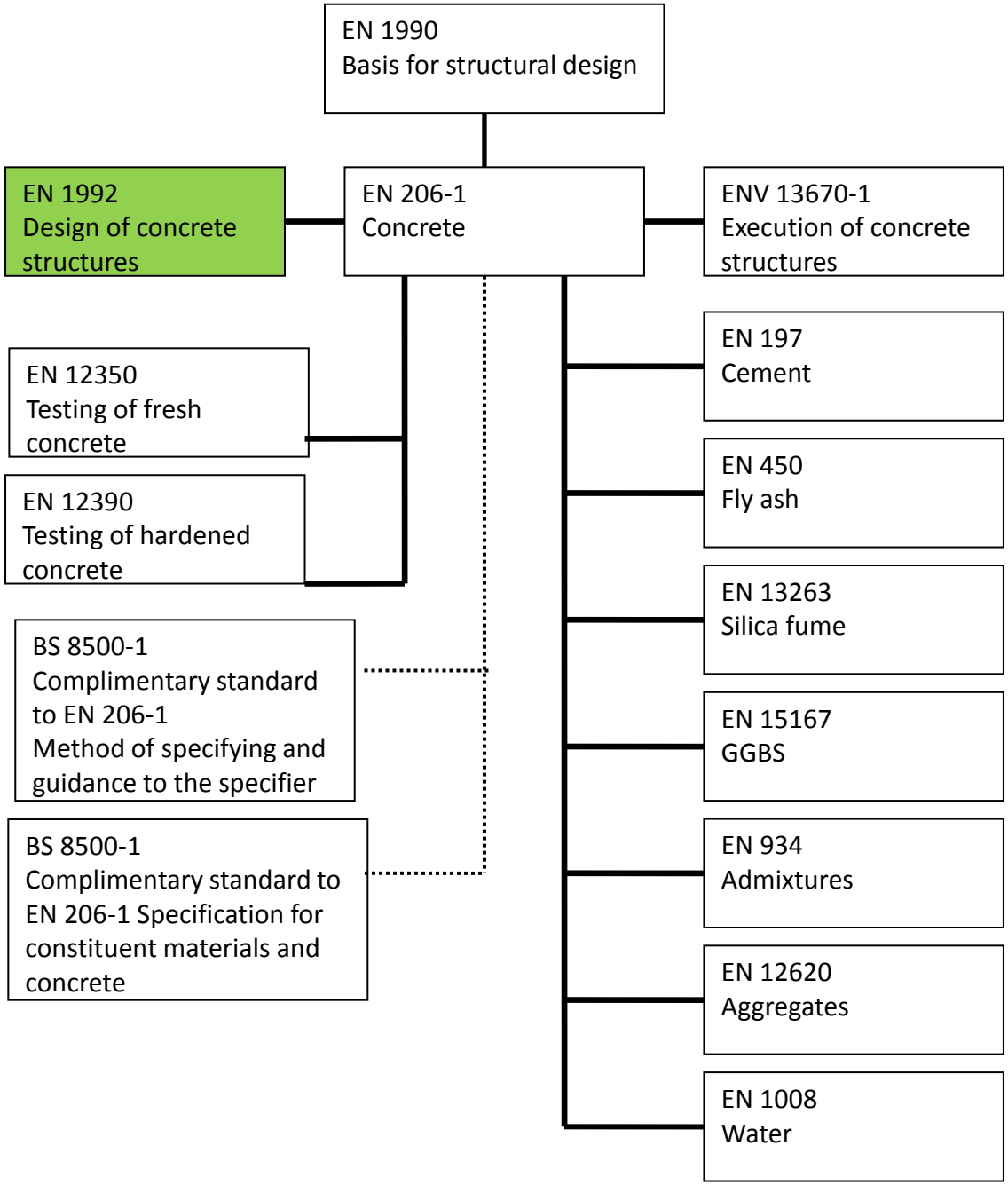

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Adopting EN 1992

- Time line :
  - Working group formed in August 2007
  - Review of relevant parts 2007 – 2010
  - Choose nationally determined parameters : 2011
  - Draft annexure(s) to National Annex (2012)
  - Draft code : END ????

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Specifying Concrete

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Traditional Approach

- Specify certain properties and actions
  - Aggregates
  - Concrete
  - Construction process
  - Quality control (strength)

- Prescriptive approach with some performance requirements

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Traditional Approach

- Changes recently to add properties to control “covercrete”
- Specify those actual properties which prevent deterioration
- Move towards preventing
  - Ingress of chlorides
  - Ingress of CO_2
  - Poor curing

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Traditional Approach

- Design structurally and then

- Determine how to make the structure durable

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New Philosophy

- Determine environment and required longevity
- Determine required durability
- Choose an approach to achieve durability, and then

