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Cost and Benefits Analysis of Sustainable Building Production in Western Cape Province, South Africa.

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ABSTRACT AND KEYWORDS

PURPOSE OF THIS PAPER
The increasing demand for shelter in the developing world is alarming. The provision of these facilities involves intense construction activities. Although construction activities in the past decades have been observed to impact the environment adversely, researchers opined that the adoption of sustainable buildings will significantly reduce the impacts of construction activities on the environment. Conversely, the high cost of total production has been a barrier to sustainable building adoption. Hence, this paper is set to ascertain the cost benefits of sustainable building production

DESIGN/METHODOLOGY/APPROACH
This paper evaluates the perceptions of construction stakeholders (contractors. consultants and clients) on the cost and benefits of sustainable buildings using a questionnaire survey. Quantitative data collected were analysed using descriptive statistical techniques.

FINDINGS
Findings from the analysis shows that the concepts and benefits of sustainable building production are familiar ideologies in the construction industry. In addition, the evaluation disclosed that achieving the benefits of sustainable buildings depends on the collaborative effort of the construction stakeholders and government towards construction materials cost reduction during construction.

RESEARCH LIMITATIONS/IMPLICATIONS

This paper provides empirical findings to the conference sub-theme on sustainable green building thus promoting sustainable construction education.

WHAT IS ORIGINAL/VALUE OF PAPER

This paper has recognised that the costs of materials for construction and procurement processes are core contributors to the high cost of producing sustainable buildings. The results can be useful to all construction stakeholders to enhance the adoption of sustainable buildings with the cost and benefits of production in perception. These combined efforts encourage stakeholders' participation in the production of sustainable building to reduce the environmental impacts of construction and improve social-economic statues of the population.

Keywords: Building production, Construction cost, Construction materials, Construction stakeholders, Sustainable building.

1.0: INTRODUCTION

Construction industries in developing countries have over the years intensify its pursuit to provide comfortable, affordable and sustainable structures. This is to satisfy the increasing demand for housing and infrastructure. Notably, the negative environmental impacts of these construction activities have increasingly become a concern in the construction industry towards sustainable development. In the quest to reduce these impacts, the concept of sustainable building production emerged in the late 1980's by the United Nation's World Commission on Environment and Development (WCED). In the past few decades, sustainability has been defined by various researches and writers in different ways. Although, literatures reveal that sustainable development was first defined by WCED (1987) in the "Brundtland report" as 'the ability to meet the present needs without compromising the ability of the future generations to meet their own needs'. Consequently, the essence of sustainability in every aspect of the human life (economic, social & environmental) cannot be over emphasized as every choice and actions made in the present affects the future.

Several researchers notably (Azis *et al.,* 2012; Lindahl *et al.,* 2014; Singhaputtangkul *et al.,* 2014; Gan *et al.,* 2015) have carried out studies in the area of sustainability and sustainable building production. Worthy of note, these studies and reviews indicates that sustainability has been a focus of study amongst researchers, with the most studies emphasising on how best to produce and deliver sustainable buildings (Khalfan *et al.,* 2011; Gan *et al.,* 2015; Yudelson, 2009). Relatively, these studies were focused on sustainable building production in the context of design, decision making and stakeholder's perspectives during construction. Comparatively,

few articles have investigated on the cost benefits of sustainable building (Kats, 2013), which poses as a major concern amongst contactors who perceive sustainable buildings as outrageously expensive. This research aims at addressing this gap by conducting a study on the cost benefit of producing sustainable buildings in the Western cape of South Africa.

In modern construction techniques, buildings that significantly consume less energy and water with reduced environmental impact than traditional conventional buildings have been termed as sustainable buildings (SP). Therefore, sustainable buildings according to Yudelson (2010) are buildings designed and constructed to reduce negative environmental impacts and improve the health of the habitat with the significant use of minimum water and energy. Consequently, Kubba (2012) describes sustainable buildings as structures designed, built, renovated, operated, or reused in an ecological and resource-efficient manner to meet the objectives of enhancing the health status of the occupants and efficient utilization of materials, water and other resources. Thus, this paper is set to ascertain the cost benefits of sustainable building production to encourage the adoption of the concept of sustainable construction in the industry.

2.0: OVERVIEW OF SUSTAINABLE BUILDING DEVELOPMENT

2.1: Sustainable construction

The term 'sustainable construction' is often interchanged with the term 'sustainable. According to Kibert, and Kibert, (2008), the term 'Sustainable construction' embodies issues related to the ecological, economic and social aspects of a building. Conversely, Kibert (2012) further stressed that sustainable construction is the process of creating and operating a health facility based on ecologically designed building plans and resource efficiency while sustainable buildings are the end products of applying this processes throughout the lifecycle of the building.

