

CURRICULUM VITAE

Name: Cássio Baumgratz VIOTTI.

Birth: Born in Astolfo Dutra, Minas Gerais, Brazil, December 4, 1944.

Nationalities: Brazil, Italy.

Education:

1968 Civil Engineer, University of Minas Gerais.
1969 Specialization in Dams, University of Minas Gerais.
1973 MS, Civil Engineering, University of Illinois, USA.
1975 Course on Rock Mechanics and Engineering Geology applied to Hydroelectric Engineering, University of Florida, USA.

Languages: Portuguese, English and Spanish – fluent.
French and Italian - reading and listening comprehension.

Mr. Viotti's professional experience includes active involvement, for 46 years, in all phases of dam engineering. He worked for 29 years in one of the leading Brazilian power companies, Cemig. He has been field engineer, head of the Soils Laboratory, head of the Geotechnical Division, head of the Civil Engineering Department and staff Consultant in Cemig. He has retired from Cemig and acts as a private consultant.

He started as a geotechnical engineer and has developed broad experience in overall design for dams and hydro structures. Today his main fields of activity are: layout design, foundations, embankment dams, safety assessment, instrumentation, remedial measures and rehabilitation. As a consultant Mr. Viotti has performed safety inspection and reporting for more than 70 dams. Most of these were included in the 5-year regulatory type of inspection.

Mr. Viotti was a visiting professor of the Master's Course on Dam Engineering at the University of Ouro Preto (Brazil) for more than 20 years; initially he taught Safety of Dams and Dam Construction, afterwards Foundations for Dams. He was invited speaker at international conferences in Peru, 1987; China, 1995; Brazil, 1999, Argentina; 2002; China 2009; Dominican Republic, 2011. In the 3rd International Symposium on Rockfill Dams (Kunming, 2013), Mr. Viotti delivered the Keynote Speech – Rockfill Deformability, showing comparative experience and studies covering several dams. In April 2015, Mr. Viotti gave a speech about Safety of Embankment dams at a course on Specialization in Dams organized by Federal University of Bahia with the partnership of Itaipu, in Iguazu Falls.

Membership of Professional Associations:

International Commission on Large Dams (ICOLD). Honorary President.
Brazilian Committee on Dams (CBDB). Honorary Chairman.
Brazilian and International Societies for Soil Mechanics and Foundation Engineering.
Brazilian and International Associations for Engineering Geology and the Environment.
Minas Gerais State Engineering Society.
Formerly Council member of the International Hydropower Association. .
Formerly member of the Board of Governors of the World Water Council

Professional Experience:

*1998/2015 - Private consultant.
(Jobs listed in italics are in foreign countries).*

Member of the Board of Consultants of Copel's **HPP Colider** (300MW) under construction on the Teles Pires river, Mato Grosso state (2011/2015).

Chairman of the Board of Consultants that realized the Periodical Safety Review – **HPP Baguari** (140 MW), Minas Gerais state, for Baguari Energia SA (2015).

Member of the Board of Consultants of Mineração Taboca that oriented emergency actions at **SHPP Pitinga** (24 MW), Amazon state, and is now orienting forensic investigations in the partially failed dam and future remediation (2015).

Consultation to Eletronorte in the evaluation of possible defects at **UHE Coaracy Nunes** (70MW), Amapá state, due to the flood caused by a cofferdam failure in an upstream job in May 2015.

Chairman of the Board of Consultants that realized the Periodical Safety Review – **HPP Três Marias** (380 MW), (3rd review) for Cemig, Minas Gerais state (2015).

Chairman of the Board of Consultants that realized the Periodical Safety Review – **HPP Sá Carvalho** (78 MW) for Sá Carvalho SA (2015).

Member of the Board of Consultants for 1100MW “Site C” HPP in final stages of design, Peace River, BC Hydro, Canada (2010/2014).

Chairman of the Board of Consultants that realized the Periodical Safety Review – **TPP Igarapé** (125 MW), and its dam for Cemig (2014).

Chairman of the Board of Consultants that realized the Periodical Safety Review – **HPP Jaguará** (400 MW), (2nd review) for Cemig (2014).

Chairman of the Board of Consultants that realized the Periodical Safety Review – **HPP Funil** (180 MW), (2nd review) for UHE Funil SA (2014).

Member of the Board of Consultants that realized the Periodical Safety of **SHPP Ivan Botelho III**, in Astolfo Dutra, MG, for Brookfield (2014).

