From Concept to Innovation: Advancing the Home Building Environment

Proceedings of the 12th International Housing and Home Warranty Conference

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FORWARD

Dear Reader,

I have no doubt in my mind that it is unnecessary to convince you of the importance and relevance of the 12th International Housing & Home Warranty Conference to the challenges of the global housing industry and the protection of human habitat. Yet, it is even more appropriate in the context of the developing world, which faces the challenge of a chronic shortage of acceptable, safe and durable human shelter.

Since the start of the conference organising process, our intention was to develop an enduring book of Conference Proceedings. This was to reflect the efforts of the participants and contributors and serve as a future reference document for the home warranty industry. This has proved to be a challenging task, as it has ‘rocked’ tradition and resulted in a substantial paradigm shift of the IHHWC conferences.

Well, we have done it! We have the pleasure of presenting you with a wide selection of relevant papers with topics ranging from exploring the mechanisms of social dynamics, through to complexities of technical challenges and innovation, to financing and warranty provisions in various countries, amongst others.

Thanks to all whose contributions enabled us to compile this book of proceedings. We hope that our initiative will be followed in future international gatherings of the International Housing & Home Warranty Association.

On behalf of the Technical Conference Panel

Adam Goliger
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THE NEED FOR APPROVAL OF INNOVATIVE CONSTRUCTION PRODUCTS
—Vanessa Adell & Benson Wekesa

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ABSTRACT

Agrément South Africa, supported by the Department of Public Works, provides assurance of fitness-for-purpose of products and systems which are not fully covered by a South African Bureau of Standards (SABS) standard or code of practice. This paper describes Agrément South Africa’s commitment towards sustainable construction through assessments of innovative construction products and the processes for the awarding of Agrément Certificates. The paper outlines Agrément South Africa’s intention to promote the adoption and use of sustainable and innovative construction methods and products and describes how Agrément Certificate holders are able to include environmental claims and declarations of their product and/or systems in the Agrément Certificate.

INTRODUCTION

Agrément South Africa

Agrément South Africa has been operating since 1969 and is the only internationally recognised centre in South Africa under the World Federation of Technical Assessment Organisations’ (WFTAO) umbrella for the assessment and certification of construction products, systems, materials, components and processes. Agrément South Africa delivers under the mandate and financial support of the Department of Public Works.

Agrément South Africa shall support and promote the process of integrated socio-economic development in South Africa as it relates to the construction industry by facilitating the introduction, application and utilisation of satisfactory innovation and technology development, in a manner which will add value to the process and by so doing enhance Agrément South Africa’s position as the internationally acknowledged, objective South African centre for the assessment and certification of innovative non-standardised construction products, systems, materials, components and processes, which are not fully covered by a South African Bureau of Standard standard or code of practice.

Agrément South Africa shall do this inter alia by providing assurance of fitness-for-purpose of such technologies which optimise resource utilisation and realise cost savings in industry.

In assessing fitness-for-purpose, a holistic view must be taken which includes technical, commercial and social factors, for example, economic viability, cost benefit and consumer acceptability.

Agrément South Africa has continued to exercise its mandate and supports the five key priority areas for the government and the Department of Public Works:

- economic development
- infrastructure maintenance and provision
- rural development
- sustainable resource management
- improved public service delivery.

By facilitating and promoting the use of innovative and non-standard construction products and systems through its certification process, Agrément South Africa’s mission meets the government’s key priority areas and thereby contributes to the social and economic development of all South Africans.

Agrément Certificates

Agrément Certificates are awarded to products or systems that satisfactorily fulfil the assessment criteria established by Agrément South Africa. These assessments involve the technical evaluation of the fitness-for-purpose of the product or system, compliance with the Building Regulations and the evaluation of the manufacturer’s quality system.

Fitness-for-purpose is assessed against performance-based criteria and test methods established by Agrément South Africa. These criteria have been developed by Agrément’s technical experts, scientists and engineers and in consultation with the national leading experts. The ongoing validity of Agrément Certificates is ensured by conducting regular quality inspections of the manufacturing process and/or applications or installations on site. The Agrément Certificate is subject to a validity review every three years.

Agrément Certificates:

- give a brief description of the subject and the uses for which its fitness-for-purpose performance has been assessed
- summarise the performance that may be expected of the subject and the conditions and requirements that must be met if the assessed performance is to be attained
• provide a technical description of the subject including information on manufacturing and installation of the subject
• list compliance with the Building Regulations.