Sustainability in building production is a subset of sustainable development aimed at restoring or maintaining a balance between built environment and the eco-system to create a settlement that promotes economic and social equity. Kibert (2012) in Figure 2.1 illustrates the framework for sustainable construction which is applicable throughout the construction phase of a building. Accordingly, Vatalis *et al.,* (2013), highlighted that the principles of sustainable construction is attainable where the construction resources are efficiently utilized and planned for at every phase of construction. Abeysundara *et al.,* (2009) buttressed further that the construction resources, especially materials should be selected in line with the principles of sustainability as it is essential to note that buildings are characterised by the materials used in its construction. Thus, the adoption

of sustainable construction principles effectively reduces the negative impacts of conventional construction.

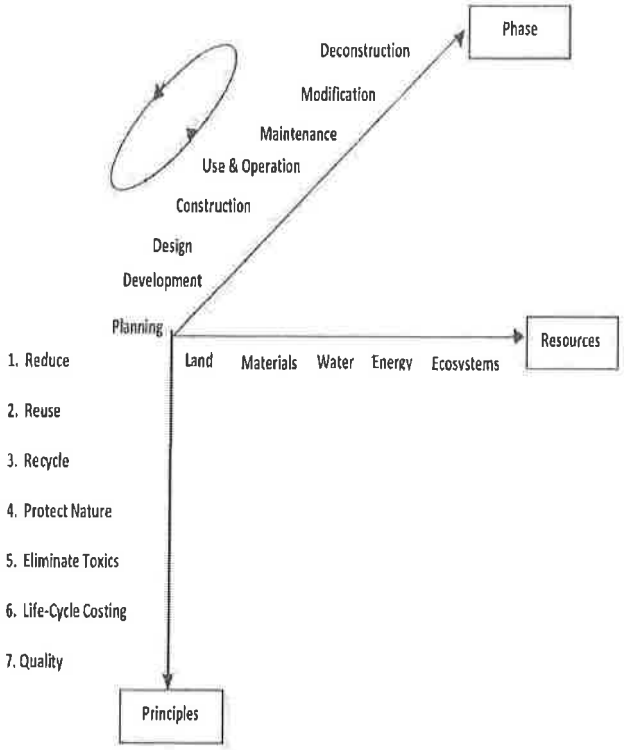

Fig. 1: Framework for sustainable construction (adapted from Kibert, 2012)

2.2: Barriers and Challenges of Sustainable building production

The construction industry has been faces with theoretical and practical issue that have lingered over the years as a result of rapid growth in construction projects. Doubtless, the rapid growth of construction activities in a particular jurisdiction has delivered social necessities as well as contributing significantly to the economic growth of that territory (Azis *et al.*, 2012). On the contrary, the process of constructing these facilities deters adverse environmental impacts, excessive resource wastes and budget overrun as a result of project schedule delays (Azis *et al.*, 2012). As a result, authors notably (the Construction Industry Development Board: CIDB, 2002; Häkkinen, & Belloni, 2011) identified the following as barriers to attaining sustainable buildings in South Africa as a developing country:

- Lack of capacity of construction sector to implement sustainable principles
- Poverty, high demographic growth and low urban investment
- Declining government investment in construction
- Lack of interest in sustainability issues among stakeholders
- Resistance to new technology
- Lack of effective enforcement on existing sustainability rules.
- Unforeseen high cost of production
- Lack of client understanding on the components of sustainability.

2.3 Significance of sustainable building production

Sustainable buildings basically built to create a balance between the social, economic and environmental statues of humans. As established earlier, the rapid growth of urbanization in developing countries such as South Africa has initiated an unprecedented opportunity for the provision of sustainable buildings by the government (Gan *et al.,* 2015). Du Plessis, (2007) highlighted that the conception of sustainable building production over the years has also afforded developing countries stable solutions to the challenges of urbanization through the production of adequate, safe, sufficient housing and social infrastructure for the populace. As a result, the social-economic and ecological development experienced by these countries enhances the eradication of poverty and deteriorating health conditions in that territory (Golubchikov & Badyina, 2012).

GBCSA, (2010) have noted global warming, along with rising temperatures and sea levels, severe climate events and the extinction of various species are also other persistent threats to our planet and according to experts we have ten years to reduce gas emissions or face the consequences. The CIDB (2009) reported that the operation of the building sector in South Africa accounts for 23% of greenhouse gas emissions, while emissions from the manufacture of the major materials for the building sector amounts to around 18mt CO2 per year, or around 4% of total CO2 emissions. This challenge can be brought under control by the implementation of sustainable principles at the planning and materials selection stage.

2.4 Benefits of sustainable building production

In a research study, the World Green Building Council (WGBC, 2013) reported that sustainability in building production have compelling benefits over the traditional or conventionally built structures. However, the benefits which included environmental, social and economic benefits seemed incomplete without the financial benefits, raised a controversial questionable issues amongst stakeholders in the industry. In an effort to

answer this controversial question, WGBC (2013), catalogued the following as benefits of sustainable buildings:

Table 1: Benefits of sustainable building

Environmental benefits	Social benefits	Economic benefits
Enhancing and protecting biodiversity and ecosystems	Enhance occupant health and comfort	Reduce operating costs
Improving air and water quality	Improve indoor air quality	Improve occupant productivity
Reducing waste streams	Minimize strain on local utility infrastructure	Enhance asset value and profits
Conserving and restoring natural resources	Improve overall quality of life	Optimize life-cycle economic performance

Financial benefits

Financially, sustainable buildings afford investors benefits that the traditional buildings cannot offer. The financial benefits of sustainable buildings to building owners, private investors, government investors or the population at large includes: provision of employment during construction, greater employee comfort/productivity, reduced employee health costs, energy and water savings, reduced waste, improved indoor environmental quality and lower operations and maintenance costs.

