# *Workshop fib MC2020 - Developments in Codes for New and Existing Structures*

# Overview of Brazilian Standardization for Structural Concrete

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ABNT – Brazilian Association of Technical Standards

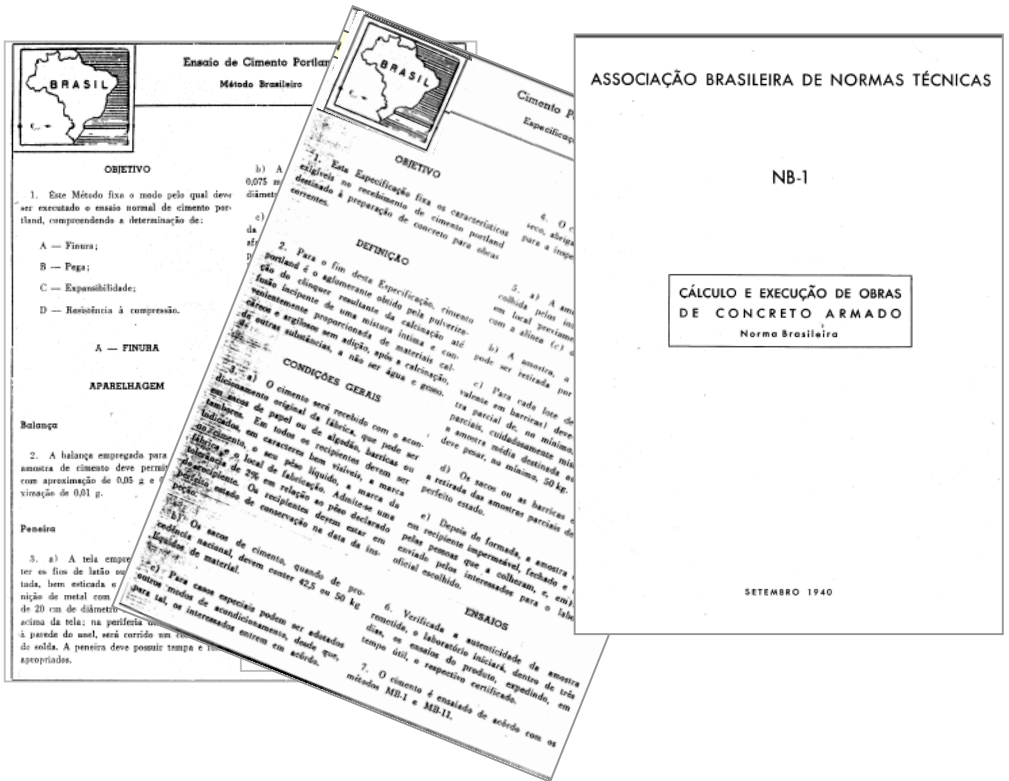
**São Paulo, 29 September 2017**

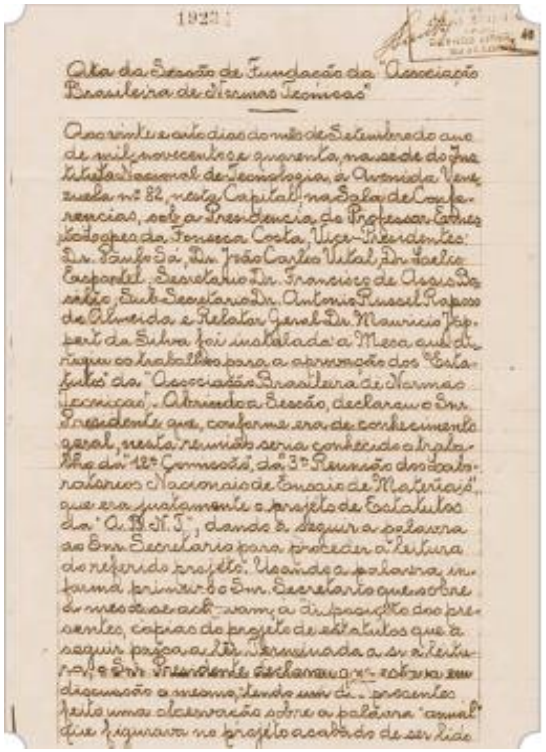
# Brazilian Standardization

## The history began with structural concrete:

**1940 – ABNT was founded and three Standards were published:**

- **EB1** – Requirements for ordinary Portland cement
- **MB1** – Test methods of cement
- **NB1** – Design and execution of reinforced concrete structures



# Brazilian Standardization

## Brazilian Association of Technical Standards:

- is a non-governmental national organization
- is recognized by the Brazilian government as the National Forum of Standardization
- is an ISO founder member
- develops voluntary and consensus-based Brazilian Standards in several areas

**The developing of Brazilian Standards**

**is carried out through**

**ABNT Technical Committees**

# Brazilian Standardization

## Brazilian Association of Technical Standards:

- two Brazilian Technical Committees are responsible for the standards of concrete and concrete structures:
  - **ABNT/CB-02** Brazilian Committee of Civil Construction
  - **ABNT/CB-18** Brazilian Committee of Cement, Concrete and Aggregates

- ABNT is a P member of ISO/TC71 – *Concrete, Reinforced Concrete and Pre-stressed Concrete (*and all its Subcommittees)

# Brazilian Standards

## Some highlights...

**EB 1** Ordinary Portland cement

**EB 2** High early strength Portland cement

**EB 3** Laminated steel bars for reinforced concrete

**MB 1** Test methods for Portland cement

**NB 5** Loads on building structures

**NB 6** Loads on road bridges structures

**NB 1** Design and execution reinforced concrete structures

**NB 2** Design and execution concrete bridges

**EB 208** Blast furnace Portland cement

**EB 781** Prestressed concrete steel strand

**EB 758** Pozzolanic Portland cement

**EB 780** Prestressed concrete steel wire

**NB 14** Design and execution steel structures

**NB 116** Design and execution Prestressed concrete structures

**NBR 6123** Wind Loads

**NBR 5737** Sulphate resistent Portland cements

**NBR 7212** Ready-mixed concrete

**NBR12655** Preparation control, and acceptance of concrete

**NBR 8681** Actions and safety of structures

**NBR 9062** Design and execution Precast concrete structures

**NBR 15575** Performance habitational buildings -

**NBR15823** Self Compacted Concrete (SCC)

**NBR 14861** Precast prestressed hollow core slabs

**NBR 16475** Precast concrete wall panels

**NBR 15146** Personnel qualification on concrete technology

**NBR 16258** Precast concrete piles

**NBR15577** Prevention of alkali - aggregate reaction

**NBR 15900** Water for concrete

1940 - 1946 Reinforced Concrete

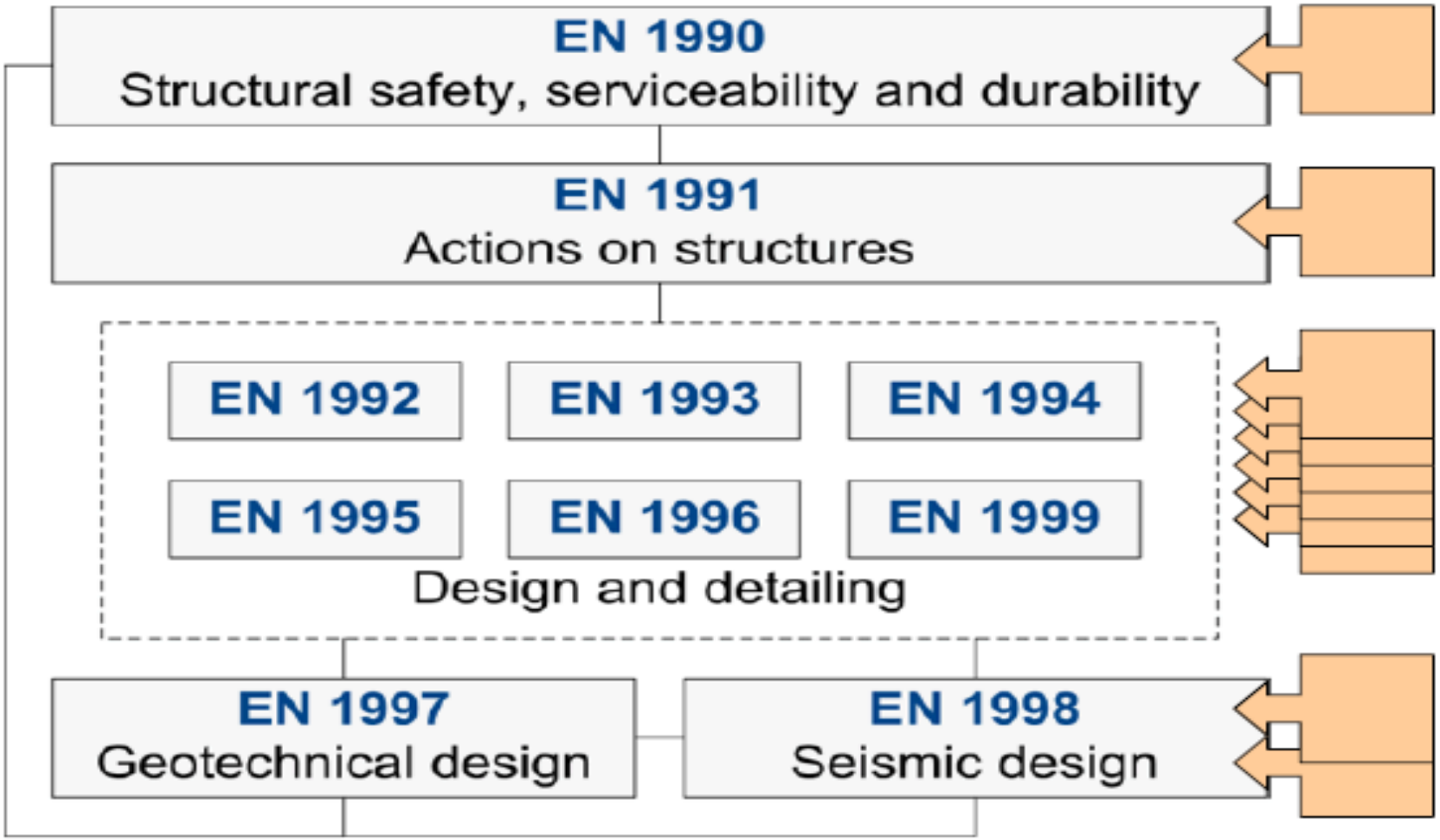
1960 - 1970 Prestressed Concrete

1980 - 1990 Precast Concrete

2000 - 2017 Systems and Durability

year

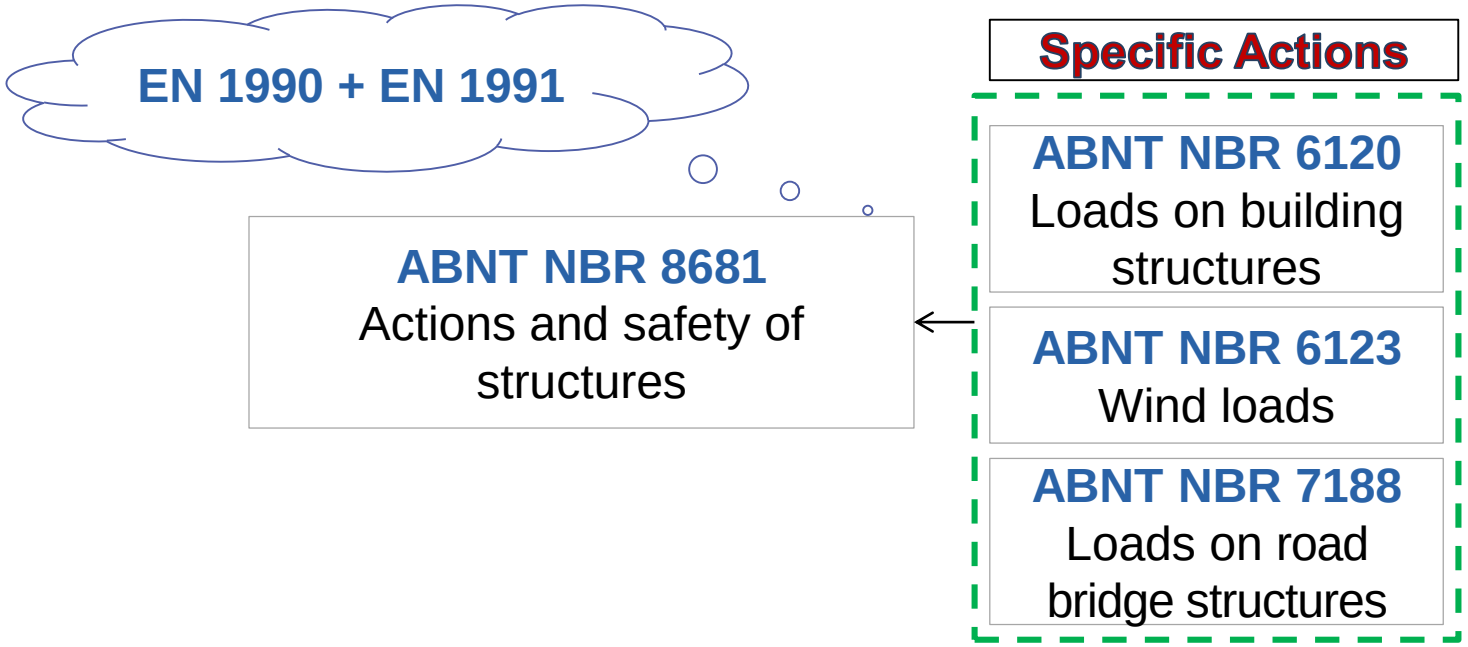
# Eurocodes and *new technical rules for the assessment & retrofitting of existing structures*