Member of the Board of Consultants that realized the Periodical Safety of **HPP Coaracy Nunes** (2014) for Eletronorte.

*Chairman of the Board of Consultants for the feasibility studies of **Boroma** and **Lupata** hydro projects in Mozambique for ATP Energia (2010/2012,2014). The Board was responsible for devising the lay-out and CFRD dams with floating plinths for both sites, due to an alluvium deeper than 100m. Dams are in the range of 20 to 40m high.*

Member of the Board of Consultants that realized the Periodical Safety Review of **SHPP Riachão**, for Brookfield Energia (2013).

Chairman of the Board of Consultants that realized the Periodical Safety Review - **HPP's São Simão** (2nd review), **Miranda** (2nd review) and **Irapé**, for Cemig (2013).

Chairman of the Board of Consultants that inspected **HPP Tucuruí** dam (8370MW) for Eletronorte (2013).

Member of the Board of Consultants that realized the Periodical Safety Review of **SHPP Riachão**, for Brookfield Energia (2013).

Consultant for Copel in the design of protection and upgrading of the fill of highway **BR-163**, which will be affected by the reservoir of HPP Colider (2013).

Consultant for Induspalma to develop 4 small dams for irrigation purposes. Dominican Republic (2013).

Chairman of the Board of Consultants that inspected **HPP Igarapava** (210MW) (2012 - 2nd inspection) for UHE Igarapava SA.

Safety inspection of **Madame Denise SHPP** for Arcelor Mittal (2012).

Chairman of the Board of Consultants that inspected **HPP Capim Branco I** (240MW) and **HPP Capim Branco II** (210MW), for Capim Branco Energia SA (2012).

Emergency inspection and recommendations on remedial measures for a levee under initial process of piping at **Resplendor** city, Aimorés, MG (2012).

Consultant for TEC3 Engenharia for small dams and ancillary works (2012).

Chairman of the Board of Consultants for inspection of Eletronorte Dams. Dams inspected and reports prepared: **HPP's Balbina, Samuel** and **Curuá-Una** (2010/2012)

Member of the Board of consultants that inspected the following dams and hydropower plants for Brookfield Energia: **Cachoeira Encoberta, Palestina, Ponte, Nova Sinceridade, Granada, Cachoeira do Emboque, Anna Maria, Ervália and Barra do Braúna**. State of Minas Gerais (MG), Brazil (2010/2012).

Chairman of the Board of Consultants that inspected **HPP Queimado** (130MW) (Consórcio Cemig/CEB) (2011).

Chairman of the Board of Consultants that inspected **HPP Aimorés** (300MW) (Vale/Cemig) (2011).

Emergency safety inspection of **Caatinga** dam, under risk of failure, for the Civil Defense of the State of Minas Gerais (2010).

Co-organizer and teacher – Course “Training on Inspection of Dams” – BVP Engenharia/Brookfield Energia (2010).

Consultant to BVP Engenharia on the **SHPP Santa Luzia** (2009).

*Consultant to the constructor SINTRAM - **Martil** project in Morocco, under construction at the time for the “Direction des Aménagements Hydrauliques” (2009). Martil project has a 100m high CFRD in the river course and a 50m high embankment dam in a saddle.*

*Chairman of the Board of Consultants for the **Massingir** dam, Mozambique. The Board inspected the dam and made recommendations about proposed repair after failure of the bottom outlet. The Board made also recommendations about the earth dam which has presented faulty behavior since its first impounding in the 1970's and also reviewed the proposed additional spillway solution (2009).*

Member of the Board of Consultants for **HPP Batalha** (50MW - Furnas), São Marcos river, border of Minas Gerais/Goiás states (2009).

Chairman of the Board of Consultants for the safety inspection of **HPP Guilman-Amorim** dam (Arcelor-Mittal/Samarco), 140MW, Santo Antônio river, MG (2008).

Chairman of the Board of Consultants for the safety inspection of **HPP Funil** dam 180MW, Grande river, MG (2008).

*Member of the Advisory Board for **Hackren** dam safety review, in Sweden, owned by Vattenregleringsföretagen (2008).*

Chairman of the Board of Consultants for **Ernestina** dam safety review, in Rio Grande do Sul, Brazil. This is a pre-stressed concrete dam 20m high, for CEEE (2008). Upon recommendation of the Board the dam has been rehabilitated.

Member of the Board of Consultants convened by the owner (CEBEL) to report on the failure of the dam, **Apertadinho** Project (30MW, Vilhena, Rondônia state, Brazil), which happened in January 2008.