In summary, Azis *et al* (2012) and Gan, *et al.* (2015) buttressed that the adoption of sustainable principles in building production could either be long-term or intangible summed-up as follows: i). Reduced planning risk. ii) Reduction of building operation and maintenance cost during the building service span. Iii) Enhancement of environmental performance. iv). Construction waste minimization. v) Provision of healthier working and living environments. vi). Enhances the efficient process of materials procurement with extended building lifespan .vii). Enhance asset value and profits.

2.5: Cost of producing sustainable buildings

Kats (2003) argues that there has been a common perception in the real-estate industry that the cost of green building is considerably more than a traditional method of development. Allegedly, the biggest barrier to the adoption of sustainable building principles is the perception that it cost more than conventional building (Kubba, 2012). In order to effectively attain sustainability in the production of buildings and social infrastructures,

Kubba (2012) bolstered that the following factors should be considered for implementation throughout the construction phase of the building:

- Setting clear cost values at the design stage. i.e. defining cost management rubrics.
- Implement the principles of sustainability at the materials selection phase to avert construction waste.
- Create awareness on the benefit sustainable building in by industry through seminars, workshops and practical integration in projects.
- Integrating government policies and regulations as an effective approach to enforcing economic, environmental, social and economically friendly construction activities.

3.0: METHODOLOGY AND RESULTS OF DATA ANALYSIS

A preliminary literature search was carried out to investigate the perception of the construction industry professionals regarding the cost benefits of producing sustainable building. From the information derived from the reviewed literatures, a well-structured questionnaire was developed and distributed amongst a randomly selected sample consisting of quantity surveyors, architects, engineers, developers and contractors operating in the Western Cape Province of South Africa. The questionnaire was distributed via E-mail to reputable companies which included a covering letter of invitation to participate in the study. From the total of fifty (50) questionnaires distributed, 32 (64%) questionnaires were completed and retrieved.

Questionnaires were completed anonymously to ensure a true reflection of the respondents' opinions and to meet the ethical criterion of confidentiality. It is therefore assumed that the respondents were sincere in their responses. The data collected were analysed with SPSS statistical software. Descriptive statistics was used to describe and summarise the data. Frequency analysis technique was used to for analysis in this study.

3.1: Background information of respondents

3.1.1: Professional affiliation of respondents

The respondent demography was included in the survey so as to review the proficiencies of the respondents in appraising issues relating to the cost-benefit of sustainable buildings. The first demography, Figure 2, illustrates the organisation of respondents. It was derived that majority of the respondents were Quantity surveyors, 28%, followed by Architects, 22%, Engineers, 19%, Contractors, 19%, Developers, 9%, and the lowest were denoted as others, 3%. As a result, Quantity Surveyors played a vital and influential role in this study.

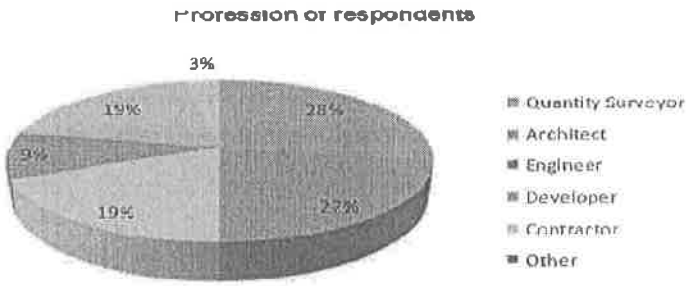

Figure 2: Professional affiliation of the respondents

3.1.2: Years of working experience

The working experience of the respondents in the construction industry was evaluated as well. It was discovered that two sets 25% of the respondents have the working experience of 0-5 years and 6-10 years respectively, followed by 22% having over 22years working experience, 16% of 16-20 years of experience and 12% of 11-15year work experience as illustrated in Figure 3. The chat (fig 3) indicates that 75% of the respondents have between 6 - over 20 years of work experience. This implies that majority of the respondents have the adequate knowledge on the concerns of the industry on the cost-benefits of sustainable buildings production.