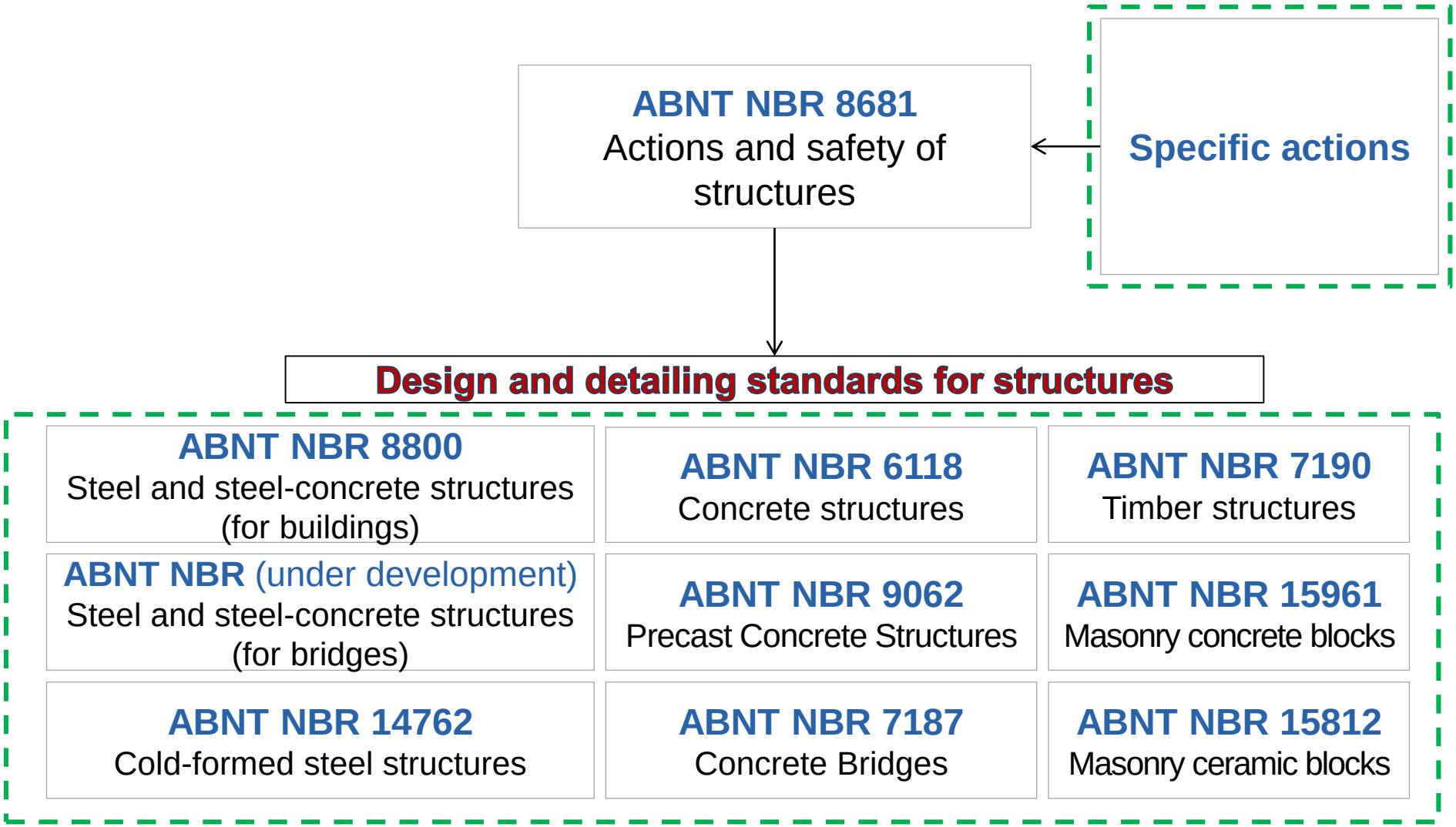

Links between the Eurocodes

Source: Dr. Stuart Matthews, Lausanne, 2016

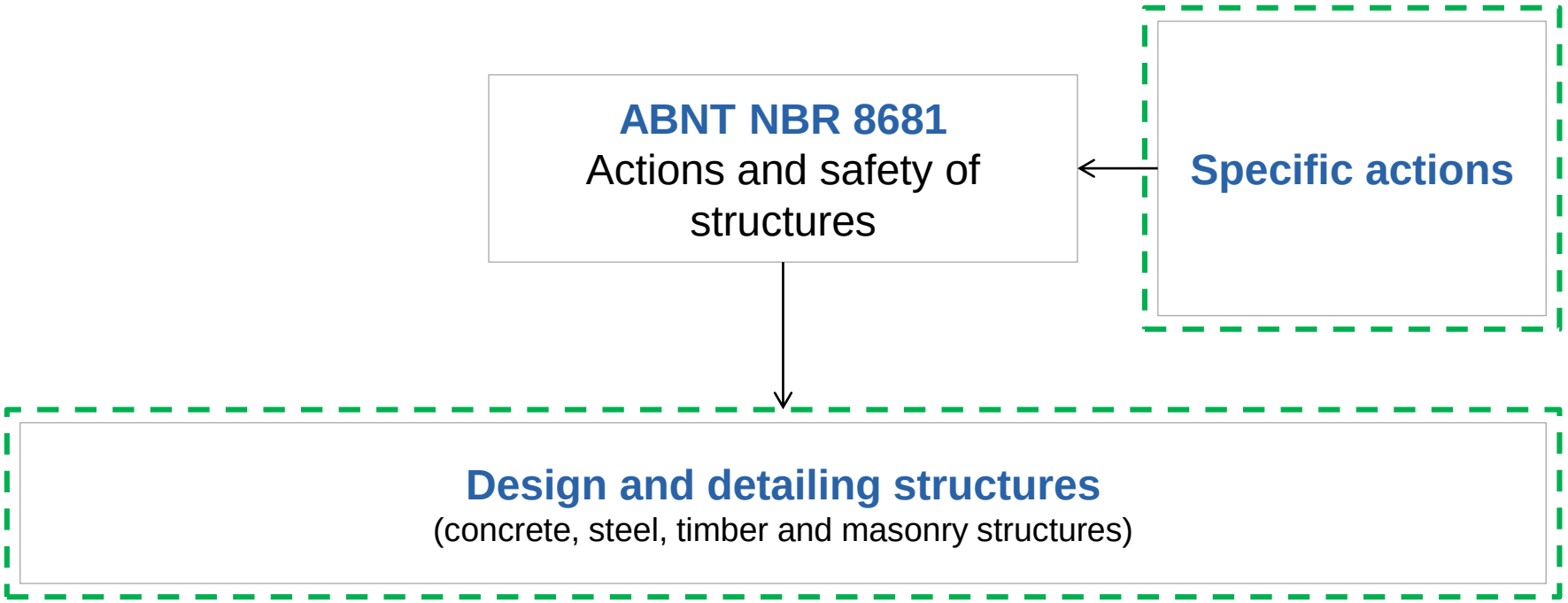
# Brazilian Standardization for Structures



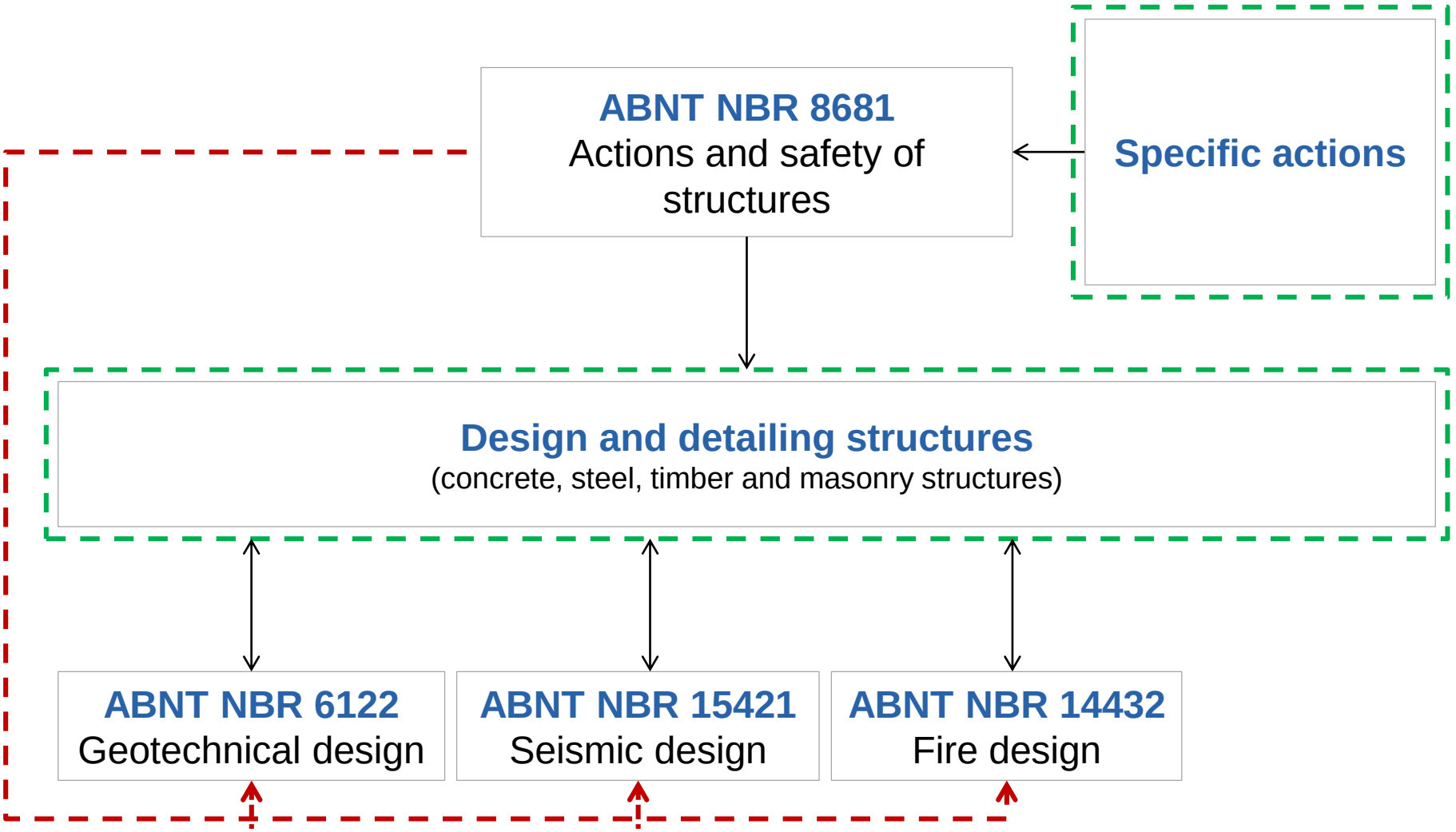
# Brazilian Standardization for Structures