- Determine structural design

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Construction Specifications

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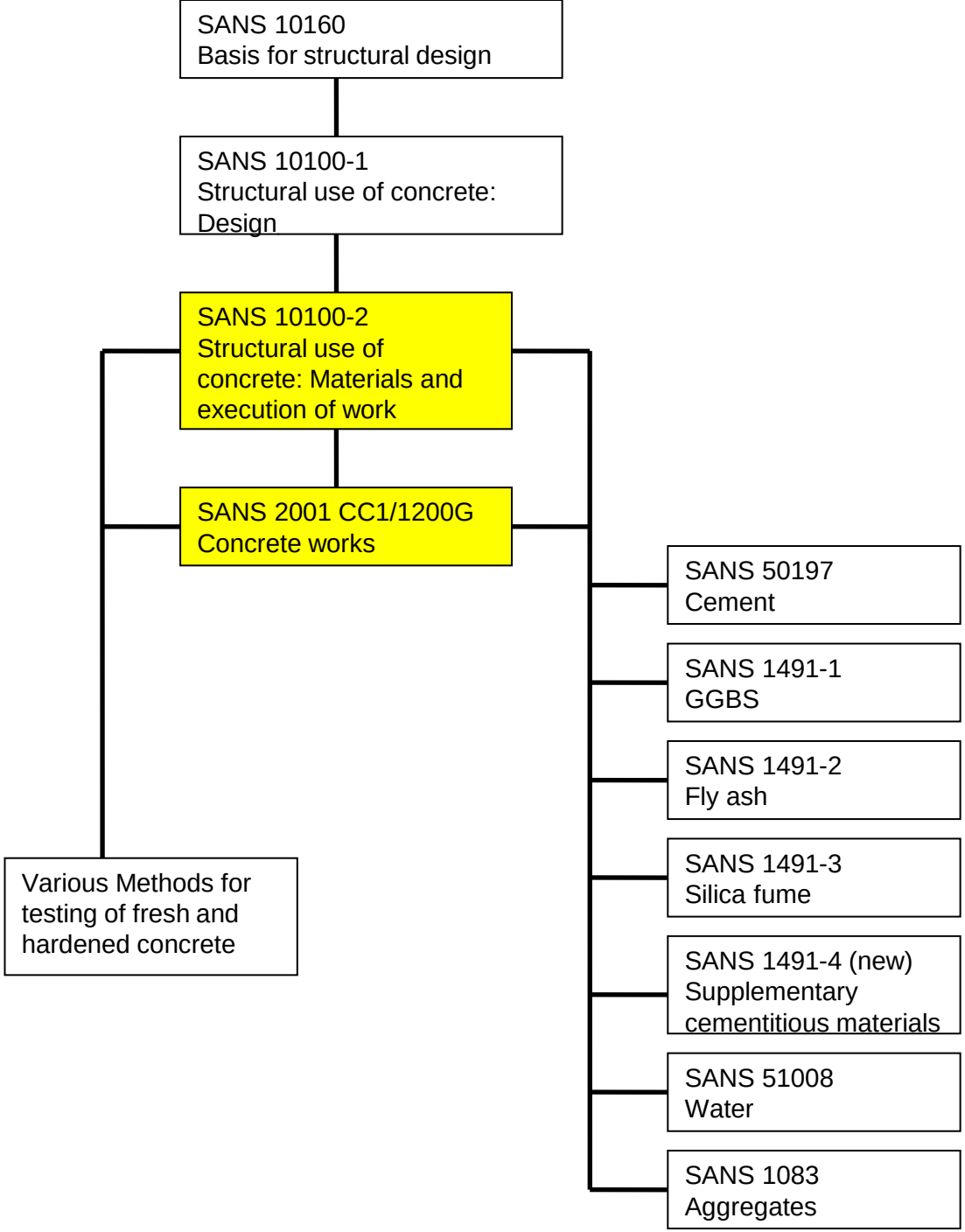