To date Agrément South Africa has issued 430 Certificates of which approximately 75% have been awarded to innovative building systems. Examples of areas where Agrément Certificates have been awarded and remain valid are:
• baths, bathroom and toilet units
• bridge deck joints
• ceilings and roofing
• concrete additives
• damp-proofing
• insulation
• non-traditional soil stabiliser and thin bituminous surfacing systems
• plumbing
• windows
• storage tanks
• sanitation
• wall coatings
• walling and building systems
• waterproofing.

Technical assessments of innovative products

As previously mentioned, the technical assessment of fitness-for-purpose of innovative construction products and building systems is performance based. The Agrément South Africa website¹ provides information on the concept of performance including the principle elements and how they are applied in Agrément South Africa’s assessment.

The principle elements of the performance concept are:
• establishment of performance criteria appropriate to the use of the product
• development or identification of suitable test methods or methods of assessment that may be applied in the measurement of performance
• measurement of the actual performance of the product according to the established methods
• judgment of acceptability in light of the results from the measured or assessed performance of the product against the appropriate performance criteria.

The criteria for assessing building systems address the following aspects:
• structural strength and stability
• safety in case of fire
• water penetration
• thermal and energy performance of the building
• natural lighting
• ventilation
• risk of condensation on the inside of the building
• acoustic performance
• durability and maintenance required
• the manufacturer’s quality management system.

The evaluation and certification process is carried out in three phases:
• The first phase is to initiate the process. Formal application for certification is provided by the applicant together with detailed supporting documentation and may include an evaluation certificate by another member of the WFTAO. An application and programme preparation fee is required at this stage.
• The second phase involves the preparation of an offer and assessment programme. It sets out the nature and scope of the technical evaluation, details of any testing that may be necessary including any test specimens and additional information that may be required. The offer also provides details on costs and time estimates. The costs can vary considerably depending on the type of certification, extent of the work, nature of tests required and documentation and test reports submitted by the applicant. The assessment and certification process might take up to eight months for a building system.
• On acceptance of the offer by payment of the evaluation fee, the process enters the third phase, which is the execution of the evaluation programme with a view to granting of a Certificate. The feedback from all the experts concerned is summarised in a technical report. Provided the results are satisfactory, an Agrément Certificate is drafted and submitted to the applicant for comments, then to the Technical Committee (TeCo) of Agrément South Africa for approval. Should the Certificate be approved then it is submitted to the board of Agrément South Africa for ratification and the new Certificate is published in the Government Gazette.

¹ See www.agrement.co.za
The Agrément Certificate remains valid subject to there being no changes to the product and an annual site and/or factory inspection. Any changes to the product must be approved by Agrément South Africa prior to implementation.

EXAMPLES OF INNOVATIVE AGRÉMENT CERTIFICATES

Examples of Agrément Certificates for innovative construction products and building systems or methods are summarised in Table 1.

<table>
<thead>
<tr>
<th>Certificate number</th>
<th>Certificate Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010/370</td>
<td>MG SIP Building System</td>
<td>The MG SIP Building System is a combination of innovative and conventional construction methods. It is a single-storey structure that utilises factory-produced wall and roof panels. Walls are 2 400 x 1 200 x 125mm thick lightweight interlocking sandwich panels comprising a polyurethane (PU) core encapsulated in two layers of 11mm thick oriental strand board (OSB). They are clad internally with 15mm thick fire-resistant gypsum plasterboard and externally with 12mm thick medium density Nutek board.</td>
</tr>
</tbody>
</table>
| 2010/371           | House-In-A-Can Building System                | The House-In-A-Can Building System is a combination of innovative and conventional construction methods. It is a single-storey structure that comprises:  
  - foundations: cast in-situ concrete surface bed and thickened edge beams, which in all cases are designed by a professional engineer or competent person  
  - columns: 125x75x3mm rectangular galvanised steel hollow sections at 2 565mm centres  
  - panels: 100mm thick lightweight interlocking sandwich in-fill panels comprising a polystyrene beaded concrete core with a density of 650kg per m³, encapsulated in two layers of 4.5mm thick magnesium oxide sheets  
  - roof trusses: light gauge structural steel  
  - roof cladding: light or heavyweight  
  - ceilings: insulated  
  - windows: ‘clisco’ type frames  
  - doorframes: galvanised pressed steel. |
| 2011/383           | VELA Steel Building System                    | The Vela Steel Building System is based on the Structural Insulated Panels (SIP) incorporating a steel frame, which enhances the structural integrity of the system. The steel frame is designed in accordance with the requirements of SANS 517. The composite wall panels comprise Autoclaved Magnesium Oxide board encapsulating polyurethane core and polystyrene blanks between panel cavities. The walls are finished with armour-coat waterproof paint. Where required, the panels are delivered on site with factory-fitted window and doorframes. |
| 2010/378           | Infra-Flash Self Adhesive Sealant              | Infra-Flash Self Adhesive Sealant comprises creped, laminated aluminium foil achieving up to 60% stretchability, one side coated with butyl adhesive and protective release foil. Infra-Flash is available in widths of 200, 250, 300, 450, and 600mm and 5m long roll. Infra-Flash Self Adhesive Sealant is available in anthracite, terracotta and brown. |
| 2011/384           | Spunulation Roofing Undertile Membrane        | The Spunulation Roofing Undertile Membrane is manufactured from pigmented ultraviolet (UV) light-resistant and non-woven spunbond polypropylene. The layer is coated with a polyolefin film blend. The membrane has a weight of 95g/m² with a thickness of between 0.33mm to 0.35mm. It is supplied in rolls of 30m long and 750mm or 1.5m wide. Spunulation Roofing Undertile Membrane is suitable for installation in all tiled-roof buildings with timber, lightweight steel or aluminium or Agrément-approved roof construction. |
| 2011/385           | Jojo Liquid Storage Tanks                     | The Certificate covers the use of the Jojo Liquid Storage Tanks. They are available in vertical and horizontal shapes for water and chemical storage, respectively, for use in all regions in South Africa for all types of occupancy classification (SANS 10400: Table 1 of regulation A (20) (1)). |