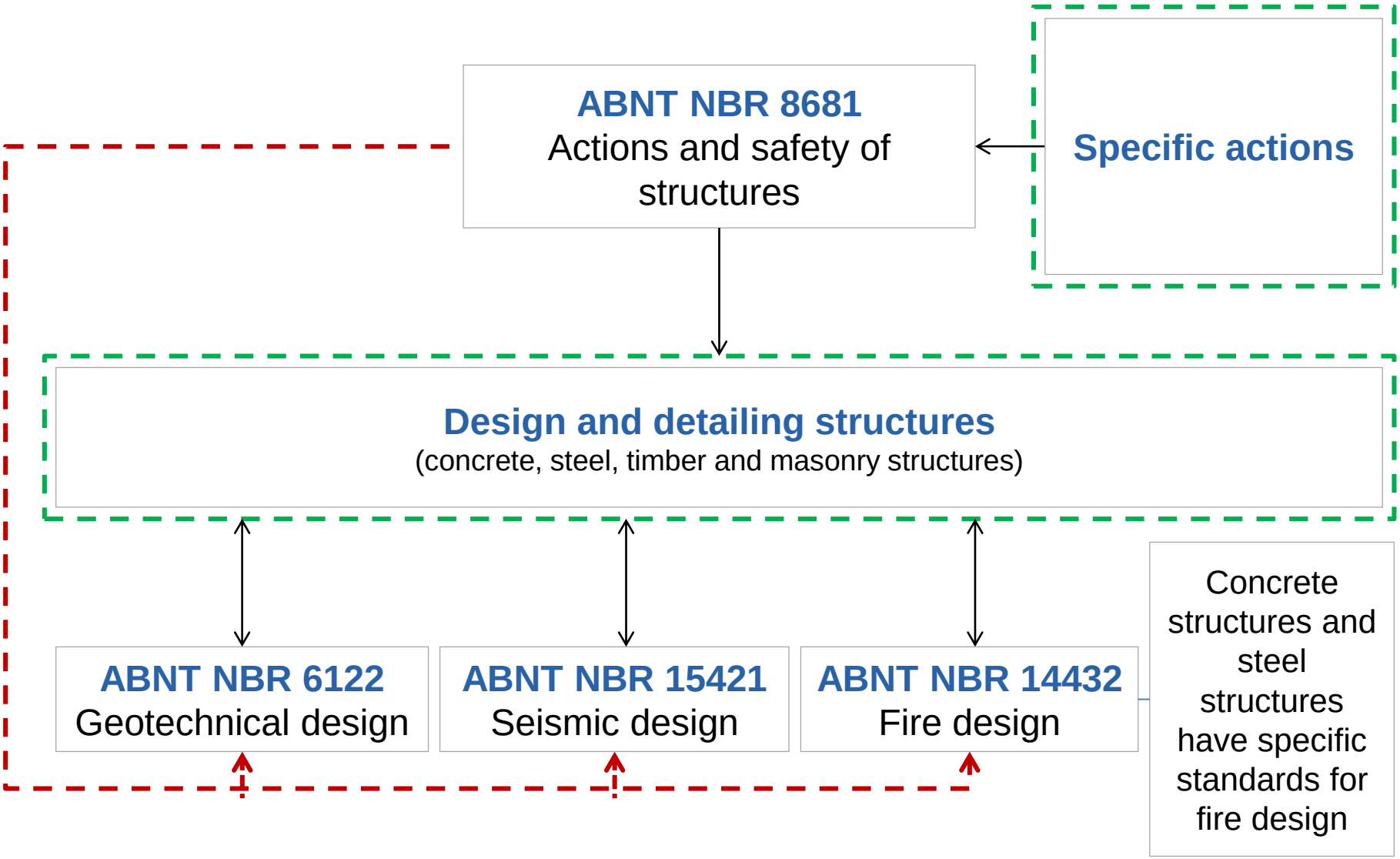
# Brazilian Standardization for Structures



# Brazilian Standardization for Structures



# Brazilian Standardization for Structures



# Brazilian Standardization

**Technical Standards must be a mirror that reflects the reality (not more than the reality)**

When a group of people develop a standard, they need to take into account the importance of the material/product/process/etc for the local economy

**It is essential that experts base their works on the most advanced technologies available**

However, they should bear in mind that the national standards must consider the country's resources and possibilities at the moment of the standardization process (realistic and sustainable requirements)

# Contextualizing the Brazilian way

## A large country:

- 8.515.767 km$^2$ (5$^{th}$)*
- 207 million people (5$^{th}$)*
- 7.400 km off shore
- 60% of the total area of world native forests
- 12% of all fresh water on the planet
- U$ 1.8 trillion - Gross Domestic Product (GDP) (9$^{th}$)*
- U$15.646 GDP *per capta* (105$^{th}$)*
- 1.5 million km – roads (only 13% paved)
- 0,3 million km – rail roads (most of them very old)
- 6.2 million houses – habitational deficit
- IDH (73$^{rd}$)*


* World position

# Some ideas for the *fib* Model Code 2020 coming from developing countries

## 1. What we understand as developing countries

We call **"developing countries" those countries whose resources are few to meet their needs**. That means large and poor countries can have even more difficulties than small poor countries.

From available resources, the needs that should be primarily attended are **health, education and safety** (we need to ensure that the child reaches maturity healthy and educated), and what's left **to invest in infrastructure** should be used with care, **seeking to optimize the processes of design, execution and maintenance**.

Since these societies end up having to accept greater risks from birth to maturity of its citizen**, it makes sense to take similar risks in these 3 processes.**

Source: Dr. Fernando Stucchi, Lausanne, 2016

# Contextualizing the Brazilian way

## A mixed cultural country:

Colonized by Portugueses 

with the “help” of people from:

...and others

# Contextualizing the Brazilian way

Our typical dish...

**Brazilian feijoada**, made with black beans and pork meat (cooked together), accompanied by rice, “farofa”, pepper, boiled cabbage and orange.

...and some examples of the Brazilian creativity, that you must taste...

Tapioca (many flavors)

Cocada

Brigadeiro

Quindim

Pumpkin candy

Milk pudding

Cheese bread

Roll cake

Paçoca

Sagu

Pamonha

Pastel (many flavours)

# Contextualizing the Brazilian way

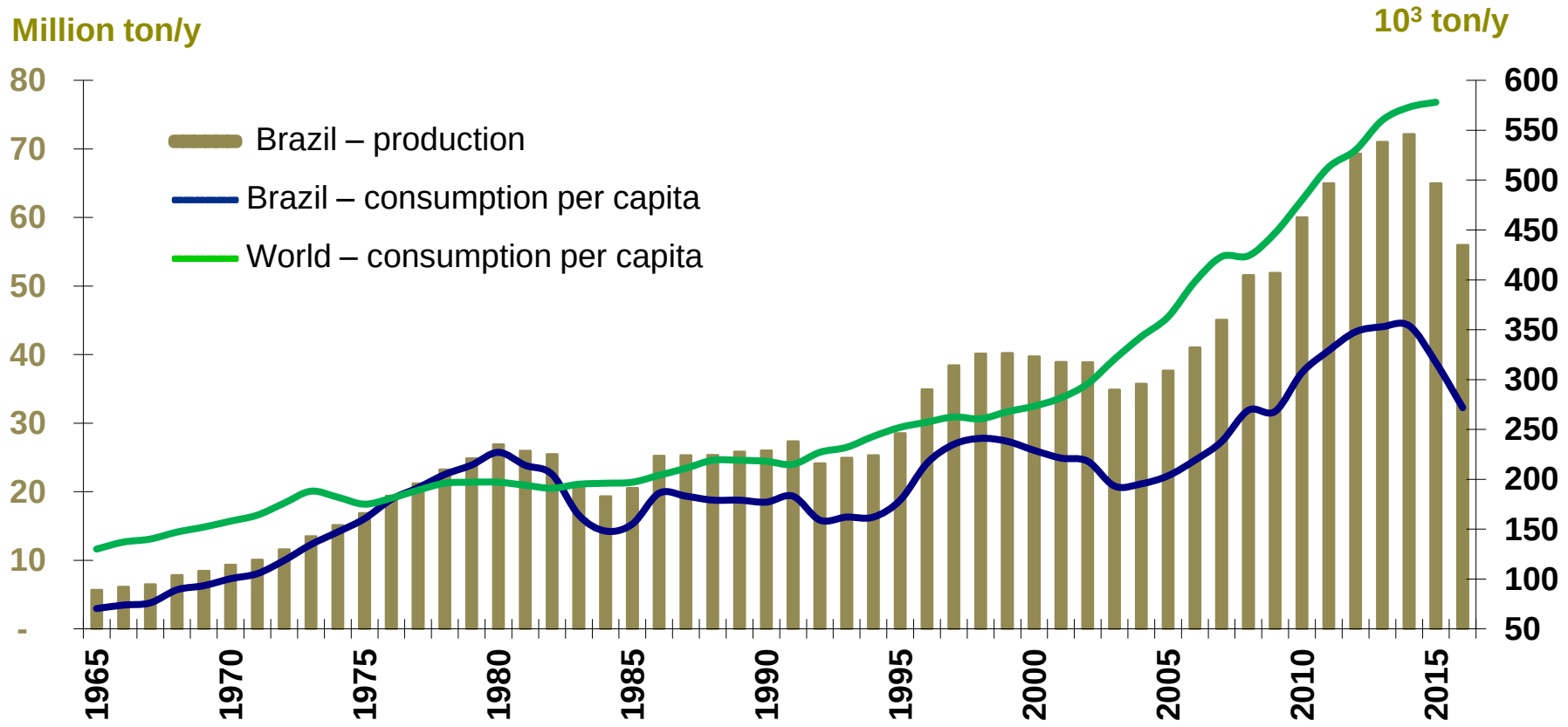
…and you also must see
our slender buildings and beautiful beaches