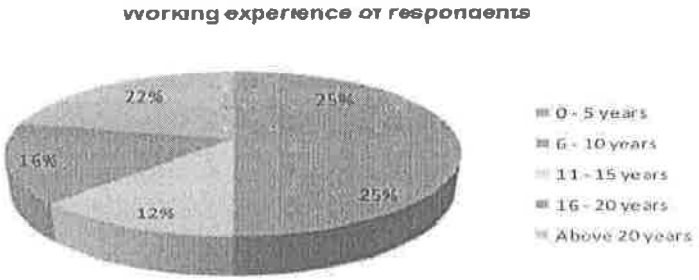

Figure 3: Working experience of respondents in construction

3.1.3: Respondents educational qualification

The highest qualification attained by the respondents as shown in figure 4, indicates that 69% of the respondents obtained Bachelor degrees, followed

by 19% of the respondents who are Diploma holders. The Masters' degree holders occupied the third largest position of 6%. The smallest percentages of respondents were Matric certificate and other qualification holders with 3% each. This indicates that the majority of the respondents obtained at least a Bachelors' degree, 75%. Hence, it could be deduced that the all the respondents were satisfactorily educated.

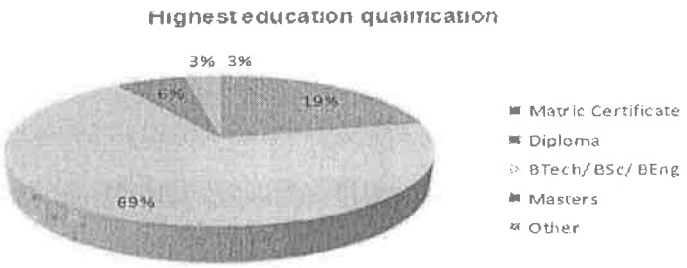

Figure 4: Highest qualification of qualification

3.2: Sustainable construction experience

The respondents were evaluated on the frequency of their participation in the adopting sustainable principles in construction. The responses are presented in Table 1.

Table 1 reveals that majority of the respondents, 65% "rarely" participate in sustainable construction. However, 22% of respondents indicated that they "often" participate in sustainable construction, followed by 9% indicating that they participate in sustainable construction "very often".

Table 2 Frequency of Participation in the adoption of sustainable principle in construction

			Frequency and numerical counts of participants				
			Not at all	Rarely	Often	Very often	Total
Profession	Quantity Surveyor	Count	0	7	0	2	9
		% within profession	0	77.8	0	22.2	100
	Architect	Count	1	5	1	0	7
		% within profession	14.3	71.4	14.3	0	100
	Engineer	Count	0	2	4	0	6
		% within profession	0	33.3	66.7	0	100
	Developer	Count	0	1	1	1	3
		% within profession	0	33.3	33.3	33.3	100
	Contractor	Count	0	5	1	0	6
		% within profession	0	83.3	16.7	0	100
	Other	Count	0	1	0	0	1
		% within profession	0	100	0	0	100
Total		Count	1	21	7	3	32
		% within profession	3.1	65.6	21.9	9.4	100

3.3: Cost-benefits of Sustainable Buildings

3.3.1: Benefits of sustainable buildings

The questionnaire survey explored respondents' perception of the perceived benefits of sustainable building. A summary of the responses is presented in Table 2

The table shows that majority, 63% of the respondent strongly agreed that they are assured of savings in energy and water as a result of sustainable building, followed by 34% that "Agree", then 3% "Disagree". This benefit was ranked 1st.. The analysis of other beneficial factors are as follows.

Table 3: Benefits of Sustainable buildings

Questions		Frequency	Mean value	Rank
Higher building value	Disagree	1	3.406	3
	Agree	17		
	Strongly Agree	14		
	Total	32		
Higher return on investment	Disagree	5	3.156	6
	Agree	17		
	Strongly Agree	10		
	Total	32		
Increase in employee productivity	Disagree	5	3.281	5
	Agree	13		
	Strongly Agree	14		
	Total	32		
Enhanced occupant comfort and health	Disagree	4	3.344	4
	Agree	13		
	Strongly Agree	15		
	Total	32		
Energy and water savings	Disagree	1	3.594	1
	Agree	11		
	Strongly Agree	20		
	Total	32		
Reduced waste	Disagree	2	3.438	2
	Agree	14		
	Strongly Agree	16		
	Total	32		

3.3.2: Cost of sustainable buildings

The questionnaire focused on evaluating the perspectives of respondents on the cost of producing and maintaining sustainable buildings. This evaluation was based on the derived information that 65% of the respondents are conversant with the concept of sustainable construction.

Table 3 clarifies that majority of the respondents "Strongly agreed and "agreed", 46% respectively, with 6% of the respondents "disagreed" that initial cost of sustainable building construction are higher than the cost of conventional building. The respondents were also asked of their perspective on the decrease of operation cost based on the use of sustainable and cumulatively 87.5% of the respondent "agreed" and "strongly agreed" with only 12.5% disagreeing to this factor. Finally, A total of 68.7% of the respondents indicated that they "agree" and "strongly agree" that sustainable building design decreases maintenance cost, while 3.6% and 25% "disagree" and "strongly disagree", respectively.