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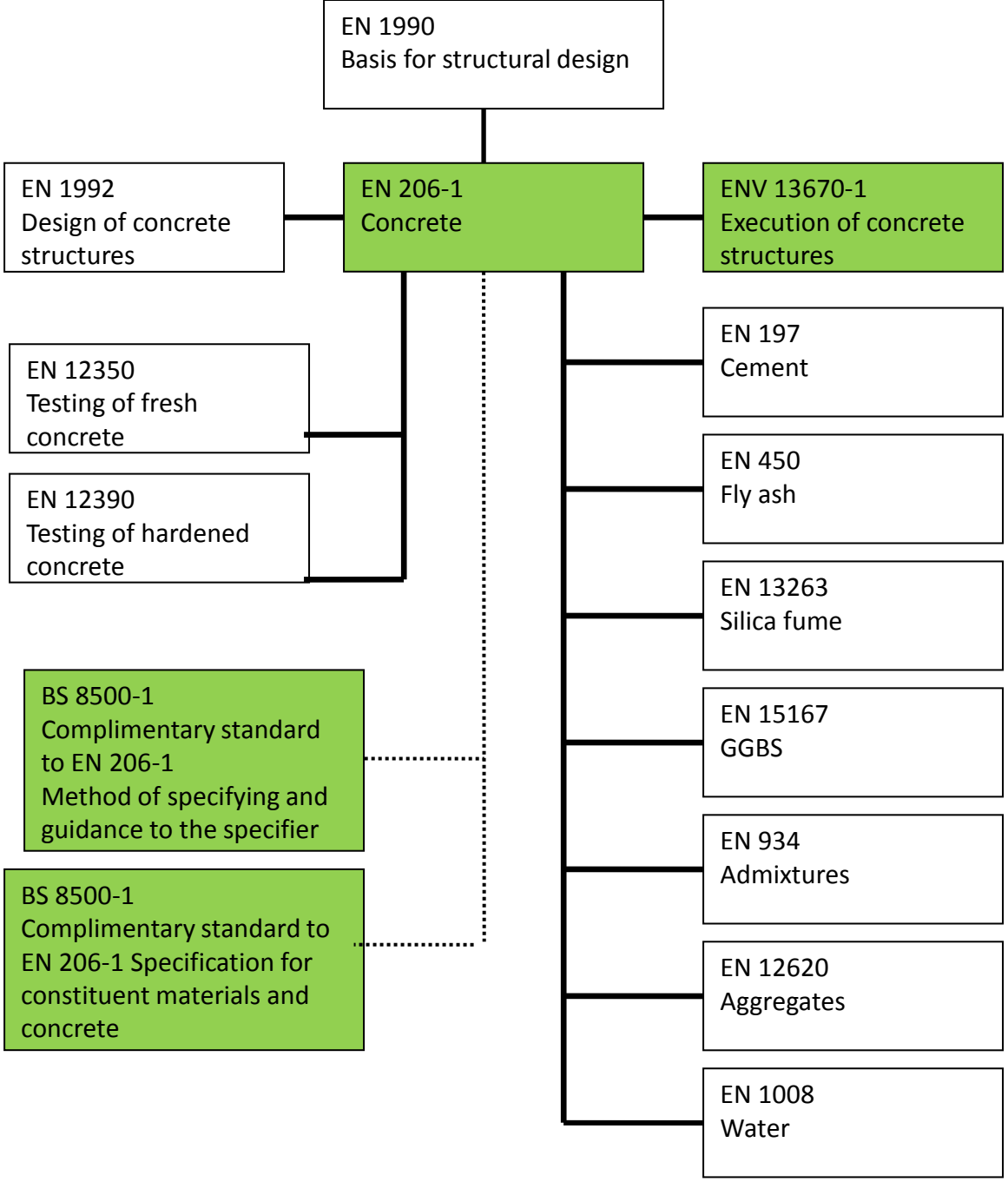

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SANS 10100-2 The Way Forward

- Adopting EN 206 *Concrete*
- Adopting EN 13670 *Execution of concrete structures*
- Developing two guidance documents (Parts A & B)
  - Same numbering
  - Incorporating a lot of current 10100-2
- By using guidance documents – compliance with 206 and 13670

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SANS 10100-2 The Way Forward

- Two small committees working on different parts
- Circulate to large industry grouping
- Submission to SANS

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SANS 2001 vs SANS 1200

- **SANS 2001 series form part of the scope of the work**
- **Unlike SABS 1200, they contain:**
- No reference to measurement of quantities
- No reference to payment items
- No reference to who is responsible for work items or the management of the site
- Requirements for the finished component of the works and work methods only where appropriate

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SANS 2001 vs SANS 1200

- Debate at SABS on 24 July 2012
- SANS 2001 will be completed and 1200 series withdrawn