Camboriú, in Santa Catarina, one of the Brazilian jewels

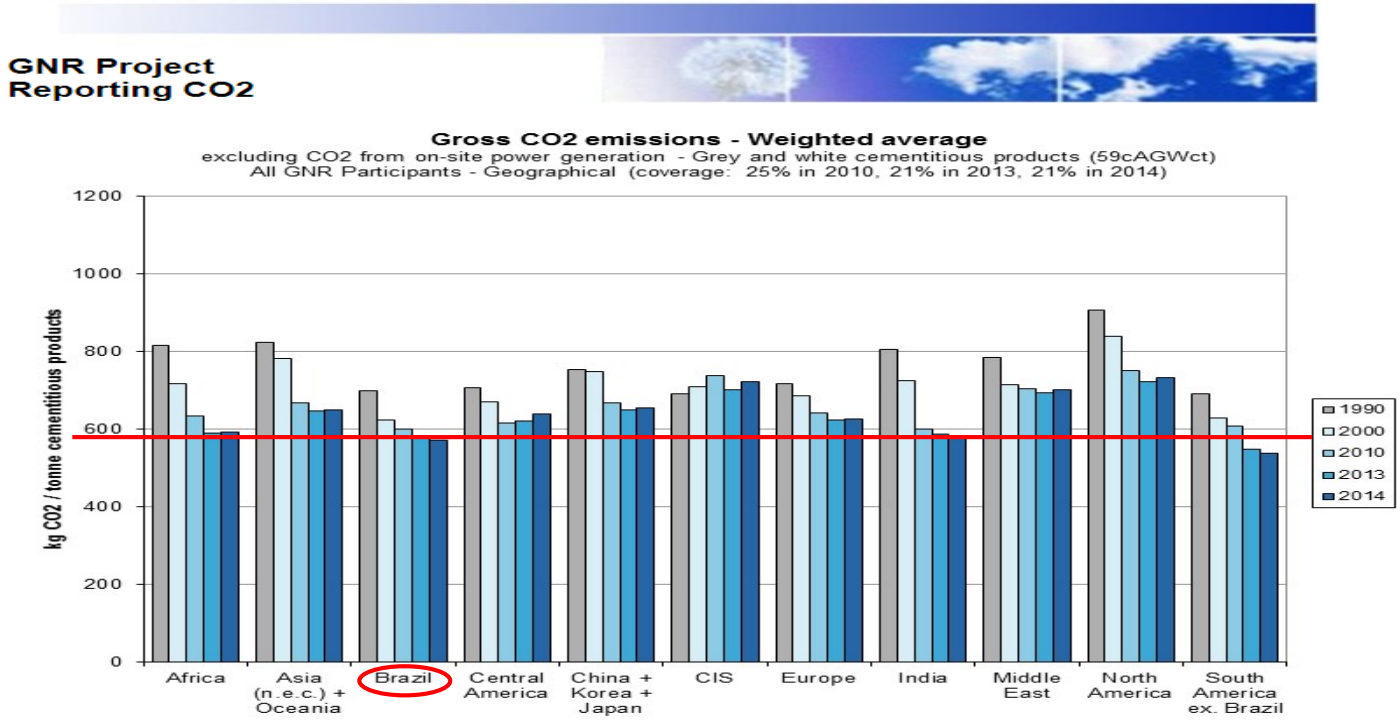
# Contextualizing the Brazilian way

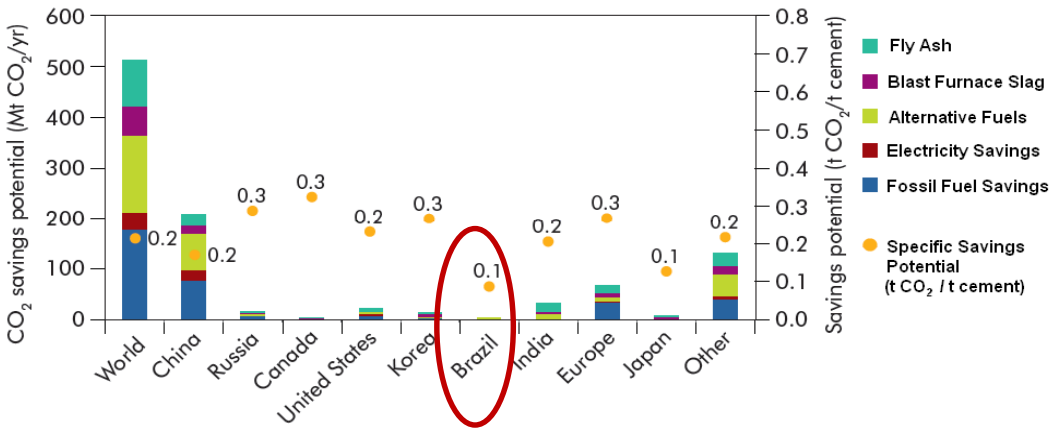
## Concrete is the base of Brazilian construction

- Most of the cement produced in the country is destined for domestic consumption
- Brazil – 7th position of the world cement production



# Brazilian cement industry in the path to a low-carbon world




Source: IEA – International Energy Agency/2009

Brazilian cement industry has the lowest reduction potential, due to the degree of excellence already achieved, as a result of the actions adopted since the 1979 Coal Protocol

# Some examples of the Brazilian concrete construction culture

Italia Building (SP)

Brasilia’s Cathedral (DF)

Immigrants Highway (SP)

Christ the Redeemer (RJ)

Lacerda's elevator (BA)

MASP (SP)

Itaipu Hydroelectric (PR)

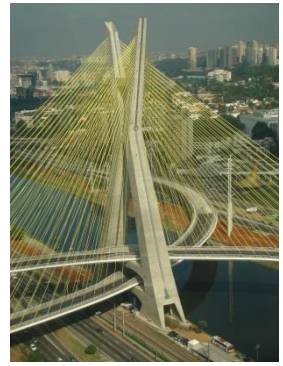
Pampulha’s Church (MG)

Alvorada Palace (DF)

Redinha Bridge (Guamá River - PA)

Rio-Niteroi Bridge (RJ)

Highway Mario Covas (SP)



Octávio Frias de Oliveira Bridge (SP)

Beira Rio (RS) and´Pernambuco (PE) Football Stadiums

# In terms of nature disasters, Brazil is a blessed country

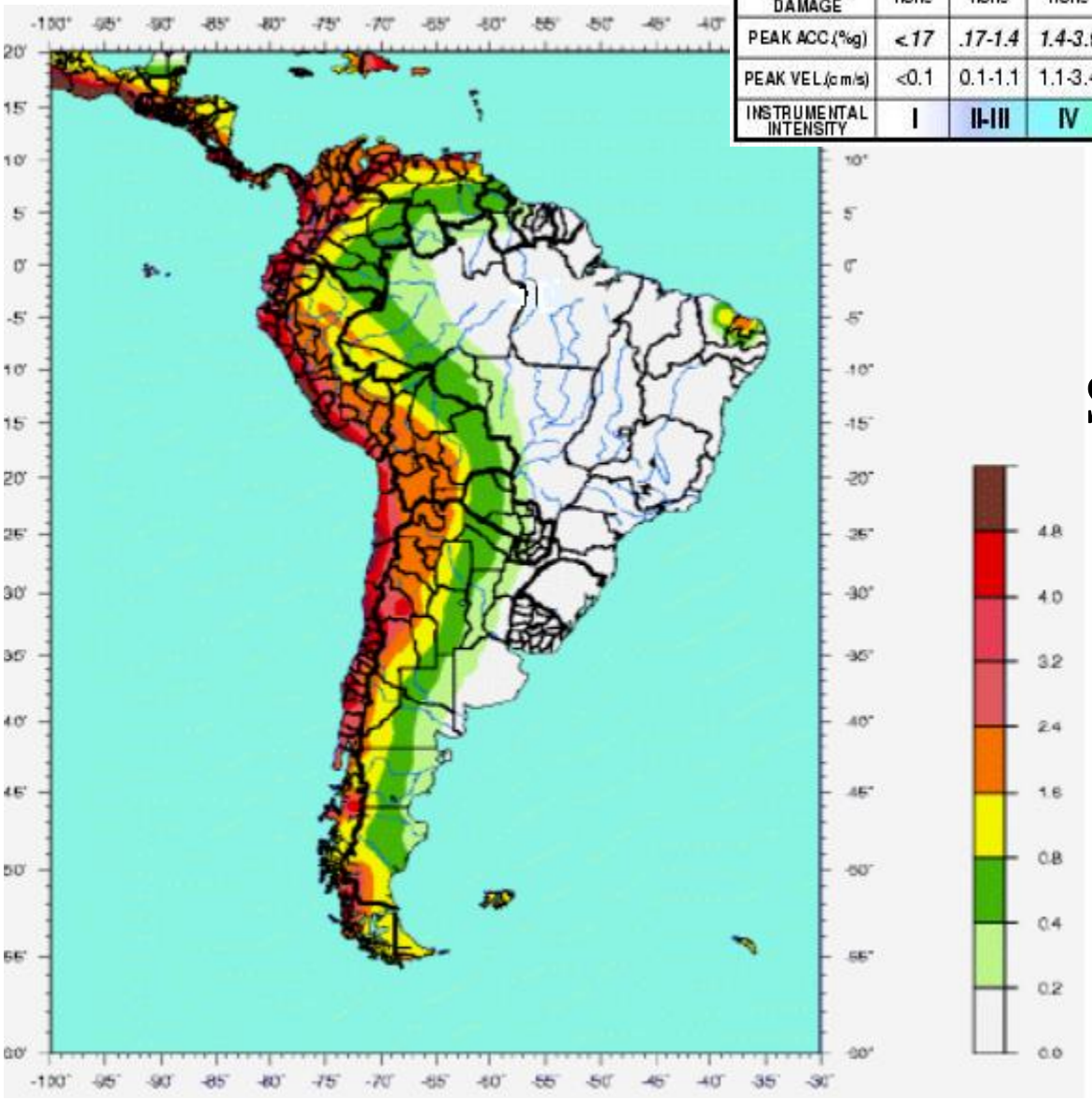
- **Brazilian territory is free from some nature disasters:**
  - hurricanes/twisters
  - snowstorms
  - extreme cold temperatures
  - tsunamis

- **Other nature events occur sporadically and in some specific areas:**
  - earthquakes
  - cyclones
  - big sea waves (3m?)

- **There are some nature events that must be taken into account always, such as:**
  - floods
  - storms
  - landslides
  - winds

# Horizontal actions
# Preventing structural damage due to earthquakes

| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | *<.17* | *.17-1.4* | *1.4-3.9* | *3.9-9.2* | *9.2-18* | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | *16-31* | *31-60* | *60-116* | *>116* |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |



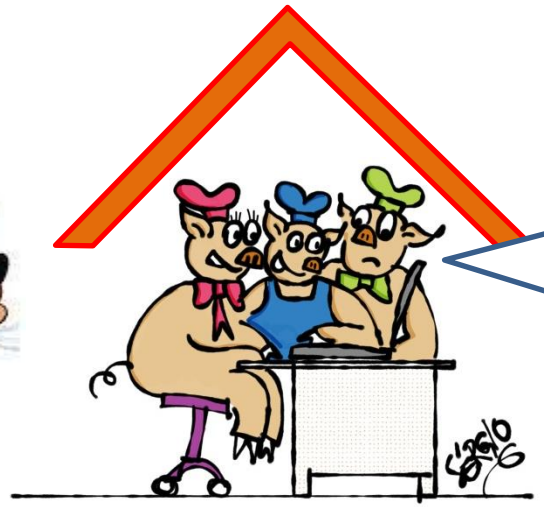

USGS
science for a changing world

Seismic Hazard Map of South America

**ABNT NBR 15421**

**Design of seismic resistant structures**

# Horizontal actions
# Preventing structural damage due to wind loads



Taking into account the wind loads provided for in ABNT NBR 6123, nobody will knock down our house

@josesergiodossantos

In special cases, it's possible to make tests in a wind tunnel simulating the reality of the actions in structure models

Souse:Téchne, Ed. 156, march, 2010 – Prof. Acir Loredo-Souza, Diretor of Aerodynamics Laboratory of Construction) of Federal University of Rio Grande do Sul)


# Contextualizing the Brazilian way

42% of the Brazilian energy matrix comes from renewable sources, such as:

- hydraulic (dams)
- biofuel
- solar
- wind

Brazilian wind towers are usually more than 100 m high, because of preferential winds

2017 – 10.8 GW of wind energy in operation, which represents 7.1% of the Brazilian power matrix (9$^{th}$ place in wind generation in the world).

# Brazil is a blessed country

## Technical Standards must be a mirror that reflects the reality (not more than the reality)

Brazilian standards accept design simplifications and reduced thickness in structural elements in some specific situations (the cover to reinforcement must be attended for durability and fire protection)

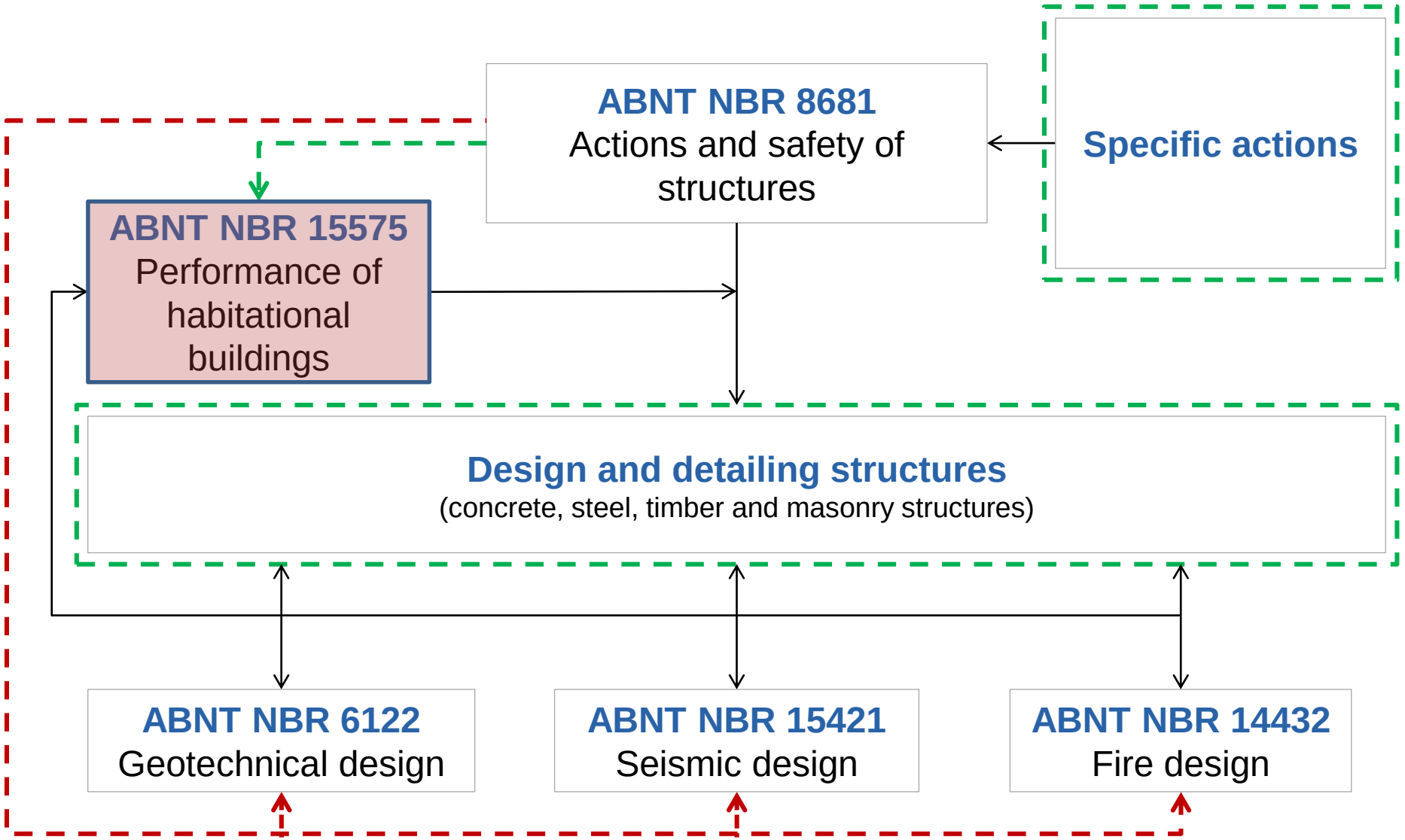
Slender columns and buildings are common in the country due to the small horizontal actions, with some exceptions (previously shown)