Table 4: Cost of sustainable building

Question		Frequency	Mean value	Rank
Initial costs of sustainable building	Disagree	2	3.406	
construction are higher than	Agree	15		1
cost of conventional building	Strongly agree	15		
	Total	**32**		
Sustainable building design	Disagree	4	3.125	
decreases operation costs	Agree	20		2
	Strongly agree	8		
	Total	**32**		
Sustainable building design	Strongly disagree	2	2.781	
decreases maintenance costs	Disagree	8		3
	Agree	17		
	Strongly agree	5		
	Total	**32**		

4.0: DISCUSSION OF RESULTS

The results from the study reveal the 5 factors as indicated by the Built Environment stakeholder as the perceived benefits of sustainable building in ranking order as: energy and water savings, reduced waste, higher building value, followed by enhanced occupant comfort and health, resulting in an increase in employee productivity. A study done by Katz in 2003, confirm these findings. The results also reveal that majority of the respondents (96%) are in agreement that sustainable building construction cost more initially compared to that of conventional building, The majority also agree that sustainable building design decrease the operation and maintenance costs which is a cost benefit and are confirmed by the literatures reviewed.

From the findings, it is interesting to note that despite the level of stakeholders' awareness on the benefits of sustainable building production, majority of construction professionals do not implement the principles of sustainable construction in their projects.

5.0: CONCLUSION.

The findings of this exploratory study has enhanced in identifying the long-term cost-benefits of producing sustainable building in developing countries. The most significant benefits of sustainable buildings are reduced construction waste, reduced operational and maintenance cost,

energy and water saving, higher building value, enhanced occupant comfort and health, resulting in an increase in employee productivity. Hence, these findings will give a better understanding to construction stakeholders, most especially the clients, who play an influential role in adopting the practice of sustainable buildings production in the construction industry for future construction projects.

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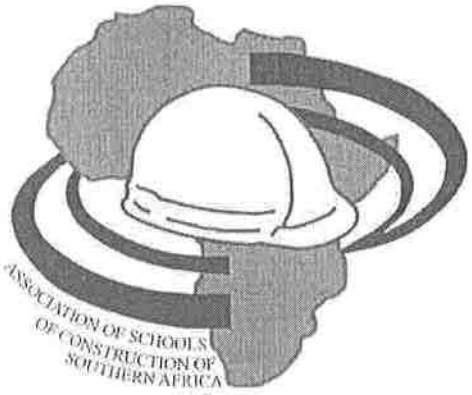

Association of Schools of Construction of Southern Africa

The Ninth Built Environment Conference

2 - 4 August 2015, Durban, South Africa

Conference Proceedings

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PREFACE

The ASOCSA Built Environment conference series has become the undisputed leading built environment conference on the African continent. It is one of only two construction-related conferences in South Africa that has been fully accredited by the Department of Higher Education (DHET) for subsidy. Since its inception in 2006 the blind peer reviewed conference proceedings have been referred to by private and public sector policy and decision makers. The series produces a post-conference edition of the Journal of Construction, which is on the list of journals approved by the South African Department of Higher Education and Training (DHET) for subsidy. The series continues to underwritten by major industry stakeholders that have included the Construction Industry Development Board (CIDB), Council for the Built Environment (CBE), Master Builders South Africa (MBSA), branches of the MBA, major construction companies and PPC Cement. It has been endorsed by the International Council for Research and Innovation in Building and Construction (CIB), one of the largest global built environment research organizations.

OBJECTIVES

The Ninth Built Environment Conference continued in the tradition of previous conferences in the series and provided in an ever-increasing challenging global economic environment with shrinking sponsorship budgets an international forum with a very clear industry development and sustainability focus that provides the opportunity for researchers and practitioners from developed, developing and underdeveloped nations to deliberate topical current issues that impact the Built Environment.

The broad objectives of the conference are:

- To provide a forum for multi-disciplinary interaction between academics and industry practitioners;
- To disseminate innovative and cutting edge practices that respond to the conference theme and outcomes, namely Reflections on Directions in Construction;
- To provide a world class leading internationally recognized, accredited conference for the built environment; and
- To contribute to the existing built environment body of knowledge (BEBOK) and practice.

The conference organizers brought together in a single forum a group of researchers and academics from the full range of built environment disciplines that include engineers, architects, quantity surveyors, construction and project managers. Delegates were drawn not only from South African institutions of higher education, government agencies, and other construction-related organizations but also from the African continent, Australia, Europe and the United Kingdom.

CONFERENCE THEME AND OUTCOMES

Reflections on Directions in Construction

This conference sought responses to questions related to current conversations and debates on infrastructure delivery and sustainability such as, for example,

Infrastructure Development Management
Integrated Project Delivery (IPD) including professional practice
Sustainable Green Building
Information and Communication Technologies (ICT) including
Innovative construction education
Building Information Modelling
Improved project management
Inappropriate construction practices and ethics
Construction Health and Safety
Construction contracts
Innovation in construction technologies

and includes papers that address, inter alia,

- Current trends and developments
- Policies
- Legislation and regulations
- Practices
- Case studies

These internationally peer reviewed and edited proceedings were aimed at contributing significantly to the body of knowledge relative to the science and practice of construction not only in South Africa but everywhere that the products of construction are being produced.

