CURRICULUM VITAE

CELESTE BARNARDO

19 April 2011

PERSONAL DETAILS

Surname:	Barnardo
Names:	Celeste
Gender:	Female
Date of birth:	17 October 1979
Nasionality:	South African
Languages:	Afrikaans and English
Address:	37 Haakdoring Street Welgevonden Stellenbosch 7600 South Africa
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CURRENT POSITION

Senior Lector, Structures Division, Department of Civil Engineering, University of Stellenbosch

Department of Civil Engineering,
Private Bag X1,
Matieland, 7602,
South Africa
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ACADEMIC QUALIFICATIONS

2006: PhD (Structural Engineering), Stellenbosch

Dissertation title: *Load and Response Estimation and Model Recalibration using Inverse Finite Element Methods.*

2003: MSc.Eng upgraded to PhD.

2001: B.Eng (Civil Engineering), Cum Laude, Stellenbosch

1997: Secondary school education, High School Bredasdorp

AWARDS

2006: Chancellor's Medal (University of Stellenbosch)

2003: Academic Honours (University of Stellenbosch)

2001: Merit Medal - Engineering Student of the year (Engineering Council of South Africa)

1998-2003: First class position, all subjects cum laude.

LEADERSHIP

2002/03: Chairperson of the Engineering Student Council.

2002/03: Student Representative on the Engineering Faculty Committee.

2002/03: Engineering Faculty student representative on the Academic Affairs Council.

INTERNATIONAL EXPOSURE

Norwegian University of Science and Technology, Trondheim, Norway: 01/2005 – 02/2006

Stipendium student (PhD)

Bauhaus University of Weimar, Germany: 10/2002 – 01/2003

Exchange student (M.Sc Eng)

ACADEMIC EXPERIENCE

University of Stellenbosch: 01/09/2009 – current

Department of Civil Engineering

Senior Lector

Research field Reliability and Risk Assessment

University of Stellenbosch: 01/02/2007 – 31/06/2009

Department of Civil Engineering

Part time lecturer Continuum Mechanics and Finite Element Methods

Subjects Lectured	Description	Responsibilities
Construction Risk Management 2011	▪ Posgraduate block course for Masters students, Part II ▪ Contact time: 6hrs	▪ Content planning ▪ Lectures ▪ Assessment
MT02 Probability and Risk Analysis in Civil Engineering 2010, 2011	▪ Posgraduate semester course for Masters students ▪ Contact time: 65hrs	▪ Subject administration ▪ Content planning ▪ Lectures ▪ Assessment
SL143 Strength of Materials 2010, 2011	▪ Undergraduate semester course for First year students ▪ Contact time: 4 Lectures & 3hr Tutorial per week.	▪ Subject administration ▪ Lectures ▪ Assessment
SL143 Strength of Materials 2009	▪ Undergraduate semester course for First year students ▪ Contact time: 4 Lectures & 3hr Tutorial per week.	▪ Lectures ▪ Assessment
MT04 Continuum Mechanics and Finite Element Analysis 2007, 2008, 2009,2010	▪ Postgraduate semester course for Master's students ▪ Contact time: 4 Lectures per week	▪ Subject administration ▪ Content planning ▪ Lectures ▪ Tutorials ▪ Assessment

Courses presented to Industry	Description
New SANS 10160 Loading Code Seminar 2011	▪ Session : ▪ Contact time: 1hr
ECRI Advanced Course in Construction Risk Management 2011	▪ Session I: Probabilistic Theory ▪ Contact time: 1hr

MANAGEMENT EXPERIENCE

Director of the Institute for Structural Engineering, Department of Civil Engineering, University of Stellenbosch: 01/06/2010 – Current

Head of Concrete and Steel Structural Laboratories, Department of Civil Engineering, University of Stellenbosch: 07/12/2009 – 31/05/2010

CONSULTING EXPERIENCE

Element Consulting Engineers: 01/03/2006 – 31/08/2009

Structural Design Department

Projects & Design Experience: Reinforced Concrete Design and Detailing. Mainly Bridge Design. (See Table)