# Aspirations for *fib* Model Code 2020

- **Single merged structural code dealing with both new and existing concrete structures**
- **Operational model code that is oriented towards practical needs**
- **Includes worldwide knowledge with respect to materials and structural behaviour**
- **Recognizes the needs of engineering communities in different regions of the world**
- **Integrated life cycle perspective**
- **Holistic treatment of structural safety, serviceability, durability and sustainability**
- **Fundamental principles and a safety philosophy based on reliability concepts**

Source: Dr. Stuart Matthews, Lausanne, 2016

# Brazilian Standardization for structures



# Brazilian Standard for Performance of Buildings

**ABNT NBR 15575**
Performance of habitational buildings

More than 200 requirements divided in three important areas:

- Safety
- Habitability
- Sustainability

Recognizes the suitability of some Brazilian standards, such as NBR 6118 and NBR 9062

"*Standard of Performance*", as ABNT NBR 15575 is known, has six parts:

Part 1 – General requirements
Part 2 – Structure system
Part 3 – Floor system
Part 4 – Walls system
Part 5 – Coverture system
Part 6 – Hydro-sanitary system

**All of the habitational buildings are covered by this standard, regardless of its type, size or material**

# Brazilian Standard for Performance of Buildings

## ABNT NBR 15575 – Users Requirements

### Safety

- Structural safety
- Fire safety
- Use and operational safety

### Habitability

- Watertightness
- Thermal performance
- Acoustic performance
- Light performance
- Health, hygiene and air quality
- Functionality and accessibility
- Tactile and anthropodynamic comfort

### Sustainability

- Durability
- Maintenance
- Environmental impact

Recognizes the suitability of some Brazilian standards, such as NBR 6118 and NBR 9062

# Brazilian Standardization for Structures

**ABNT NBR 8681**
Actions and safety of structures

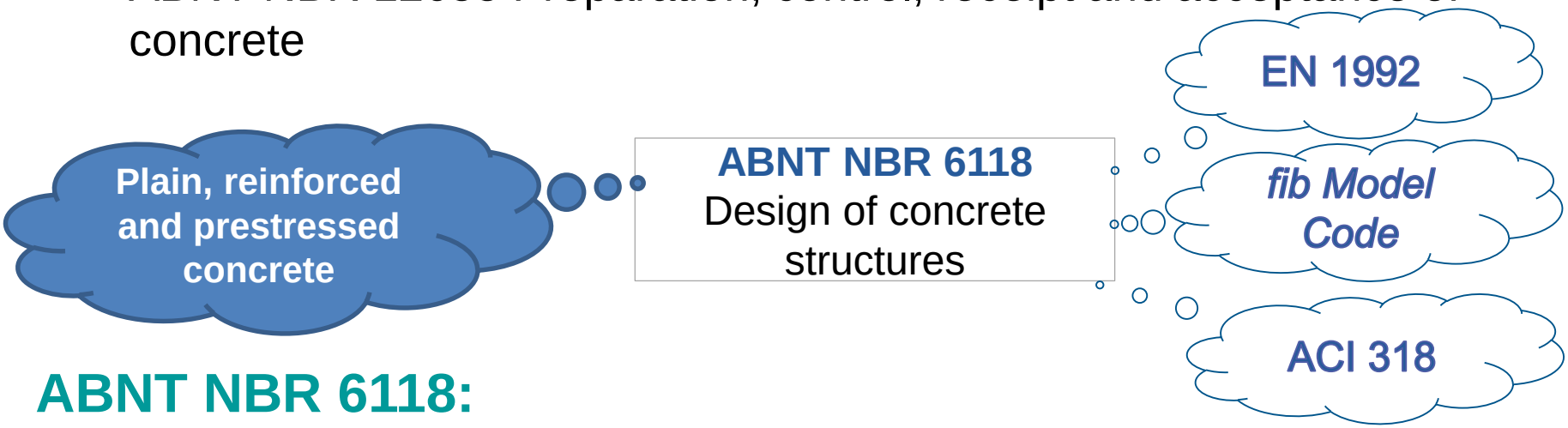
Design and detailing standards for structures

| | | |
|---|---|---|
| **ABNT NBR 8800**<br>Steel and steel-concrete structures (for buildings) | **ABNT NBR 6118**<br>Design of concrete structures | **ABNT NBR 7190**<br>Timber structures |
| **ABNT NBR** (under development)<br>Steel and steel-concrete structures (for bridges) | **ABNT NBR 9062**<br>Precast Concrete Structures | **ABNT NBR 15961**<br>Masonry concrete blocks |
| **ABNT NBR 14762**<br>Design cold-formed steel structures | **ABNT NBR 7187**<br>Design of Concrete Bridges | **ABNT NBR 15812**<br>Masonry ceramic blocs |

# Brazilian Standardization for Concrete Structures

## NB-1 Design and execution of reinforced concrete structures:

- ✓ was published in 1940, at the ABNT foundation
- ✓ was reviewed seven times
- ✓ is the precursor of:
  - ABNT NBR 6118 Design of concrete structures
  - ABNT NBR 14931 Execution of concrete structures
  - ABNT NBR 12655 Preparation, control, receipt and acceptance of concrete



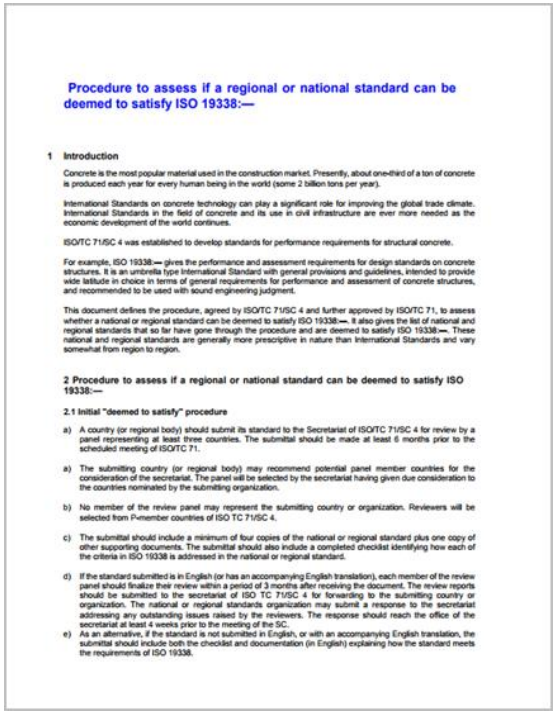

## ABNT NBR 6118:

- ✓ **2008 – met the target "deemed to satisfy ISO 19338"**
- ✓ **2014 – this recognition was updated**

# Brazilian Standardization for Concrete Structures

## ISO 19338:2014

## Performance and assessment requirements for design standards on structural concrete



**Procedure to assess if a regional or national standard can be deemed to satisfy ISO 19338:—**

**1 Introduction**

Concrete is the most popular material used in the construction market. Presently, about one-third of a ton of concrete is produced each year for every human being in the world (some 2 billion tons per year).

International Standards on concrete technology can play a significant role for improving the global trade climate. International Standards in the field of concrete and its use in civil infrastructure are ever more needed as the economic development of the world continues.

ISO/TC 71/SC 4 was established to develop standards for performance requirements for structural concrete.

For example, ISO 19338:— gives the performance and assessment requirements for design standards on concrete structures. It is an umbrella type International Standard with general provisions and guidelines, intended to provide wide latitude in choice in terms of general requirements for performance and assessment of concrete structures, and recommended to be used with sound engineering judgment.

This document defines the procedure, agreed by ISO/TC 71/SC 4 and further approved by ISO/TC 71, to assess whether a national or regional standard can be deemed to satisfy ISO 19338:—. It also gives the list of national and regional standards that so far have gone through the procedure and are deemed to satisfy ISO 19338:—. These national and regional standards are generally more prescriptive in nature than International Standards and vary somewhat from region to region.

**2 Procedure to assess if a regional or national standard can be deemed to satisfy ISO 19338:—**

**2.1 Initial "deemed to satisfy" procedure**

a) A country (or regional body) should submit its standard to the Secretariat of ISO/TC 71/SC 4 for review by a panel representing at least three countries. The submittal should be made at least 6 months prior to the scheduled meeting of ISO/TC 71.

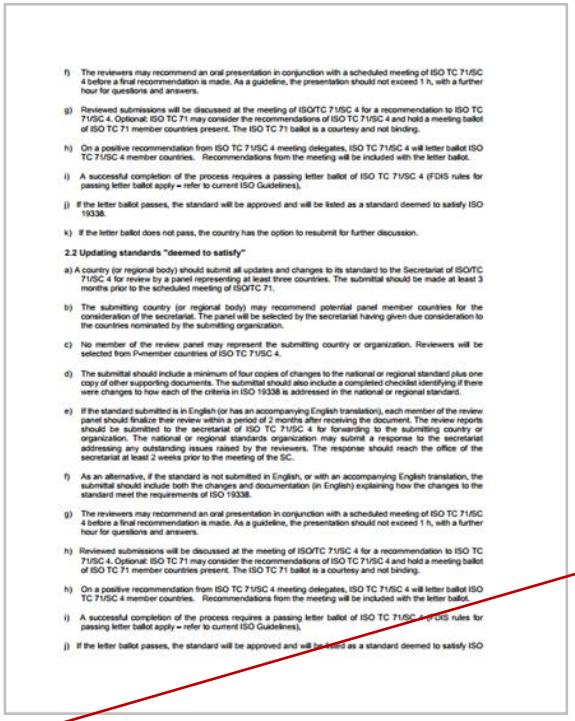
a) The submitting country (or regional body) may recommend potential panel member countries for the consideration of the secretariat. The panel will be selected by the secretariat having given due consideration to the countries nominated by the submitting organization.

b) No member of the review panel may represent the submitting country or organization. Reviewers will be selected from P-member countries of ISO TC 71/SC 4.

c) The submittal should include a minimum of four copies of the national or regional standard plus one copy of other supporting documents. The submittal should also include a completed checklist identifying how each of the criteria in ISO 19338 is addressed in the national or regional standard.

d) If the standard submitted is in English (or has an accompanying English translation), each member of the review panel should finalize their review within a period of 3 months after receiving the document. The review reports should be submitted to the secretariat of ISO TC 71/SC 4 for forwarding to the submitting country or organization. The national or regional standards organization may submit a response to the secretariat addressing any outstanding issues raised by the reviewers. The response should reach the office of the secretariat at least 4 weeks prior to the meeting of the SC.

e) As an alternative, if the standard is not submitted in English, or with an accompanying English translation, the submittal should include both the checklist and documentation (in English) explaining how the standard meets the requirements of ISO 19338.



f) The reviewers may recommend an oral presentation in conjunction with a scheduled meeting of ISO TC 71/SC 4 before a final recommendation is made. As a guideline, the presentation should not exceed 1 h, with a further hour for questions and answers.

g) Reviewed submissions will be discussed at the meeting of ISO/TC 71/SC 4 for a recommendation to ISO TC 71/SC 4. Optional: ISO TC 71 may consider the recommendations of ISO TC 71/SC 4 and hold a meeting ballot of ISO TC 71 member countries present. The ISO TC 71 ballot is a courtesy and not binding.

h) On a positive recommendation from ISO TC 71/SC 4 meeting delegates, ISO TC 71/SC 4 will letter ballot ISO TC 71/SC 4 member countries. Recommendations from the meeting will be included with the letter ballot.

i) A successful completion of the process requires a passing letter ballot of ISO TC 71/SC 4 (FDIS rules for passing letter ballot apply – refer to current ISO Guidelines),

j) If the letter ballot passes, the standard will be approved and will be listed as a standard deemed to satisfy ISO 19338.

k) If the letter ballot does not pass, the country has the option to resubmit for further discussion.