- 2001 CC--- will have to be revised once Part A and Part B finalised

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Material Specifications

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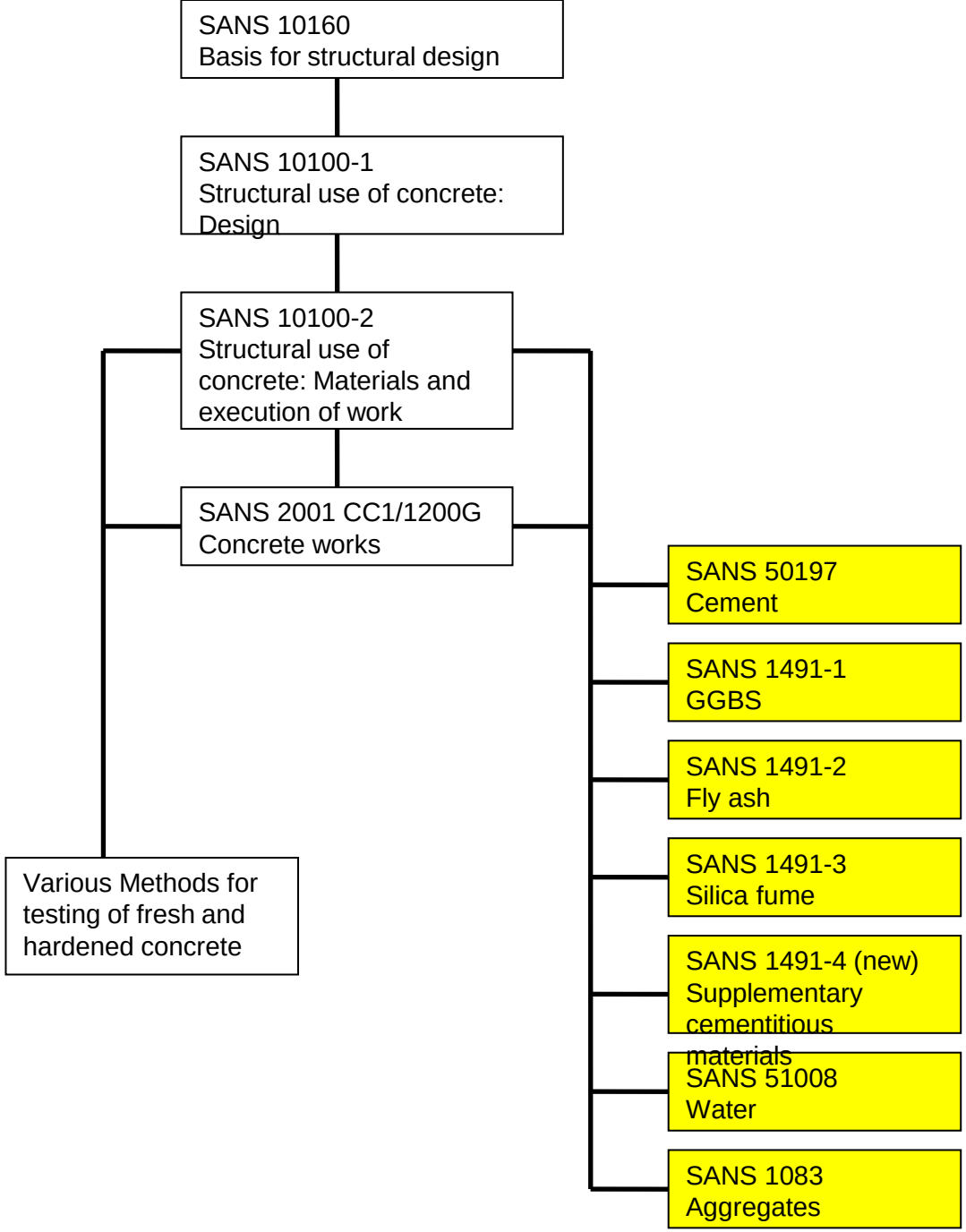

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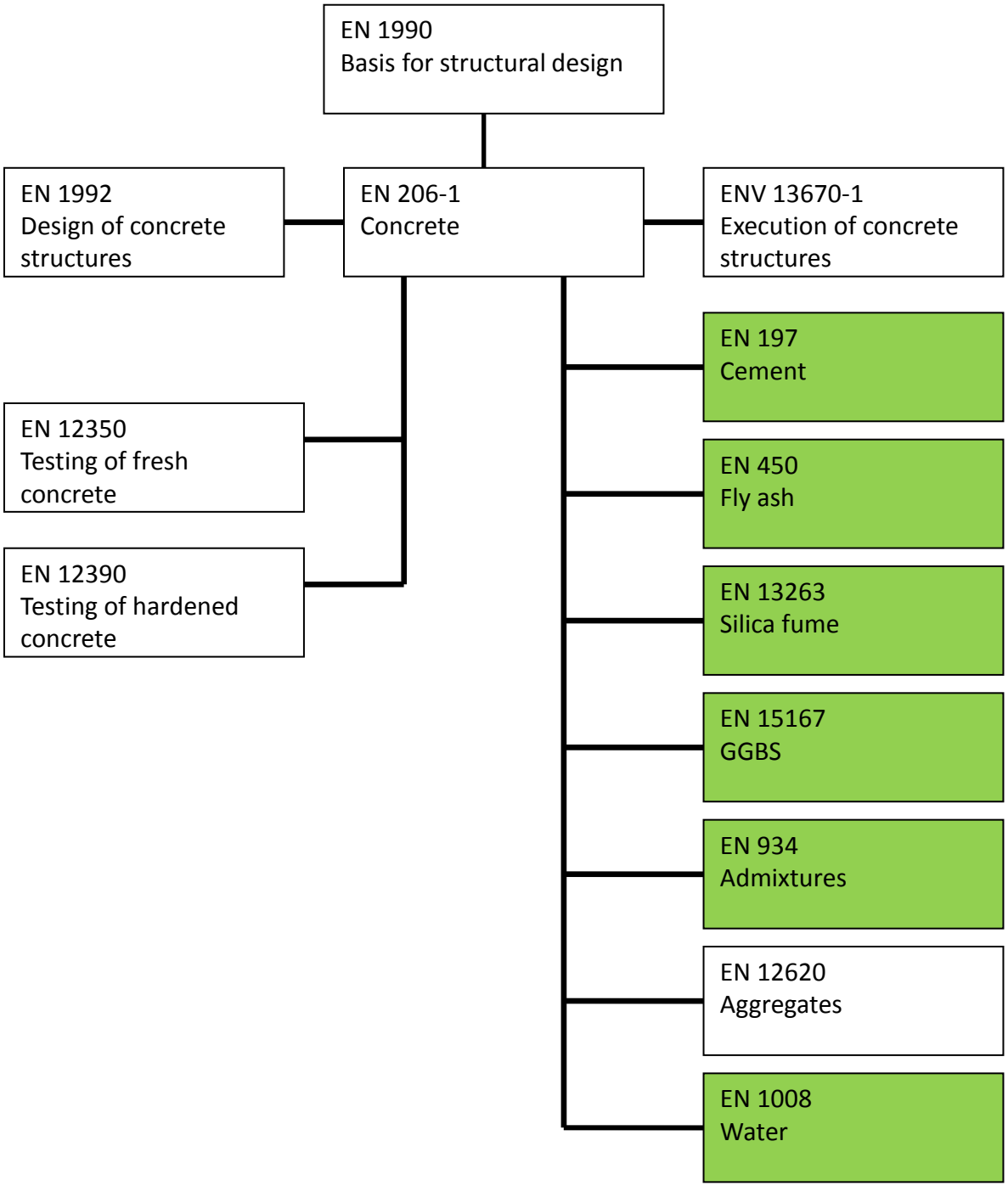