Project	Description	Responsibilities
Bridge: Bottelary Road over Kuilsriver, Brackenfell (2008/2009)	▪ A 63m long, three span Bridge. ▪ Post-tensioned continuous voided deck. ▪ Piled foundations, column piers and spill-through abutments. ▪ R 12.0 million.	▪ Preliminary design ▪ Cost estimation ▪ Approvals ▪ Tender documentation ▪ Detail design ▪ Limited/specialised site supervision
Bridge: Bottelary Road over R300 Highway, Brackenfell (2008/2009)	▪ A 65m long, four span bridge. ▪ Post-tensioned beams with in-situ slab composite deck. ▪ Piled foundations, column-and-beam type piers and spill-through abutments. ▪ R 14.0 million.	▪ Preliminary design ▪ Cost estimation ▪ Approvals ▪ Tender documentation ▪ Detail design ▪ Limited/specialised site supervision
Bridge: Rail over Road Bridge, Croydon (2007/2008)	▪ Access road underpass to Kelderhof development, Croyden. ▪ Constructability with uninterupted rail traffic a major challenge. ▪ A single span voided reinforced concrete deck, jacked into place on pre-cast abutment beams. ▪ Piled foundations. ▪ GeoNail soil stabilization. ▪ Extensive gabion retaining walls ▪ R 10.0 million.	▪ Preliminary design ▪ Cost estimation ▪ Approvals (MetroRail and CCT) ▪ Tender documentation ▪ Detail design ▪ Limited/specialised site supervision.
Bridge: Road over Road and Rail Bridge, Brackenfell Boulevard, Brackenfell (2006)	▪ A 86m long, six span road-over-road-and-rail bridge. ▪ Pre-tension beams with in-situ slab composite deck. ▪ Piled foundations, column-and-beam type piers and wall-type abutments. ▪ R 10.0 million.	▪ Approvals (Spoornet and CCT) ▪ Detail design ▪ Full site supervision
Bridge: Kransbrug Rehabilitation (2007)	▪ Rehabilitation of steel bridge and concrete support structures.	▪ Tender evaluation and report.
Building: Admin Block, Othello Retirement Village, Brackenfell (2007)	▪ Three storey admin block with care unit ▪ Problematic founding conditions on former dump site. ▪ Strip foundations. ▪ Structural brickwork, with concrete beams and columns where necessary. ▪ Composite slabs – Dismar System ▪ Shearwalls (Earthquake design)	▪ Fee proposal ▪ Preliminary design ▪ Cost estimation ▪ Detail design ▪ Limited/specialised site supervision
Building: Greenwood Mansion, Gordonsbay (2007)	▪ Three storey luxury apartment in Gordonsbay. ▪ Concrete frame structure	▪ Design and detail concrete beams, slabs and columns
Analysis & Report: Duferco	▪ Anti-Roll Blocks used to support heavy	▪ Finite Element

Anti-Roll Blocks (2007)	steel coil stacks in Steel Processing Factory Duferco, Saldanha.	Analyses. ▪ Report and Recommendations.
Analysis: Telecom Mast, Gobabis (2007)	▪ Cable stayed. ▪ 230m high. ▪ Steel truss system.	▪ Finite Element Analyses.
Research & Documentation: NewWall panel system (2007)	▪ Testing & rational design of NewWall panel system for low cost housing, to obtain Agrement certification and NHBRC approval.	▪ Oversee experimental testing of panels, rational design and documentation.

OTHER EXPERIENCE

Safran Engineering Algorithms: 01/10/2005 – 20/12/2005

Researcher/Consultant

Norsk Hydro Pilot Study: Commercial project based on iFEM research. Application of iFEM algorithms for estimation of the as-laid static configuration of pipelines on the seafloor from measurement data.

CONTINUED PROFESSIONAL DEVELOPMENT

2011: Conference: ICASP 2011: The 11th International Conference on Applications of Statistics and Probability in Civil Engineering, Zurich, Switzerland

2011: Meeting: JCSS: The 51th meeting of the Joint Committee for Structural Safety, Paris, France

2011: Course: Construction Risk Management, Advanced Course (Engineering Construction Risk Institute)

2011: Course: Risk Management (University of Stellenbosch)

2010: Conference: PSSC 2010: The 9th Pacific Structural Steel Conference, Beijing, China

2010: Conference: SEMC 2010: The 4th International Conference on Structural Engineering, Mechanics and Computation, Cape Town, South Africa

2010: Course: Post-graduate supervision (Centre for Higher & Adult Education)