**2.2 Updating standards "deemed to satisfy"**

a) A country (or regional body) should submit all updates and changes to its standard to the Secretariat of ISO/TC 71/SC 4 for review by a panel representing at least three countries. The submittal should be made at least 3 months prior to the scheduled meeting of ISO/TC 71.

b) The submitting country (or regional body) may recommend potential panel member countries for the consideration of the secretariat. The panel will be selected by the secretariat having given due consideration to the countries nominated by the submitting organization.

c) No member of the review panel may represent the submitting country or organization. Reviewers will be selected from P-member countries of ISO TC 71/SC 4.

d) The submittal should include a minimum of four copies of changes to the national or regional standard plus one copy of other supporting documents. The submittal should also include a completed checklist identifying if there were changes to how each of the criteria in ISO 19338 is addressed in the national or regional standard.

e) If the standard submitted is in English (or has an accompanying English translation), each member of the review panel should finalize their review within a period of 2 months after receiving the document. The review reports should be submitted to the secretariat of ISO TC 71/SC 4 for forwarding to the submitting country or organization. The national or regional standards organization may submit a response to the secretariat addressing any outstanding issues raised by the reviewers. The response should reach the office of the secretariat at least 2 weeks prior to the meeting of the SC.

f) As an alternative, if the standard is not submitted in English, or with an accompanying English translation, the submittal should include both the changes and documentation (in English) explaining how the changes to the standard meet the requirements of ISO 19338.

g) The reviewers may recommend an oral presentation in conjunction with a scheduled meeting of ISO TC 71/SC 4 before a final recommendation is made. As a guideline, the presentation should not exceed 1 h, with a further hour for questions and answers.

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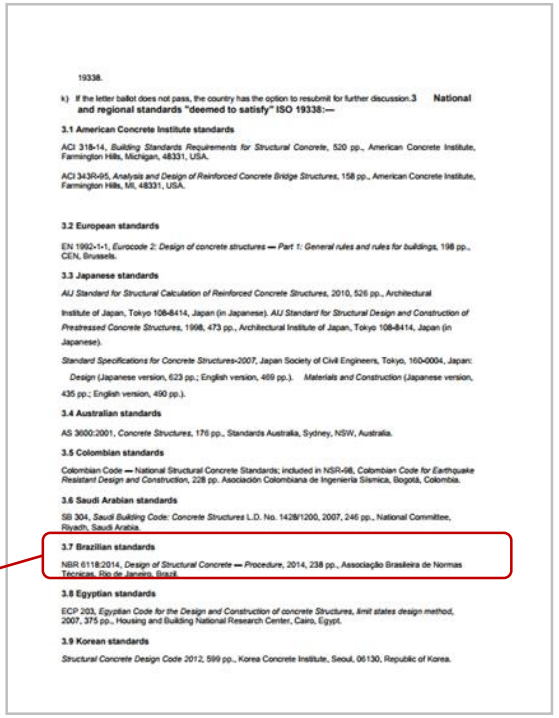


19338.

k) If the letter ballot does not pass, the country has the option to resubmit for further discussion.3 **National and regional standards "deemed to satisfy" ISO 19338:—**

**3.1 American Concrete Institute standards**

ACI 318-14, *Building Standards Requirements for Structural Concrete*, 520 pp., American Concrete Institute, Farmington Hills, Michigan, 48331, USA.

ACI 343R-95, *Analysis and Design of Reinforced Concrete Bridge Structures*, 158 pp., American Concrete Institute, Farmington Hills, MI, 48331, USA.

**3.2 European standards**

EN 1992-1-1, *Eurocode 2: Design of concrete structures — Part 1: General rules and rules for buildings*, 198 pp., CEN, Brussels.

**3.3 Japanese standards**

*AIJ Standard for Structural Calculation of Reinforced Concrete Structures*, 2010, 526 pp., Architectural Institute of Japan, Tokyo 108-8414, Japan (in Japanese). *AIJ Standard for Structural Design and Construction of Prestressed Concrete Structures*, 1998, 473 pp., Architectural Institute of Japan, Tokyo 108-8414, Japan (in Japanese).

*Standard Specifications for Concrete Structures-2007*, Japan Society of Civil Engineers, Tokyo, 160-0004, Japan: *Design* (Japanese version, 623 pp.; English version, 469 pp.). *Materials and Construction* (Japanese version, 435 pp.; English version, 490 pp.).

**3.4 Australian standards**

AS 3600:2001, *Concrete Structures*, 176 pp., Standards Australia, Sydney, NSW, Australia.

**3.5 Colombian standards**

Colombian Code — National Structural Concrete Standards; included in NSR-98, *Colombian Code for Earthquake Resistant Design and Construction*, 228 pp. Asociación Colombiana de Ingeniería Sísmica, Bogotá, Colombia.

**3.6 Saudi Arabian standards**

SB 304, *Saudi Building Code: Concrete Structures* L.D. No. 1428/1200, 2007, 246 pp., National Committee, Riyadh, Saudi Arabia.

**3.7 Brazilian standards**

NBR 6118:2014, *Design of Structural Concrete — Procedure*, 2014, 238 pp., Associação Brasileira de Normas Técnicas, Rio de Janeiro, Brazil.

**3.8 Egyptian standards**

ECP 203, *Egyptian Code for the Design and Construction of concrete Structures, limit states design method*, 2007, 375 pp., Housing and Building National Research Center, Cairo, Egypt.

**3.9 Korean standards**

*Structural Concrete Design Code 2012*, 599 pp., Korea Concrete Institute, Seoul, 06130, Republic of Korea.

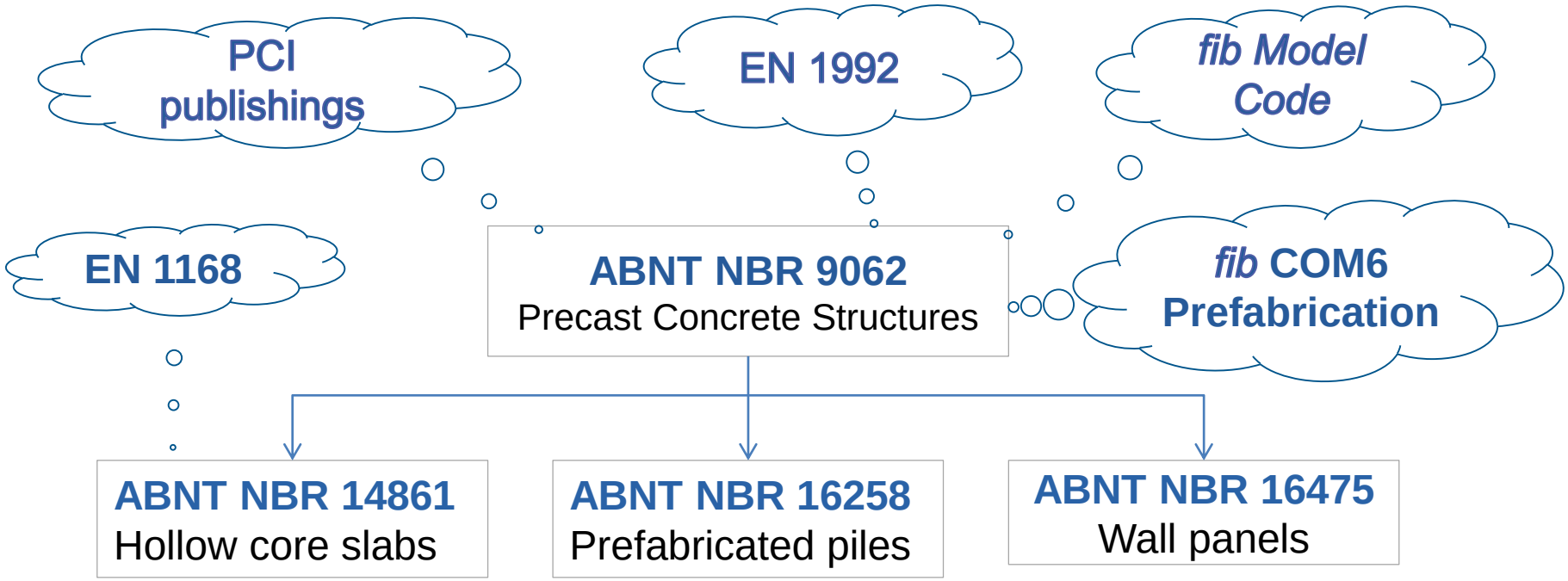
**3.7 Brazilian standards**

NBR 6118:2014, *Design of Structural Concrete — Procedure*, 2014, 238 pp., Associação Brasileira de Normas Técnicas, Rio de Janeiro, Brazil.

# Brazilian Standardization for Concrete Structures

**ABNT NBR 9062 Design and execution of precast concrete structures**:

- ✓ is perfectly aligned with ABNT NBR 6118
- ✓ first edition was published in 1985
- ✓ was reviewed in 2001, 2006 and 2017
- ✓ has Brazilian standards for precast products as complements



# Brazilian Standardization for Concrete Structures

# Brazilian Standardization for Structural Concrete

**ABNT NBR 14931**
Execution of concrete structures (buildings cast in place)

**ABNT NBR 6118**
Design of concrete structures

**ABNT NBR 8953**
Classification of structural concrete

**ABNT NBR 9062**
Design and execution of precast concrete structures

**ABNT NBR 7187**
Design of concrete bridges

**MATERIALS**

# Brazilian Standardization for Structural Concrete

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Execution of concrete structures (buildings cast in place)

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Design and execution of precast concrete structures