Ferdinand Fester
Durban, South Africa
August 2, 2015

ACKNOWLEDGEMENTS

The organizing committee of The Ninth Built Environment conference, held in Durban, South Africa, wish to thank the Master Builders Association KwaZulu-Natal, the School of Engineering at University of KwaZulu-Natal, the Council of the Association of Schools of Construction of Southern Africa and membership universities and individuals for supporting this conference through their valued contributions. Without that support this conference and the further development and growth of the Association of Schools of Construction of Southern Africa (ASOCSA) with respect to its mission in the region would not have been possible. Further, this support demonstrates the commitment to the further development of the body of knowledge relative to the science and practice of construction. This commitment is deeply valued and acknowledged.

Our thanks are extended to Professor Theo Haupt (University of KwaZulu-Natal) and Ferdinand Fester (University of Johannesburg) who worked unstintingly on every aspect of the conference. Together with the Scientific and Technical Committee and additional reviewers to whom special thanks are extended they worked hard and long to prepare refereed and edited papers and published proceedings of the highest standard that satisfy the criteria for subsidy by the South African Department of Higher Education and Training (DHET).

The contribution and excellent support of our webmaster, Wendal Koopman, in setting up and supporting our conference website is appreciated.

Finally, the sterling contribution and efforts of Ferial Lombardo to the success of this conference is acknowledged in her capacity as conference organizer working with the conference committee and evident in the superlative logistic coordination and attention to detail in every aspect of the conference organization.

ORGANISERS – SOUTH AFRICA

Ferdinand Fester, University of Johannesburg, South Africa, President
Prof Theodore Haupt, Academic Chair
Ms. Ferial Lombardo, Conference Organiser

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PEER REVIEW PROCESS

In order to maintain and ensure the highest quality in the conference proceedings and comply with the requirements for subsidy of the South African Department of Higher Education and Training (DHET), a rigorous two-stage system of peer review by no less than two acknowledged experts in the field has been followed. In terms of this process, each abstract received was twice blind reviewed in terms of:

- Relevance to overall conference theme and objectives;
- Relevance to selected sub-theme;
- Originality of material;
- Academic rigour;
- Contribution to knowledge; and
- Research methodology.

Authors whose abstracts were accepted after a blind peer review process was completed, were provided with anonymous reviewers' comments and requested to submit their full papers noting and addressing these comments. Evidence was required relative to the action taken by authors regarding the comments received. These resubmitted papers were twice blind reviewed again in terms of:

- Relevance to overall conference theme and objectives;
- Relevance to selected sub-theme;
- Originality of material;
- Academic rigour;
- Contribution to knowledge;
- Research methodology and robustness of analysis of findings;
- Empirical research findings; and
- Critical current literature review.

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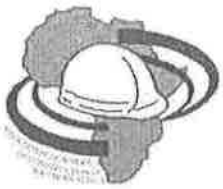

Association of Schools of Construction of Southern Africa

History

ASOCSA is not the first attempt to form a body that addresses, inter alia, matters of construction education and training. In the days of the Building Industries Federation South Africa and the National Development Fund there were regular annual meetings of the Heads of Departments that offered construction-related programs. Recognizing the two-tiered higher education sector in South Africa, there were separate meetings for universities and the former technikons. In the more recent past, the Chartered Institute of Building - Africa initially convened annual educators' forums that did not quite fulfill the same function as the previous forums. However, during 2005 the very first meeting of University Heads of Departments drawn from all higher education institutions in South Africa met for the very first time since the re-landscaping of the sector in the same venue to discuss matters affecting construction, and particularly construction education in the country. This meeting was repeated in 2006 where the need was expressed for the establishment of a formal forum / association of universities to engage in discussion / debate / collaboration / promotion of matters of mutual interest.

Broad Aims

ASOCSA aims to be the professional association for the development and advancement of construction education in Southern Africa, where the sharing of ideas and knowledge inspires, guides and promotes excellence in curriculums, teaching, research and service. To achieve this aim ASOCSA is partnering with the construction industry to find ways to effectively represent the interests of both construction academic and industry practitioners. ASOCSA will offer a variety of programs and services designed to help its members serve their customers more effectively and succeed in an increasingly challenging environment of construction information management and technology. To this end ASOCSA provides a forum for the debate and discussion of issues of mutual interest to all industry stakeholders. For example, one of the tasks of ASOCSA will be supporting the development of curriculums that address the needs of the construction sector in the Southern African region. ASOCSA convenes an annual conference that is one of only two construction-related conferences accredited by the Department of Higher Education and Training (DHET) where construction academics and practitioners can interact relative to practical experience and the findings of relevant research. This conference series is endorsed and underwritten by the International Council for Research and Innovation in Building and Construction (CIB) as well as several major industry stakeholders.