*Member of the Advisory Board for **HPP Bergforsen** (155MW) safety review, in Sweden. This Board was initially convened by Vattenfall's Dam Safety Controller to provide advice on the safety of the foundation of Bergforsen dam. Following, in view of additional concerns raised by the consultants, the scope was broadened to address all necessary dam safety improvements (2006/2008).*

Chairman of the Board of Consultants that inspected **HPP Igarapava** (210MW). 2006

Currently Chairman of the Board of Consultants for inspection of Cemig's dams and hydropower plants. Projects which were inspected from 2004 to 2012 and respective safety report concluded: **Nova Ponte, Itutinga, Camargos, Santa Marta, Pandeiros, Paraúna, Machado Mineiro, Calhauzinho, Bananal, Mosquito, Samambaia, Caraíbas, Salinas, Piau, Rio de Pedras, São Simão, Cajuru, Gafanhoto, Sumidouro, Bom Jesus do Galho, Salto Grande, Tronqueiras, Poquim, Três Marias** (2nd inspection), **Peti, Miranda, Jaguará, Volta Grande, Emborcação, Nova Ponte** (2nd inspection) and **Pai Joaquim**.

Member of the Board of Consultants of Furnas for the feasibility studies of **Jirau** (3300MW) and **Santo Antônio** Projects (3150MW), Madeira river, Brazil (2004 - 2005).

Projects **Murta** (90MW) and **Unaí Baixo** (30MW) - Study of foundation conditions and proposal of cross sections for the embankments, for the design company, SPEC (2005).

Aimorés Project (300MW) - professional guidance for the foundation design, for the definition of the typical cross-sections and for the stability and seepage analyses of the two dams. Design of the interface between the main dam and the spillway and the interfaces of the intake structure with the right abutment and with the auxiliary dam. Guidance also on levees for the town of Resplendor and on slope stability at the new town of Itueta (2001 - 2005).

Capim Branco II Project (210MW) - inspection of the works under construction and provision of a report to the contractor on the construction materials and possible alternative uses in the earth dam. Guidance on placement and compaction and on improvements on the typical cross-section (2004).

Irapé Project (360MW). Inspection of the site in initial stage of construction, evaluation of the construction materials available and proposal of modification on the cross section of the 210m high rockfill dam. Report presented to the constructor and meetings with the design company to discuss the modification on the cross section, which was adopted (2004).

Funil Project (180MW) - Design of the embankment dam, including definition of the foundations, typical cross sections, employment of the different construction materials, guidance for the stability, seepage and stress-strain analyses. Also guidance for the construction activities. Analysis of the behavior after the impoundment (2000 - 2004).

Queimado Project (108MW). Guidance to the design company (SPEC) on stress- strain analyses of the embankment (2000 - 2002).

Dona Francisca Project (125MW) - Chairman of the Board of Consultants that inspected the RCC dam and presented a safety report to the owner (2003).

Porto Estrela Project (112MW) - Development of an alternate lay-out of the structures for the constructor (Estacon) to bid the job. It included a new position for the hydraulic circuit, new cross-section for the embankment dam, preliminary construction planning and balance of materials. Estacon won the bid and the project has been built. During the construction stage, consulting advice was given to the engineering firm, SPEC. After impoundment, an analysis was made of the behavior of the embankment dam (1998 - 2002).

Piau Project (18 MW) - Inspection and proposal of remedial measures for a problem in the internal drainage system of the earth dam (2002).

Peixe, Traíra II, Serra do Facão, São Salvador, Mosquitão and Salto Projects - Study of foundation conditions and proposal of cross sections for the embankments and respective interference on the lay-out. For the design company, SPEC (2001 - 2002)

Três Marias Dam - Chairman of the Board of Consultants that inspected the structures and presented a report (2001).

Ernestina, Maia Filho and Itaúba Dams - Inspection, analysis of the behavior and production of a report to the owner, CEEE (1999).

Arneiróz and Taquara dams - Site inspection and preparation of preliminary report for the feasibility studies. Client Engesoft/Montgomery Watson (1999).

Cana Brava Project - Member of Board of Consultants that visited the site and proposed alternative lay-out. Clients were Cemig and Light (1998).

Member of the Board of Consultants that analysed the failure of the tailings dam at **Paraibuna de Metais**, Juiz de Fora – MG, and followed the implementation of remedial measures (1987/1990).

João Penido dam, for water supply of Juiz de Fora - MG. Analysis of the safety conditions of the dam and evaluation of the design for upgrading the earth dam (1987).