Reassurance of fitness-for-purpose and house warranty

It is a legal requirement that houses built in South Africa must be enrolled with the National Home Builder’s Registration Council (NHBRC). The NHBRC normally insist on Agrément certification of all houses constructed using innovative or unconventional methods or non-standardised construction systems or products. The NHBRC is represented on the Agrément board.

AGRÉMENT SOUTH AFRICA AND SUSTAINABILITY

In South Africa the construction industry sector has experienced a constant growth in the last decade, possibly explained by the boom in residential and commercial property development. It has had significant implications in terms of resource use and pollution as the construction industry is among the largest consumers of primary resources such as minerals, energy and water. Moreover, manufacturing of construction products generates a range of solid, liquid and gaseous wastes that have an effect on the country’s environment (DEAT, 2011). There is therefore a need to address the negative environmental impact caused by the construction industry sector in South Africa.
Agrément South Africa aims to promote the adoption and use of sustainable and innovative construction methods and products without jeopardising the quality of the end product. To do so Agrément South Africa is involved in several initiatives such as the verification of environmental performance, sustainability and ‘green’ claims made by the construction products manufacturers and the endorsement of national strategies such as the Eco-labelling Scheme and the Green Star SA Rating System.

The need to address sustainability issues not only follows the requirements of its mandate, but also the increasing demand from its stakeholders to deal with sustainability and compares with similar international initiatives adopted by the WFTAO sister organisations.

**Awareness and alignment with international initiatives**

Agrément South Africa’s initiatives on sustainability are similar to the numerous international initiatives and aims to align the South African construction industry’s environmental initiatives with worldwide trends and these are:

- EU Eco-labelling
- Environmental Product Declarations (UK, France, Norway, Poland)
- Carbon Footprinting
- Green Star
- Green Guide Ratings and BREEAM (UK)
- LEAD

**National initiatives**

Agrément South Africa is currently participating and supporting the following national initiatives.

**Eco-labelling (Indalo Yethu)**

Eco-labelling is a voluntary labelling system (Type I) for consumer products as a form of sustainability measurement directed at consumers. It is intended to make it easy to take into account environmental and energy concerns when selecting products. Agrément South Africa will cooperate and promote the Eco-labelling governmental initiative coordinated by Indalo Yethu. Indalo Yethu has developed the Eco-labelling criteria for detergents and tourism and is in the process of developing an Eco-labelling system for construction products.

**Green Star SA (Green Building Council of South Africa)**

Green Star is a comprehensive, national and voluntary environmental rating system that evaluates environmental design and construction. As part of the Green Building Council organisations, the Green Building Council of South Africa (GBCSA) has developed the Green Star South Africa rating tools based on the standards developed by the Green Building Council of Australia (GBCA). These tools are based on a series of standards and benchmarks, which result in an objective measurement of the environmental performance of buildings. This initiative’s ultimate objective is to recognise and reward environmental leadership within the property sector.

The GBCSA has currently developed rating tools for two sectors: office and retail, and it is currently working on the development of multi-unit residential, expected to be finalised by the end of 2011. Agrément South Africa supports the initiative and in particular wants to conform to the testing criteria for the requirements of section 3 ‘Indoor Air Quality’ and section 6 ‘Materials’.