**ABNT NBR 7187**
Design of concrete bridges

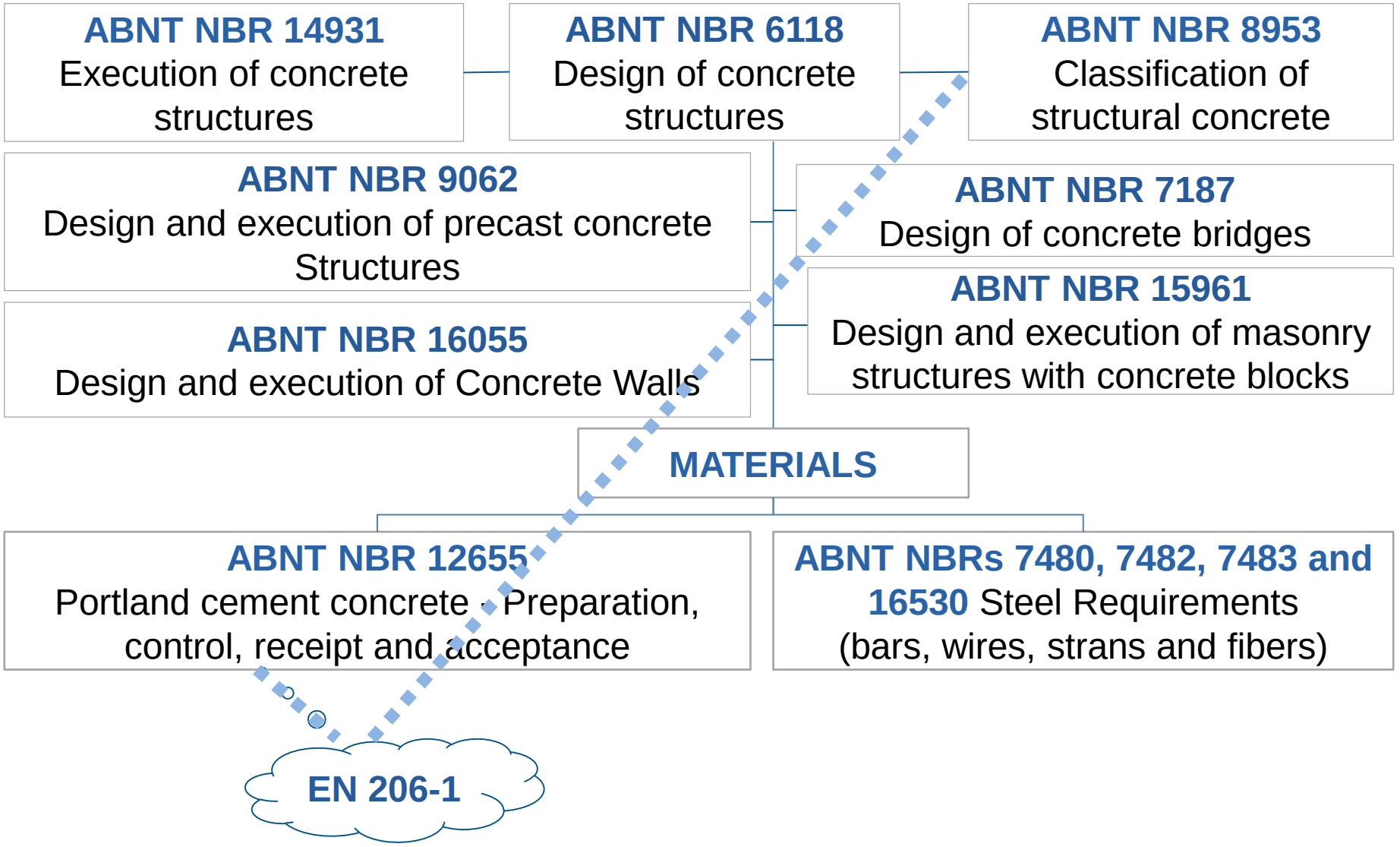
**ABNT NBR 16055**
Design and execution of concrete walls (for buildings)

**ABNT NBR 15961**
Design and execution of masonry structures with concrete blocks

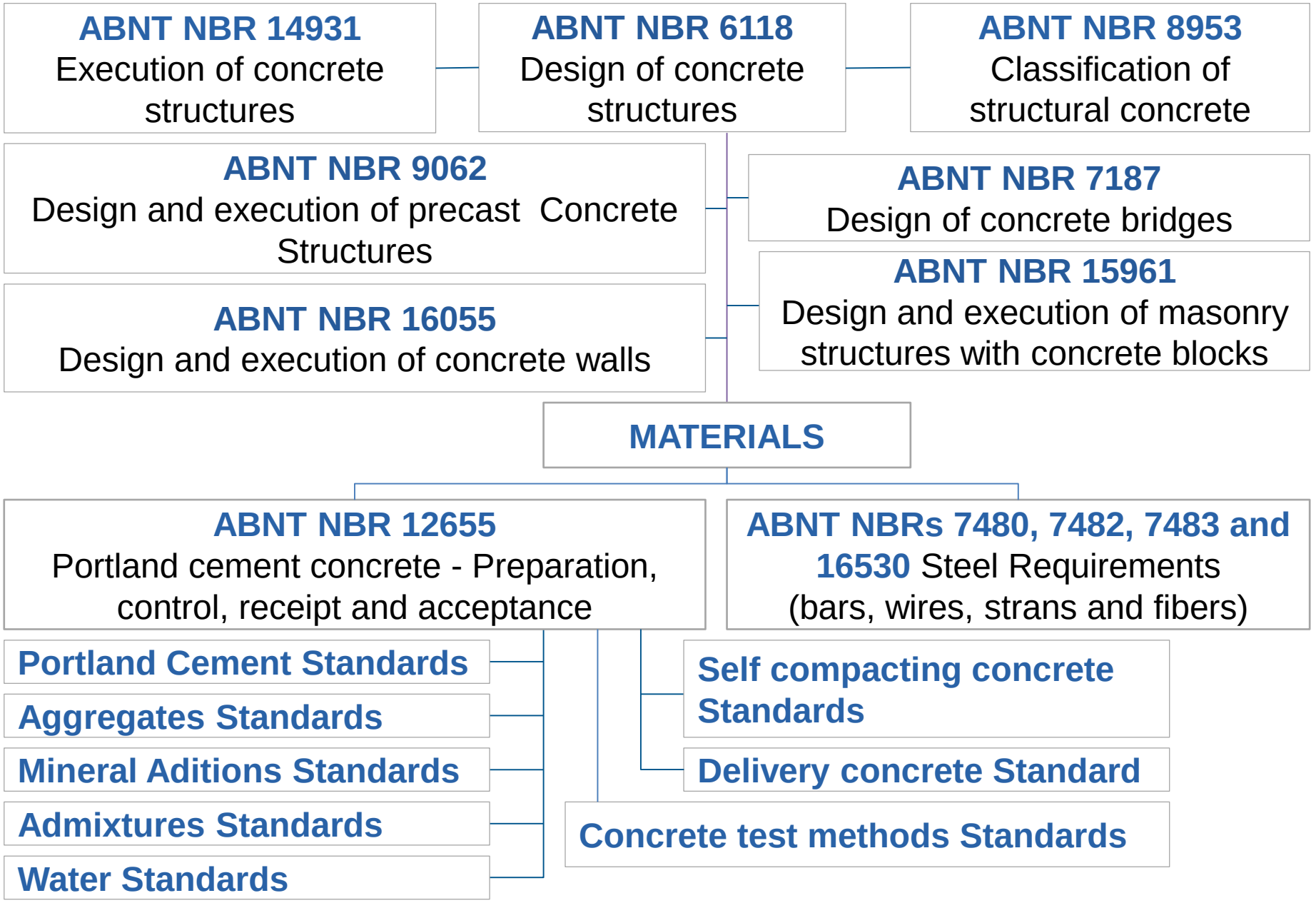
- **ABNT NBR 6136** Hollow concrete blocks for masonry - Requirements
- **ABNT NBR 12118** Hollow concrete blocks for masonry – Test methods
- **ABNT NBR 16422** Mansory of concrete blocks - Test methods

**MATERIALS**

# Brazilian Standardization for Structural Concrete



# Brazilian Standardization for Structural Concrete



# Brazilian Standardization for Structural Concrete

**MATERIALS**

**ABNT NBR 12655**

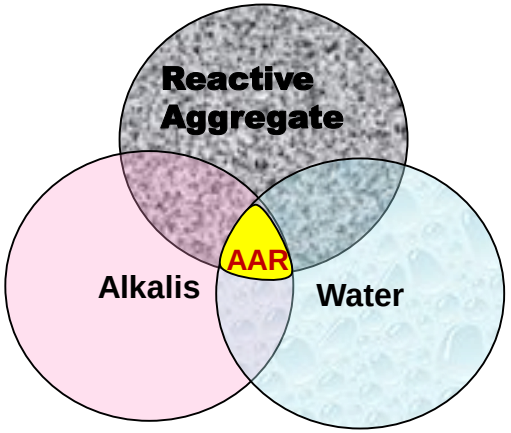
Portland cement concrete - Preparation, control, receipt and acceptance

- **Portland Cement Standards**
- **Aggregates Standards**
- **Mineral Aditions Standards**
- **Admixtures Standards**
- **Water Standards**

# Brazilian Standardization for Structural Concrete

There are some precautions that should be taken into account to guarantee the durability of concrete structures.....

…in some Brazilian regions, the prevention of alkali-aggregate reaction is a point of attention.




**Aggregates Standards**

**ABNT NBR 7211** Natural aggregates for concrete

**ABNT NBR 15116** Recycled aggregates for concrete

Test Methods

Test Methods

**ABNT NBR 15577** AAR – Evaluation and prevention

Inspired in Canadian Standards for AAR and ASTM test methods

# Prevention of AAR is the best choice

**Brazilian Standard ABNT NBR 15577 – Parts 1 to 6:**

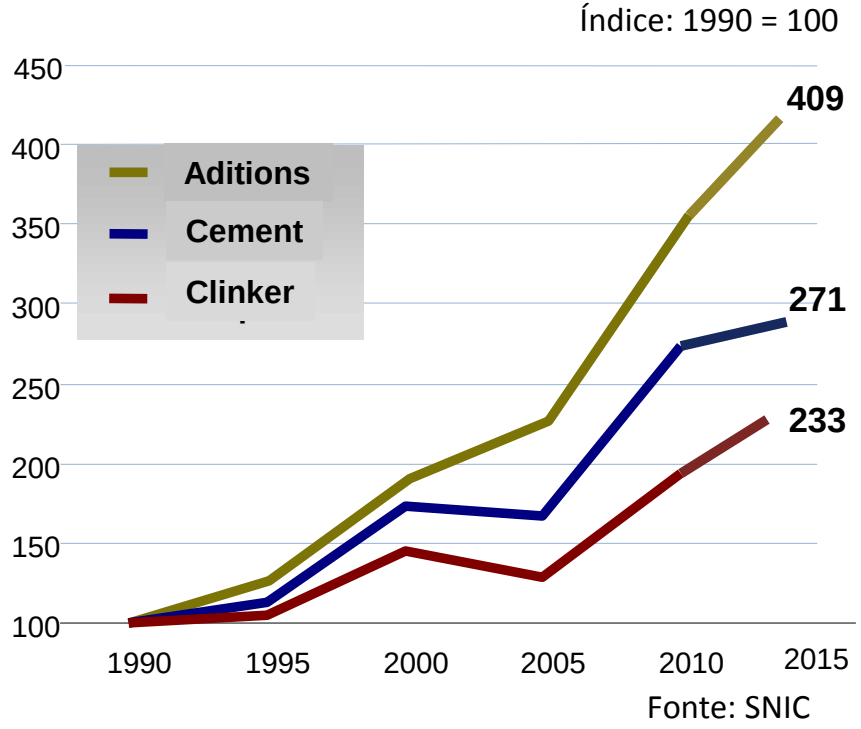
- analyzes the risk of AAR development
- evaluates the risk of structural pathologies
- sets out materials for the reaction mitigation
- establishes test methods to verify whether the requirements were fulfilled

**It is difficult and expensive to stop or to contain the effects of the reaction and recover the structure**

**Thus, we prefer to prevent the occurence of the reaction, using composite cements**

**with or without (depending on the case) some active additions, such as silica fume and metakaolin**

# Brazilian Standardization for Structural Concrete

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## Brazilian Portland Cement Standards

- **ABNT NBR 5732** Ordinary Portland Cement
- **ABNT NBR 5733** High early Portland Cement
- **ABNT NBR 5735** Slag Portland Cement
- **ABNT NBR 5736** Pozzolanic Portland Cement
- **ABNT NBR 11578** Composite Portland Cement
- **ABNT NBR 5737** Sulphate Resistant Portland Cement
- **ABNT NBR 12989** White Portland Cement
- **ABNT NBR 13116** Lower heat hydration Portland Cement

# Brazilian Standardization for existing structures

- we have been using the same standards for new and existing structures (sometimes with adaptations)