The Journal of Construction which is accredited by the Department of Higher Education presently published electronically four times per year is the official journal of ASOCSA and in the past more than 5,000 complimentary copies were distributed to all industry stakeholders in the Southern African region. The production and distribution of practice notes and technical papers is a further endeavor to grow the partnership between academia and industry.

With respect to the Southern African region, ASOCSA is committed to the following:

Vision

To drive innovative construction related higher education

Mission Statement

To promote, facilitate, develop and monitor the relevance and quality of construction related curricula, research and graduates in conjunction with higher education institutions, industry and government.

Strategic objectives

The objectives of the Association are:

- to promote and facilitate the development of curricula for construction related programmes
- to assist with the accreditation of construction related programmes

- to hold an annual conference that acts as a forum for multi-disciplinary interaction between academics and practitioners
- to publish an accredited research-based journal and contribute to the built environment body of knowledge (BEBOK)
- to disseminate information dealing with construction education and related matters
- to develop and maintain closer links with industry and government
- to represent the collective views of its members
- to liaise with other organisations and persons to promote the interests of its members
- to promote and support relevant postgraduate research
- to provide bursaries to postgraduate students in accordance with set criteria

ASOCSA continues to seek opportunities to promote both academic and industry employment opportunities. Finally, ASOCSA intends to play a significant role in the accreditation of construction-related academic programs.

Heads Forum meetings

ASOCSA believes that meetings of the Heads Forum comprising of Heads of School and Departments of Construction is a vital component of its functions and holds Heads meetings during each conference. It is still the aim of ASOCSA to bi-annual Heads meetings.

International Affiliation

ASOCSA has commenced discussions about closer collaboration with similar institutions such as the Associated Schools of Construction (ASC) in the United States, the Royal Institute of Chartered Surveyors (RICS), the Chartered Institute of Building (CIOB), Australian Institute of Building (AIB) and Council of the Heads of the Built Environment (CHOBE) in the United Kingdom. ASOCSA has entered into a Memorandum of Understanding with the International Council for Research and Innovation in Building and Construction (CIB).

In summary, benefits of membership of ASOCSA which are self-evident include participation in meetings of the Heads Forum throughout the region, access to the Journal of Construction, reduced rates at all ASOCSA, MBA and CIB events, involvement at regional level with industry-academia forums, interaction and networking opportunities relative to, for example, collaborative research, curriculum development, external moderation of courses, and external examination

ASSOCIATION OF SCHOOLS OF CONSTRUCTION OF SOUTHERN AFRICA

Office bearers

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Vice-president	Prof. Theo C Haupt	University of Kwa-Zulu Natal

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Associate Editor:	Dr Justus Agumba – University of Johannesburg
Assistant Editor:	Dr Nishani Harinarain – University of KwaZulu-Natal

Chair of Heads Forum

Nazeem Ansary	University of Johannesburg

For more information on ASOCSA and its activities visit www.asocsa.org

TAX BENEFIT

ASOCSA is a registered Public Benefit Organization as defined in Section 30 of the Income Tax Act and a registered Section 21 Company as defined in the Companies Act. Therefore all donations made to ASOCSA will be fully deductible for income tax purposes and a section 18A certificate, for proof of deductibility will be issued to the donor upon receipt of the donation. The deductible donation is limited to 10% of the donors' taxable income before providing for Section 18A and Section 18 deductions.

International Council
for Research and Innovation
in Building and Construction

Introduction

CIB is the acronym of the abbreviated French (former) name: "Conseil International du Bâtiment" (in English this is: International Council for Building). In the course of 1998, the abbreviation has been kept but the full name changed into:

INTERNATIONAL COUNCIL FOR RESEARCH AND INNOVATION IN BUILDING AND CONSTRUCTION

CIB was established in 1953 as an Association whose objectives were to stimulate and facilitate international cooperation and information exchange between governmental research institutes in the building and construction sector, with an emphasis on those institutes engaged in technical fields of research.

CIB has since developed into a world wide network of over 5000 experts from about 500 member organisations active in the research community, in industry or in education, who cooperate and exchange information in over 50 CIB Commissions covering all fields in building and construction related research and innovation.

CIB Members are institutes, companies and other types of organisations involved in research or in the transfer or application of research results. Member organisations appoint experts to participate in CIB Commissions. An individual also can be a member and participate in a Commission.
CIB Commissions initiate projects for R&D and information exchange, organise meetings and produce publications. These meetings can be Commission meetings for members only or international symposia and congresses open to all. Publications can be proceedings, scientific or technical analyses and international state of the art reports.

CIB Past and Present

CIB was established in 1953 with the support of the United Nations, as an association whose objectives were to stimulate and facilitate international collaboration and information exchange between governmental research institutes in the building and construction sector. At that time an implicit objective also was to help rebuild the European infrastructure for building and construction research following the ravages of the second World War.

At the start 43 research institutes were members of CIB and by far the majority of these were European. And just as in the programmes of these institutes at that time, so in the CIB programme there was a strong emphasis on technical topics.