**Verification of environmental claims**

Agrément South Africa intends to allow Certificate holders to include environmental claims and declarations of their product and/or systems in the Agrément Certificate; hence it is in the process of developing criteria for the verification of these claims. These can include recycled content, carbon emissions, recyclability, embedded and operating energy, responsible sourcing or manufacturer’s commitment such as compliance with ISO 14001 management systems. These independent third party verifications will provide the reassurance sought by the industry that such information is reliable.

**Development of a national LCI database**

It is extremely important to use national, regional and local Life Cycle Inventory (LCI) databases to carry out accurate environmental calculations. It has been identified that the environmental databases and datasets in South Africa are very limited in comparison to other regions such as Europe, the United States or Australia. Agrément South Africa and the division of Building Science & Technology, both part of the Department of Built Environment at the Council of Scientific & Industrial Research (CSIR), have initiated a joint project to develop a national LCI database of generic environmental information of construction products, processes and systems.

**CONCLUSIONS**

The main points in this paper can be summarised as follows:

- Agrément South Africa, founded in 1969, is the only internationally recognised centre in South Africa for the assessment and certification of innovative construction products, systems, materials, components and processes.
- Agrément Certificates are awarded to products or systems that satisfactorily fulfil the assessment criteria established by Agrément South Africa.
- Assessments include an evaluation of the fitness-for-purpose of the product or system, an evaluation of compliance with the Building Regulations and an evaluation of the manufacturer’s quality system.
The technical assessment of fitness-for-purpose of innovative construction products and building systems is performance based.

Under its mandate and mission Agrément South Africa must facilitate and promote the use of innovative and non-standard construction products and systems through its certification process with the aim of contributing to the social and economic development of all South Africans.

To date Agrément South Africa has issued 430 certificates of which approximately 75% have been awarded to innovative building systems.

It is a legal requirement that houses built in South Africa must be enrolled with the NHBRC and the NHBRC normally insist on Agrément certification of all houses constructed using innovative or unconventional methods or non-standardised construction systems or products.

Agrément South Africa aims to promote the adoption and use of sustainable and innovative construction methods and products without jeopardising the quality of the end product.

The Agrément South Africa’s initiatives on sustainability are similar to the numerous international initiatives and aims to align the South African construction industry’s environmental initiatives with the worldwide trends.

REFERENCES

Agrément South Africa (2011). www.agrement.co.za


ESTABLISHING MINIMUM QUALIFICATIONS FOR HOME BUILDERS:
A COLLABORATIVE APPROACH IN BRITISH COLUMBIA, CANADA

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BACKGROUND

The mandatory licensing and home warranty insurance system in British Columbia, Canada, was developed in response to the so-called ‘leaky condo crisis’ – a systemic failure of the building envelopes of multi-unit residential buildings constructed throughout the 1980s and 1990s. BC Housing’s Homeowner Protection Office (HPO) administers the system by licensing residential builders and enforcing the legislated requirements for mandatory home warranty insurance on all new homes (with some regulated exceptions). Home warranty insurance policies benefit homebuyers and are offered by regulated insurance companies in a competitive marketplace.

The first priorities of the new system in 1998 were to establish immediate protection for consumers through home warranty insurance, and create a no-interest loan programme for owners of leaky homes who were unable to obtain conventional financing to make the necessary building envelope repairs. The licensing scheme was seen as a necessary component to control and ensure the provision of mandatory home warranty insurance. However, at the outset, a robust set of qualifications for the licensing of builders was not implemented despite the legislation anticipating the development of such qualifications.

EVOLUTION OF CONSUMER PROTECTION

After the solutions to resolve the immediate leaky condo crisis were in place and consumer confidence began to be restored, the public, government and industry identified the need to establish a system of qualifications for licensed home builders. The main qualification required by a licensee was to obtain the support of a home warranty insurance company. As insurance companies, warranty providers are proficient at analysing financial capabilities. However, the regulation permitted — but did not require — warranty providers to assess technical capability or experience. This led to sometimes inconsistent results in terms of the quality of builders approved, and was not seen as adequate protection against faulty construction practices. Warranty providers in BC are competitive insurance companies, so even if one warranty company declines or cancels a builder’s coverage, another company may accept the builder, unaware of any possible previous problems due to restrictions in information-sharing. Although consumers were ultimately protected with a strong warranty insurance policy against construction defects, prevention rather than cure was seen as the next important step in the process. Warranty providers spoke out in support of a new process that would work towards achieving a higher quality of residential construction without duplicating the warranty providers’ role. A strong proponent of mandatory qualifications was the home building industry itself, which recognised the benefits of increased professionalism to both the industry and consumers.