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- Cement SANS 50197 and SANS 50413

- GGBS SANS 1491-1 SANS 55167 (EN 15167)
- Fly ash SANS 1491-2 SANS 50450 (EN 450)
- Silica Fume SANS 1491-3 SANS 53263 (EN 13263)

- Other metallurgical slags

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- Admixtures SANS 50934 1-6 (EN 934)
- Water SANS 51008 (EN 1008)
- Aggregates SANS 1083 ?????

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Test Methods

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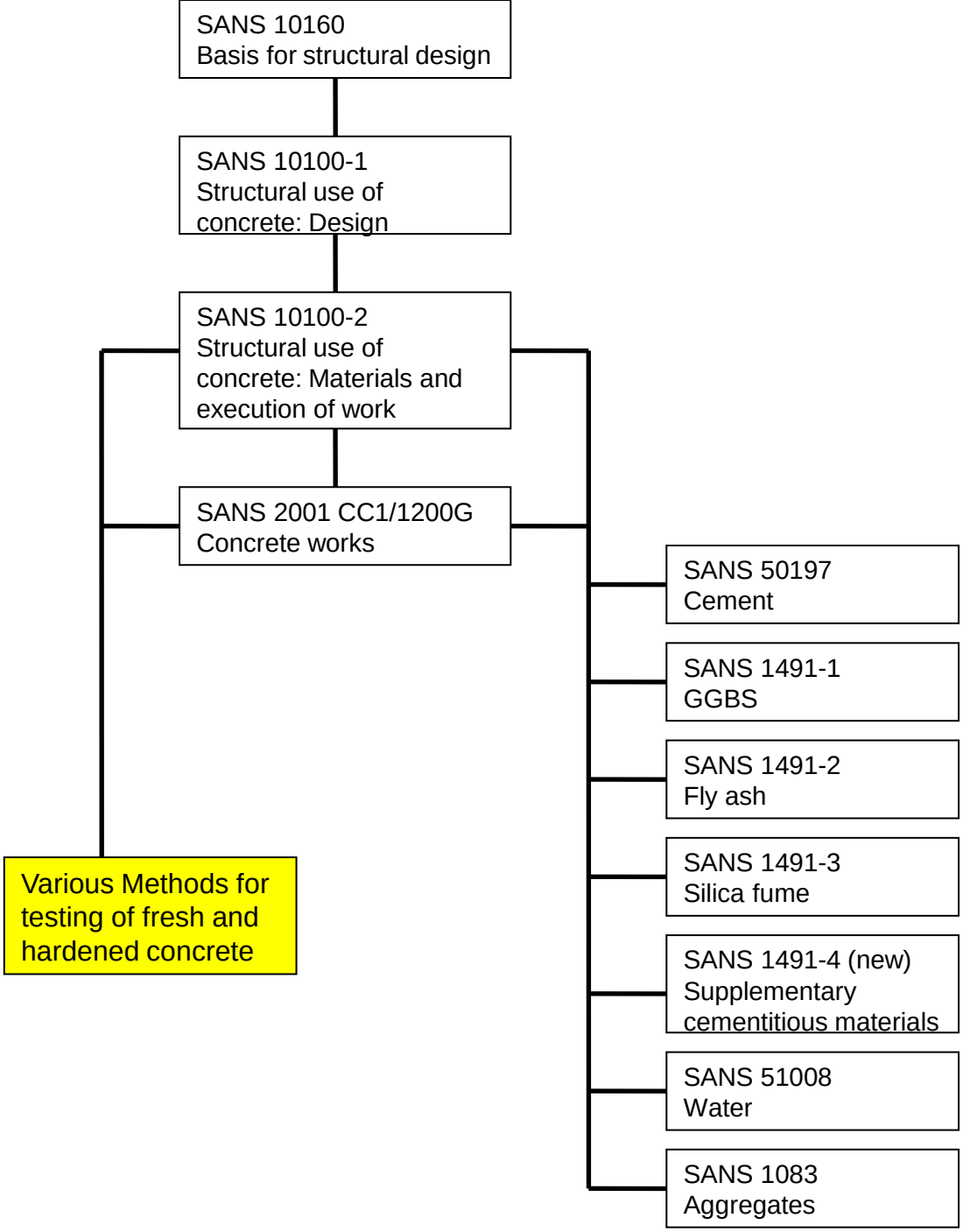