For selected topics CIB Commissions were established to which member organisations appointed experts from their staff to participate.

Along with all types of less visible activities, this collective participation resulted in many important international symposia and congresses and in a large number of publications acknowledged as of global standing. Indeed many of these formed the factual basis for developing international standards or were themselves used as such. Others were international state-of-the-art reports that for a long time provided an indispensable input to programming new research by the participating institutes and countries.

However, CIB has come a long way since 1953.

At present about 500 organisations are members of CIB from whom about 5000 individual experts participate in over 50 CIB Commissions. These extend over the whole area of building and construction research and innovation.
Amongst the CIB member organisations we can now find almost all the major national building research institutes in the world, as well as many other types of organisations in the building and construction sector who have joined us since. And although within the CIB programme considerable attention is still given to

technical topics, there are now also activities focused on topics like organisation and management, economics of building, legal and procurement practices, architecture, urban planning and human aspects.
It is no exaggeration to say that at present CIB is the world's foremost platform for international cooperation and information exchange in the area of building and construction research and innovation. And we continue to increase our membership, to expand our scope, to initiate new activities while constantly striving to improve the quality of our products and services.

Master Builders KwaZulu-Natal

KwaZulu-Natal Master Builders and Allied Industries Association is an Employers' organisation registered in terms of the Labour Relations Act, the Association exists to represent the interests of members, as well as to provide them with specialist support services to assist them in the successful running of their business. The membership comprises over 700 enterprises involved in the building industry and related activities in the province of KwaZulu-Natal. The organisation has been in existence for 114 years and is recognised and respected by a wide range of role players in the building industry and beyond.

The Head office is based in Essex Terrace, Westville, supported by area offices across the province in Zululand, South Coast, Midlands, and Northern Natal. The Association continually strives for excellence in service delivery in all areas of operation, providing a wide range of services including training, building services, occupational health and safety, employee benefit schemes and more.

Our special projects include an emerging contractor programme, Vuka Makhi programme and a bursary fund.

Complementary operations include:

- Building inspections, quality assurance and construction risk management
- Health and safety consulting
- Mediation and dispute resolution
- Conference and meeting facilities
- Café Indaba
- Master Builders Print Studio
- Mobile clinic
- Master Builders Occupational Health Clinic
- Property leasing
- Training academy
- E-learning
- Recruitment agency

The general management of the Association is, subject to the direction and control of general meetings of the Association, controlled by the Executive Council. The Executive Director is the Association's Chief Executive (CEO).

The Association continuously reviews its operations with the object of introducing new and innovative services in the building and allied industry.

27 July 2015

Dear Author

PEER REVIEW PROCESS: 9TH BUILT ENVIRONMENT CONFERENCE: DURBAN, SOUTH AFRICA 2015

I confirm that the following peer review process was strictly followed relative to this conference.

In order to maintain and ensure the highest quality in the conference proceedings and comply with the requirements for subsidy of the South African Department of Higher Education and Training (DHET), a rigorous two-stage system of peer review by no less than two acknowledged experts in the field has been followed. In terms of this process, each abstract received was twice blind reviewed in terms of:

- Relevance to overall conference theme and objectives
- Relevance to selected sub-theme;
- Originality of material;
- Academic rigour;
- Contribution to knowledge; and
- Research methodology.

Authors whose abstracts were accepted after the blind review process was completed, were provided with anonymous reviewers' comments and requested to submit their full papers noting and addressing these comments. Evidence was required relative to the action taken by authors regarding the comments received. These resubmitted papers were twice blind reviewed again in terms of:

- Relevance to overall conference theme and objectives;
- Relevance to selected sub-theme;
- Originality of material;
- Academic rigour;
- Contribution to knowledge;
- Research methodology and robustness of analysis of findings;
- Empirical research findings; and
- Critical current literature review.

Authors whose papers were accepted after this second review were provided with additional anonymous reviewers' comments and requested to submit their revised full papers. These final papers were only included into both the conference presentation schedule and the conference proceedings after evidence was provided that all comments were appropriately responded to, having been multiple peer-reviewed for publication. At no stage was any member of the Scientific and Technical Committee or the editor of the proceedings involved in the review process relative to their own authored or co-authored papers. The role of the editor was to ensure that the final papers incorporated the reviewers' comments and arrange the papers into the final sequence based on the conference presentation schedule as captured on the conference proceedings flashdrive and Table of Contents. Of the 78 abstracts originally received, only 47 papers were finally accepted for presentation at the conference and inclusion in these proceedings, representing an acceptance rate of 60%. To be eligible for inclusion these papers were required to receive one of three recommendations from at least two reviewers, namely

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Dr Geraldine Kikwasi, Ardhi University, Tanzania

Regards

Ferdinand Fester (ASOCSA President)

Prof Theo C Haupt (ASOCSA Vice-President)

Ms Ferial Lombardo (ASOCSA Conference Organizer)

CONTENTS

Session: Construction Education

Session: Sustainable Construction and Infrastructure Delivery

Session: Development and Innovation