1969/1997 - Engineer at Cemig. Main tasks performed.

1994/1997 - Staff consultant at Cemig. Overview of the design of the dams and hydropower stations of **Miranda** (85m high rockfill dam - 390MW) and **Igarapava** (45m high - 210MW), both under construction at the time, and the following projects under design stage at the time: **Aimorés** (2 earth dams, one 18m high, the other 30m high - 300MW), Porto Estrela (60m high initially RCC dam, finally embankment dam - 112MW), **Irapé** (210m high rockfill dam - 360 MW), **Capim Branco II** (32m high rockfill dam - 210MW).

1985/1994 - Head of the Civil Engineering Department. Responsible for checking and approval of the civil engineering design of dams and powerplants of Cemig. Projects built: **Nova Ponte** (144m high zoned dam - 510MW) and **Machado Mineiro** (40m high earth dam - 3MW); projects designed: **Miranda**, **Igarapava**, **Capim Branco**, **Irapé**, **Pai Joaquim** (23MW), **Bocaina** (83m high CFRD - 150MW), **Formoso** (40m high earth dam - 300MW), **Santa Rita** (79m high CFRD - 75MW).

Acted as consultant for the following dams, owned by Cemig and built for purposes other than generation: earth dams of **Bananal**, **Salinas**, **Samambaia**, **Calhauzinho** and **Mosquito** and RCC dam of **Caraíbas**, all in the range of 20-40m high; and for the feasibility studies of the basins of the São Francisco and Jequitinhonha rivers.

Responsible for checking instrumentation records and doing safety evaluation of Cemig's dams. Also responsible for the Soils and Concrete Laboratories of Cemig and in charge of the network to monitor induced seismicity in the reservoirs.

Responsible for coordinating the Board of Consultants, that periodically reviewed Cemig's projects.

1975/1984 - Head of the Geotechnical Division - Responsible for "in situ" and laboratory investigations of several projects and also for induced seismicity studies. Responsible for checking the design and the quality control of the earth and rockfill dams of **São Simão** (127m high - 1700MW) and **Emborecação** (158m high - 1200MW).

1973/1974 - Soils engineer at Cemig's headquarters in Belo Horizonte, in charge of checking the design of São Simão earth and rockfill dam. Head of the Central Soil Mechanics Laboratory.

1972/1973 - At the University of Illinois, USA, for the Master's degree.

1969/1972 - Field Engineer - Responsible for core drilling at **São Simão** site; field inspector at **Jaguara** rockfill dam (40m high - 440MW); head of the Soils Laboratory at the site of **Volta Grande** earth dam (40m high - 380MW).

Publications:

More than 30 papers published in the fields of dam engineering and geotechnics, the main ones being:

- 1979 - Some Conceptual Aspects of Interfaces between Embankments and Concrete Dams and Experimental Data from São Simão Dam. Q.48 - R.43. XIII ICOLD, New Delhi. Co-author: Joaquim P. de Ávila.
- 1989 - Emborcação Dam: A “Rankine Lecture” Design - A Successful Performance. In “De Mello Volume”.
- 1992 - Applicability of Classical Soil Mechanics Principles to Structured Soils. National Science Foundation (USA) / University of Viçosa (Brazil). Co-editor.
- 1995 - Induced Seismicity in Cemig’s Reservoirs - Minas Gerais - Brazil. International Symposium on Reservoir Induced Seismicity, Beijing, Co-authors: L.C. Gomide, S.N.A. Brito.
- 1995 - Review of the Relocation of Nova Ponte Town in Brazil. Hydropower and Dams Magazine, November. Co-authors: B.C.A. Marques, L.A.B. Almeida.
- 1996 - Cemig’s Civil Engineering Design Criteria for Hydropower Projects (in Portuguese). Editor.
- 1997 - Induced Seismicity at Cajuru Reservoir - Minas Gerais- Brazil, Q.74 - R.75, XIX ICOLD, Florence. Co-authors: J.A.V. Veloso, L.C. Gomide.
- 1997 - Longitudinal Cracking at Emborcação Dam. Q.75 - R.50, XIX ICOLD, Florence.
- 1999 - Rockfill Deformability, Discussion on the Behavior of Brazilian Rockfill Dams. Pan-American Conference on Soil Mechanics and Geotechnical Engineering (Iguazu Falls, August 1999), also published in the Second Symposium on Concrete Face Rockfill Dams, November 1999), Florianópolis, Brazil.

Handwritten signature in blue ink that reads "Carlos B. Viotti".