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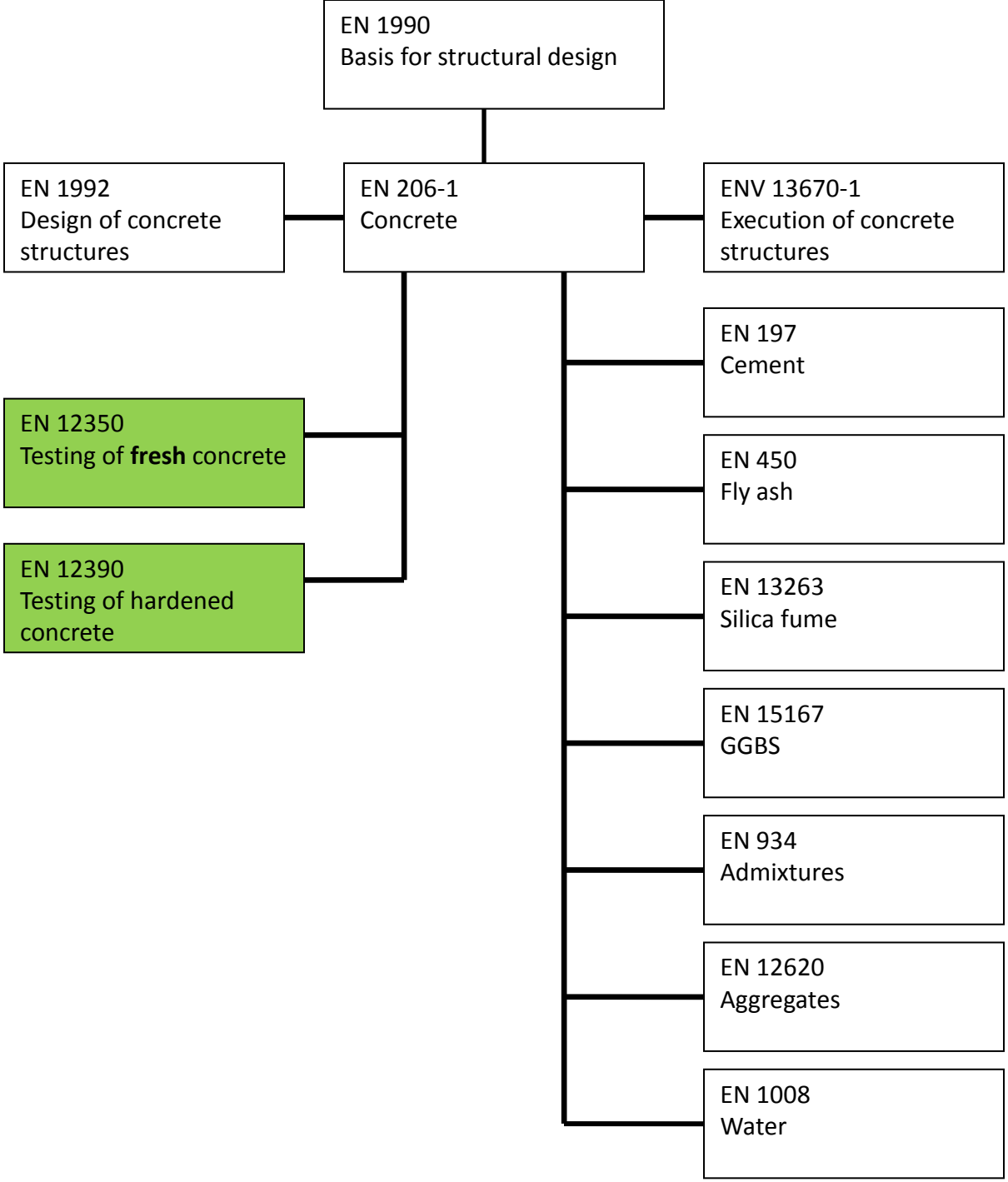

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- Driven by TMH 1
- Homogenization of both
- Uniform numbering system
- SANS 3001 series

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- Opted to look at EN methods
- Process driven by C&CI
- Hiatus with close of C&CI
- Restarting under SANS
- Restarted in 2013

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- 3001 Bi Bitumen
- 3001 So Soils
- 3001 Gr Gravels
- 3001 Agg Aggregate
- 3001 Co Concrete

- 3001 Co 1 Parts 1- ? Fresh Concrete
- 3001 Co 2 Parts 1- ? Hardened Concrete
- 3001 Co 3 Parts 1- ? Concrete in Structures