2010: Course: Risk Induction Course (Engineering & Construction Risk Institute)

2010: Talk: Forensic Structural Engineering Practice in the US (Concrete Society of SA)

2010: Conference: Accelerating Infrastructure Delivery in Middle East & Africa (SA[ICE]^2)

2010: Course: Professional Educational Development for Academics - PREDAC (University of Stellenbosch)

2009: International Workshop: JCSS Workshop on Semi-Probabilistic FEM Calculations, Delft, Netherlands

2009: Course: Applications of Reliability Analysis for Structural Design (University of Stellenbosch)

2008: Course: Business Finance for Built Environment Professionals (SAICE)

2008: Course: Prestressed Concrete Design (Cement & Concrete Institute)

2008: Course: Vibration Serviceability of Civil Structures (University of Cape Town)

2008: Seminar: Occupational health and safety (Comprac Holdings)

2007: Course: SEISMIC design of structures (University of Stellenbosch)

2007: Course: The application of finite Element Methods in Practice (SAICE)

2007: Seminar: Concrete durability (Concrete Society of SA)

MEMBERSHIPS

ECSA	Engineering Council of South Africa	Reg. No. 20075064
SAICE	South African Institute of Civil Engineers	Membership No. 201314
JCSS	Joint Committee on Structural Safety	

PROFFESIONAL INTERESTS

Systems- and Structural Reliability, Risk Assessment, Structural Analysis, Direct and Inverse Finite Element Methods (iFEM, FEM), Applied Mathematics and Scientific Programming, Structural Monitoring, Vortex Induced Vibrations (VIV).

PUBLICATIONS

Refereed Journals

- Hauser, C., Walz, B., Maincon, P., Barnardo, C., 2008, *Application of inverse FEM to earth pressure estimation*, Finite Elements in Analysis and Design, 44:705-714
- (Maincon, P., Barnardo, C., 2011, *iFEM: Inverse finite element methods for structural response and load estimation from measurement data,* Finite Elements in Analysis and Design, Submitted 25/01/2011)

International Symposia

- Retief, J.V., Barnardo, C., Dithinde, M.: *Reliability basis for adopting Eurocodes as South African standards*, The 11th International Conference on Applications of Statistics and Probability in Civil Engineering, Zurich, Switzerland, 2011

- Dunaiski, P.E., Retief, J.V., Barnardo, C.: *Harmonization of South African Standards for Structural Design to International Practice*, The 9th Pacific Structural Steel Conference, Beijing, China, October 19-22, 2010.
- Mensah, K.K., Retief, J.V., Barnardo, C.: *Structural Reliability and the Basis of Design for Concrete Structures*. SEMC: The 4th International Conference on Structural Engineering, Mechanics and Computation, Cape Town 2010.
- Maincon, P., Barnardo, C., Larson, C.M.: *VIV Force Estimation using Inverse FEM*, International Conference on Offshore Mechanics and Arctic Engineering, Estoril, Portugal, June 15-20, 2008, OMAE2008-57325
- Barnardo, C., Maincon, P.: *Inverse FEM – IV: Influence of modelling error*. SEMC The 2nd International Conference on Structural Engineering, Mechanics and Computation, Cape Town 2004.

POST-GRADUATE STUDENT SUPERVISION

PhD Students (Full supervision)

None

PhD Students (Co-supervision)

Student	Topic	Race	Gender	Status / Completion
Jeff Marengwa	Risk-based Maintenance Planning for Flood Protection Walls	Black	Male	Part-time / December 2013
Gert Cloete	Dam Safety Assessment in Namibia: Risk Analysis	White	Male	Part-time / December 2014

MScEng Students (Full supervision)

Student	Topic	Race	Gender	Status / Completion
Sonel Reynolds	Evaluation of rehabilitation measures for dam safety based on Society's willingness to pay for safety.	White	Female	Full-time / December 2012
Stephan Schoeman	Training needs for Asset Management in Western Cape Municipalities	White	Male	Full-time / December 2012
Christiaan De Witt	Calibration of the target crack width for Water Retaining Structures in South Africa	White	Male	Full-time / December 2012

MScEng Students (Co-supervision)

Student	Topic	Race	Gender	Status / Completion
Kenneth Mensah	Structural reliability and basis of design for concrete structures	Black	Male	Full-time / December 2011
Toit Oosthuizen	Probabilistic based calibration between SANS 10160 and 10162:2	White	Male	Full-time / December 2011

REFEREES

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PHD ABSTRACT:

LOAD AND RESPONSE ESTIMATION AND MODEL RECALIBRATION USING INVERSE FINITE ELEMENT METHODS

The inverse finite element method (iFEM) allows estimating the loads and the complete response of a structure, given a finite element model of the structure and imperfect measurements of its response.