- there are specific rules only in some cases

# Brazilian Standardization for Structural Concrete

**ABNT NBR 14931**
Execution of concrete structures

**ABNT NBR 6118**
Design of concrete structures

**ABNT NBR 8953**
Classification of structural concrete

**ABNT NBR 9062**
Design and execution of precast concrete structures

**ABNT NBR 16055**
Design and execution of concrete walls

**ABNT NBR 9607** Load test on concrete structures

**ABNT NBR 7187**
Design of concrete bridges

**ABNT NBR 9452** Inspection of bridges and footbridges

**ABNT NBR 15961**
Design and execution of masonry

**MATERIALS**

**ABNT NBR 12655**
Portland cement concrete - Preparation, control, receipt and acceptance

**ABNT NBRs 7480, 7482, 7483 and 16530** Steel Requirements (bars, wires, strans and fibers)

**Portland Cement Standards**

**Aggregates Standards**

**Mineral Aditions Standards**

**Admixtures Standards**

**Water Standards**

**Self compacting concrete Standards**

**Delivery concrete Standard**

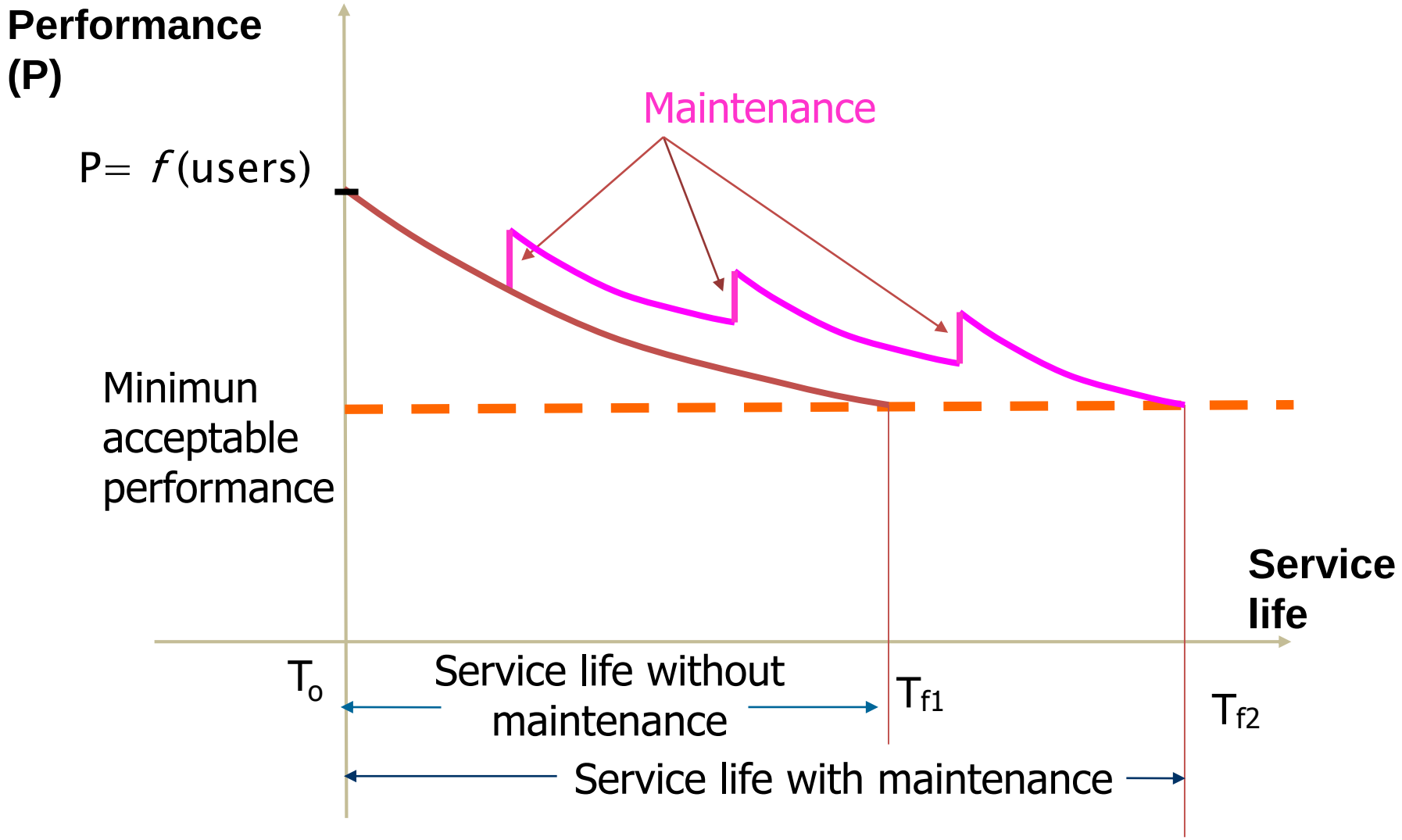
**Concrete test methods**

**Non destructive tests methods**

**ABNT NBR 7680** Extraction of concrete cores

# Buildings Maintenance

## ABNT NBR 15575-1 Performance of habitational buildings Durability and maintenance



# Buildings Maintenance

**ABNT NBR 15575**
Performance of habitational buildings

←

**Management Standards**

**ABNT NBR 5674**
Building maintenance — Requirements for maintenance management system

**ABNT NBR 14037**
Guidelines for the preparation of the manual for building use, operation and maintenance - Requirements for content preparation and presentation

**ABNT NBR 16280**
Renovation of buildings — Management system — Requirements

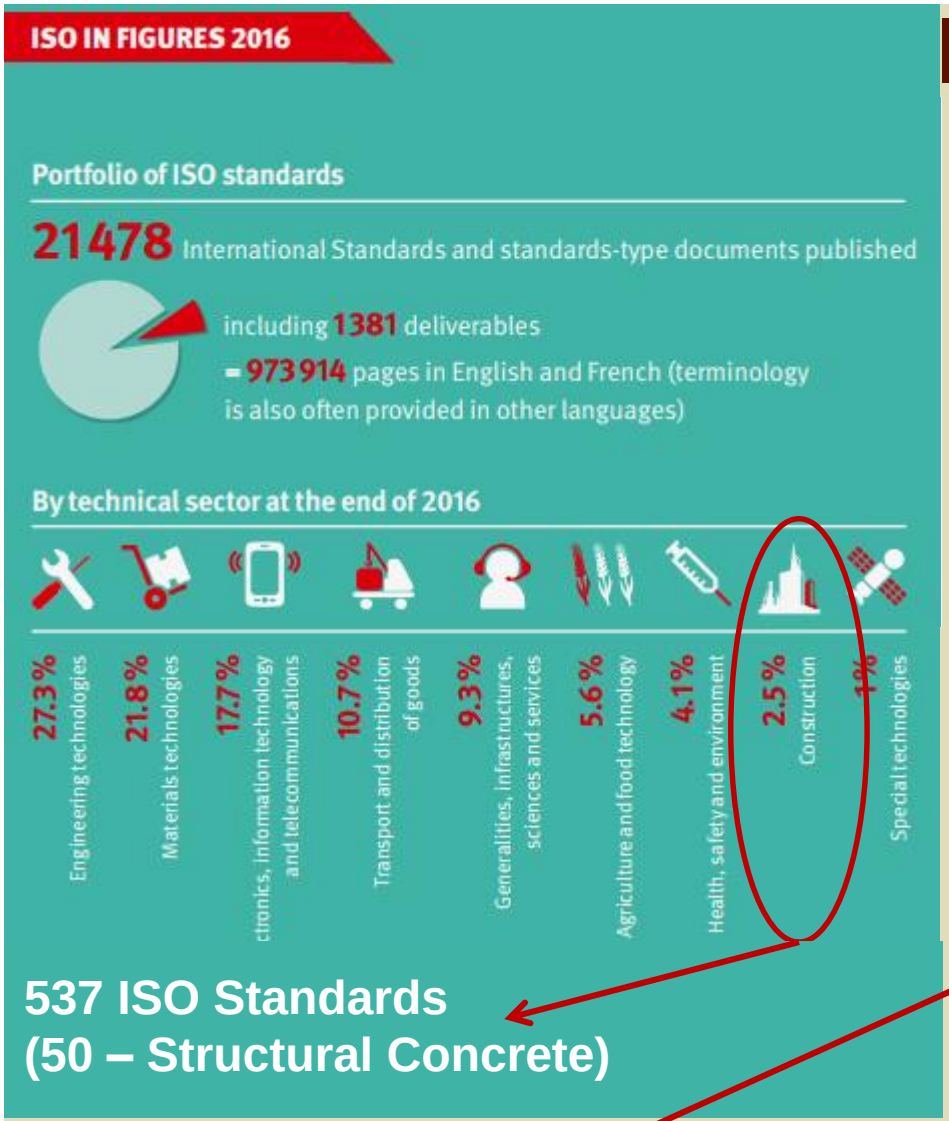
**Draft 002:140.002**
Inspection of buildings – Guidelines, concepts, terminology, criteria and procedures

# Brazilian standardization for structural concrete

## Planning for the next years:

- New standards for new materials (such as sinthetic fibers for concrete)
- Specific standards for fiber reinforced concrete
- General standard for inspection of concrete structures
- Standards for maintenance, repair and restore existing concrete structures
- Standards revision and updating process

# Standardization in Figures 2016

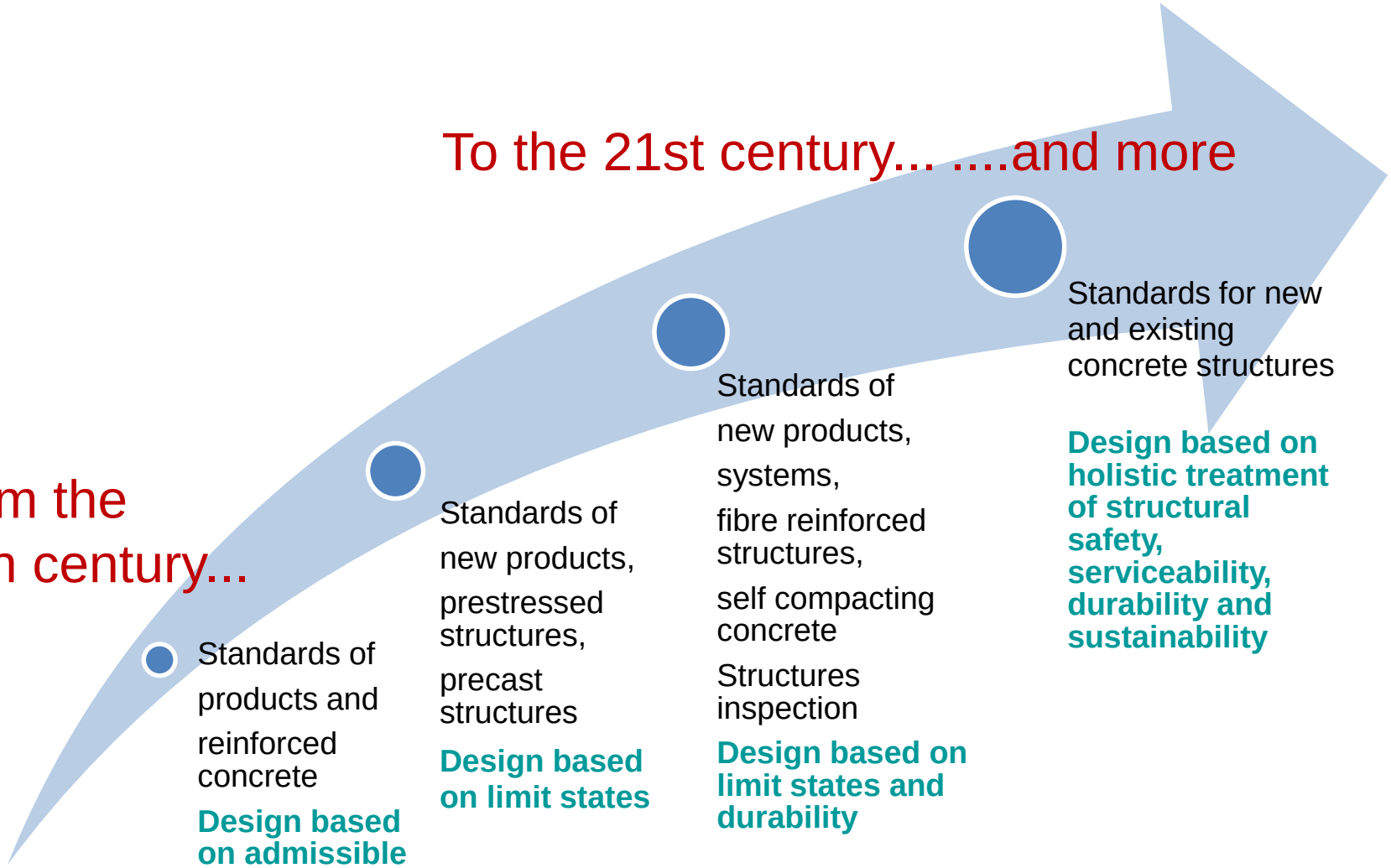



**537 ISO Standards**
**(50 – Structural Concrete)**


**825 ABNT Standards**
**(270 – Structural Concrete)**

# Brazilian Standardization for concrete structures

## Aligned with the international tendencies and knowhow



# Thank you for your attention


C3-18
BRAZILIAN COMMITTEE OF CEMENT, CONCRETE AND AGGREGATES

ABNT
BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS

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