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Final Structure

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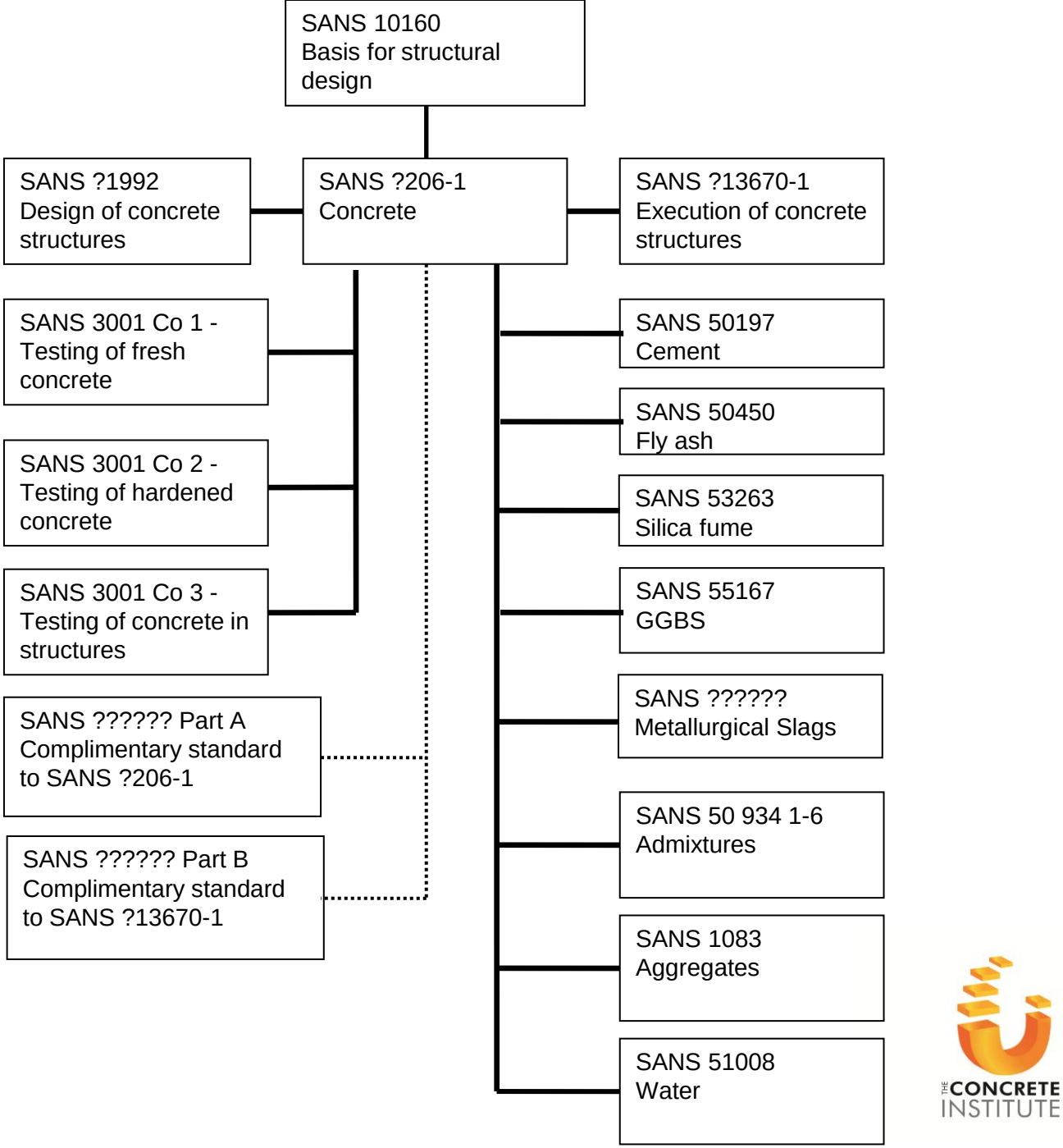
SANS 10160
Basis for structural design
SANS ?1992
Design of concrete structures
SANS ?206-1
Concrete
SANS ?13670-1
Execution of concrete structures
SANS 3001 Co 1 - Testing of fresh concrete
SANS 3001 Co 2 - Testing of hardened concrete
SANS 3001 Co 3 - Testing of concrete in structures
SANS ?????? Part A
Complimentary standard to SANS ?206-1
SANS ?????? Part B
Complimentary standard to SANS ?13670-1
SANS 50197
Cement
SANS 50450
Fly ash
SANS 53263
Silica fume
SANS 55167
GGBS
SANS ??????
Metallurgical Slags
SANS 50 934 1-6
Admixtures
SANS 1083
Aggregates
SANS 51008
Water

Implications

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New Environmental Classification

- New exposure classes
- Fresh and hardened properties classification
- New cover requirements
- Chloride content class

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Prescribed Concrete

- Specifier (or SANS – for standardized) prescribes the composition of concrete

- Specifier (or SANS) responsible for ensuring that prescribed composition will satisfy all requirements

- Can be used for routine applications, primarily with low grade concretes (less than C20/25 or C25/30)