Testing of the inverse Finite Element Method was initially done under the assumption that the model used in the iFEM analysis behaves exactly as the structure on which the measurements are taken. In practice, however, the model (represented by a stiffness matrix, and where appropriate, damping and mass matrices) will not match the actual structure exactly. Sources of modelling error include errors due to discretisation, and uncertainty on the characteristics of the structure, including structural damage.

Sensitivity to modelling errors In the first part of this work, the influence of modelling errors on the performance of iFEM is discussed. The influence of modelling errors was investigated for localised and/or distributed model errors, using data from numerically simulated experiments. This had the benefit of being much easier to carry out, less time consuming than the generation of real measurement data, and that the answer is known. In addition to the test cases with simulated measurement data, real measurement data was also obtained from dynamic experiments on a damaged beam.

The influence of modelling errors was investigated as follows: Measurement data were simulated by creating a FEM model of the structure considered, computing response values and adding adequate noise. The FEM model was then modified to obtain the inaccurate iFEM model. This approach gave a great liberty to explore different structures and scenarios.

The investigation concludes that iFEM is stable in the presence of modelling errors: Distributed model error gives rise to distributed error in the assessed external loads. The output of iFEM in the presence of localised error (damage) is such that it can be used to detect discrepancies between the model and the actual structure.

Model parameter estimation algorithms In the second part of the work, two further iFEM algorithms are developed, for model parameter identification in static and dynamic systems respectively. The new algorithms allow model parameter identification in addition to force and response estimation, combining data from several experiments. A third algorithm allows to decrease their computing time considerably. These algorithms have applications in the field of damage identification, structural health monitoring, and material property estimation. The algorithms are implemented and integrated into the existing iFEM software SAFRAN. Initial testing of the algorithms using several simulated test cases are presented and gave very encouraging results. A literature review on the topic of damage identification places the new developments in perspective.

Applications In the third part of the work, actual experiments are used to evaluate the performance of iFEM algorithms in the face of real world challenges, including model uncertainty, measurement inaccuracy and the handling of large amounts of data.

Vortex induced vibrations (VIV) are caused by oscillating hydrodynamic forces, which appear as a result of vortex shedding from fluid flow around slender structures. In the design of marine

structures, the ability to accurately predict these vibrations would be of great value. While time histories of these forces would be invaluable in aiding understanding of VIV, they are diffcult to measure. Using iFEM, the time histories of hydrodynamic forces acting along the length of a slender marine riser were estimated, based on measurements of its acceleration at several positions along the riser. These results were well received by experts in vortex induced vibrations. Data from a simpler, well understood VIV experiment allowed to validate the existing iFEM dynamic force identification theory as well as the newly developed dynamic parameter identification theory before moving on to the more difficult slender structure problem. A literature review briefly introduces the topic of vortex induced vibrations.

The iFEM dynamic parameter identification algorithm is applied to successfully locate damage in a simple vibrating beam. In addition, the parameter identification algorithm was tested against a benchmark structure. In experiments conducted on the steel frame scale model structure at the University of British Columbia, acceleration data was gathered of the response of the structure under three methods of excitation. Various damage configurations were investigated and it was proposed that this structure should be used as a benchmark for comparative studies of damage detection methods. The iFEM dynamic parameter identification is applied to locate and quantify the damage in the structure and this is compared to results obtained by other authors using different methods. Damage were identified and located for several of the damage scenarios, but for some scenarios diffculties were encountered in locating the damage. Uncertainties regarding the method and the experiment are discussed.

Study leaders:	Dr P Maincon, Stellenbosch University
	Prof PE Dunaiski, Stellenbosch University
Examiners:	Prof GPAG van Zijl, Stellenbosch University
	Dr S Saevik, MARINTEK, Trondheim, Norway
	Prof W Zahlten, Bergische Universitat, Wuppertal, Germany