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Designed Concrete

- Designer (concrete producer) decides composition of concrete – keeping strict adherence to limiting values in the table

- As long as concrete satisfies limiting values, it is deemed to satisfy the performance requirements

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	Exposure classes																
	No risk of corrosion or attack	Carbonation induced corrosion				Chloride induced corrosion						Freeze thaw attack				Aggressive chemical environments		
						Sea water			Chloride other than from sea water									
	X0	XC1	XC2	XC3	XC4	XS1	XS2	XS3	XD1	XD2	XD3	XF1	XF2	XF3	XF4	XA1	XA2	XA3
Max w/c	0.70	0.65	0.65	0.55	0.50	0.50	0.45	0.40	0.55	0.45	0.40	0.55	0.55	0.50	0.45	0.55	0.50	0.45
Minimum Strength Class	C20/25	C20/25	C25/30	C30/37	C30/37	C30/37	C35/45	**(a)** C40/50 **(b)** C35/45	C30/37	C35/45	C40/50	C30/37	C30/37	C30/37	C30/37	C30/37	C35/45	C40/50
Minimum nominal cover[2] (mm)	15	15	25	25	25	**(a)** 40 **(b)** 35	**(a)** 35 **(b)** 30	**(a)** 50 **(b)** 40	30	**(a)** 35 **(b)** 30	**(a)** 45 **(b)** 40	25	25	25	25	25	30	40
Air Content Range (%)	-	-	-	-	-	-	-	-	-	-	-	-	4 – 8[1]	4 – 8[1]	4 – 8[1]	-	-	-
Cement Type	Any If IVB-V is used in XC3 or XC4, increase minimum nominal cover to 40 mm					**(a)** I, IIA, IIB-S, SRPC, IIB-V, IIIA **(b)** IIIB, IVB-V	**(a)** I, IIA, IIB-S, SRPC, IIB-V, IIIA **(b)** IIIB, IVB-V	**(a)** I, IIA, IIB-S, SRPC **(b)** IIB-V, IIIA, IIIB, IVB-V	Any	**(a)** I, IIA, IIB-S, SRPC, IIB-V, IIIA **(b)** IIIB, IVB-V	**(a)** I, IIA, IIB-S, SRPC **(b)** IIB-V, IIIA, IIIB, IVB-V	Any Only for XF3 and XF4 – not to use IVB-V				I, IIA-D, IIA-V, IIA-S, SRPC	IIA-D, IIA-V, IIA-S, SRPC	IIB-V + SR, IIIA-S + SR, SRPC
Curing	To be performed until 70% of 28 day target mean strength is attained																	

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Performance Concrete

- This is an added category where additional requirements (over and above the designed concrete) may be proposed
- This can cover performance requirements that are not specified for the designed concretes, such as (i) heat of hydration, (ii) water penetration (permeability), (iii) gas permeability, (iv) abrasion resistance, (v) Tensile strength, etc.
- Performance criteria to be agreed upon between specifier and producer

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Proprietary Concrete

- Special concretes such as Fibre Reinforced Concrete, Self Compacting Concrete etc. that have requirements other than the normal concretes

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EN 206

- EN 206 covers:
  - Concrete mixed on site
  - Ready-mixed concrete
  - Concrete produced in a plant for precast
- EN 206 defines ready-mixed concrete as
  - Concrete delivered in a fresh state by a body who is not the user and includes
    - Concrete produced off site by the user
    - Concrete produced on site but not by the user

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EN 206

- Exposure classes
  - X0 No Risk
  - XC 1 to 4 Corrosion induced by carbonation
  - XD 1 to 3 Corrosion induced by chlorides other than sea water
  - XS 1 to 3 Corrosion induced by chlorides from sea water
  - XF 1 to 4 Freeze/thaw attack
  - XA 1 to 3 Chemical attack

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EN 206

- Consistence classes
  - By Slump
  - By Vebe
  - By compaction
  - By flow

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Table 3 – Slump classes

Class	Slump in mm
S1	10 to 40
S2	50 to 90
S3	100 to 150
S4	160 to 210
S5[1)]	≥ 220

EN 206

- Strength classes

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Table 7 – Compressive strength classes for normal-weight and heavy-weight concrete

Compressive strength class	Minimum characteristic cylinder strength $f_{ck,cyl}$ N/mm^2	Minimum characteristic cube strength $f_{ck,cube}$ N/mm^2
C8/10	8	10
C12/15	12	15
C16/20	16	20
C20/25	20	25
C25/30	25	30
C30/37	30	37
C35/45	35	45
C40/50	40	50
C45/55	45	55
C50/60	50	60
C55/67	55	67
C60/75	60	75
C70/85	70	85
C80/95	80	95
C90/105	90	105
C100/115	100	115

Conclusions

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Changes in approach with new standards:

- Determine environment and required longevity
- Determine required durability
- Choose an approach to achieve durability
- Determine structural design

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Changes coming in:

- Design codes
- Standards
- Material specifications
- Test methods

Be Aware

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We Need You

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