CONTEXTUAL CHALLENGES

In addition to the continuing focus on consumer protection, it is important to briefly outline the additional factors that make up the local context in order to understand the process to establish builder qualifications that is emerging in British Columbia. These factors are by no means unique to BC but together provide the framework within which we operate and problem-solve:

The economic importance of the residential construction industry

The construction industry made a significant contribution to strong provincial economic growth in the last decade. In 2008, it surpassed the manufacturing industry for the first time. Any changes made to regulation of the residential construction industry must be done with a view to maintaining or strengthening the industry and the efficient supply of housing to consumers. There are more than 5 000 residential builders currently licensed in British Columbia, the majority of which operate well beyond any minimum standard. With an aging population in the province and in Canada generally, it is also important to the industry that the next generation of prospective builders is encouraged to develop the skills necessary to work in the construction sector.

British Columbia’s large geographic area and relatively small population

Because of this scenario, access to services from remote areas of the province must be an important consideration in any programme. While the majority of homes and builders are located in urban areas, rural areas must be taken into account.

Focus on management competencies in the residential builders’ licensing system

Residential builders in BC are not considered tradesmen or craftsmen under the province’s Homeowner Protection Act, which sets out the regulatory framework for licensed builders. The term is broader and covers a wide range of participants whose common focus is their responsibility for the construction and/or sale of whole houses. A licensed residential builder in BC might consider themselves a general contractor, a custom or small spec home builder, a developer, a project manager or a construction manager. What these participants have in common is their overall management responsibility for the home, and their responsibility to the consumer for the quality of the home. Licensed residential builders in BC may not have the skills of a tradesperson (although many do), but they must understand the construction process well enough to be able to properly manage it and their trades if they are to be successful. Those elements will be at the forefront of any new qualifications to be required in BC.
Mobility between provinces

This is becoming increasingly important in order to allow and encourage workers to move between Canada’s jurisdictions to meet fluctuating labour demands. In Canada, each province has jurisdiction to regulate trades and professions, so the system for regulating the construction sector in each province is slightly different. Mobility agreements between provinces are still developing, and any new regulation proposed by the province of BC must be flexible, equitable and transparent to meet the requirements of mobility agreements. This can be challenging as each province is responsible for regulating trades and professions. There is currently a patchwork of regulations in place that is not fully, or even partially, harmonised in some cases.

International mobility

With low natural population growth, most provinces in Canada, including BC, rely heavily on immigration to meet workforce requirements. The most recent statistics show that 12.9% of immigrants aged 15 years or over work in the construction industry, and 29% of employees aged 15 years or over in BC are immigrants. The province’s trade policy, in particular, is also starting to shift from traditional trading partners in the US and Europe towards those in the Pacific Rim. Both of these factors have an impact on regulatory policies in terms of recognising qualifications; recognising cultural diversity; and sensitivity to the impact language requirements may have on available qualified workers.

THE PLAN

Consultation

To address the need for public and industry involvement and to ensure that new requirements did not unduly impede the ability of the industry to operate correctly, the Homeowner Protection Office embarked on a broad public consultation process in 2005 themed ‘Raising the Bar’ for builder qualifications. The results of this process validated the need for the licensing process to include builder qualifications, and an industry task force was established in 2006 to discuss and create recommendations on a system of minimum qualifications.

The task force comprised representatives from three categories, namely small home builders, developers and general contractors. It met several times over a three-year period and produced two detailed sets of recommendations. The task group recommended dividing HPO licensees into those three categories and treating each differently. There was support for establishing a system of minimum qualifications for the small home builder, defined as builders of one to four dwelling units per building. However, developer and general contractor representatives argued that increased regulations were unnecessary for larger residential buildings constructed by them due to the system of professional oversight in place under the building code. The consensus recommendations that resulted from the task group discussions included:

1. Minimum qualifications for small home builders, including continuing professional development requirements as a condition of licence renewal;
2. Minimal new requirements for developers, essentially comprising the provision of additional information to the HPO about their business plans; and
3. The deregulation of general contractors working for developers on larger (i.e. more than five dwelling units per building) residential projects.

The government decided to move ahead with minimum qualifications for the home builder group, which had strong support from the BC chapter of the Canadian Home Builders’ Association. In 2007, amendments to the governing legislation (the Homeowner Protection Act) included the establishment of a stronger framework to allow the HPO to administer minimum qualifications.

In 2010, an industry-led institute known as the Professional Builders’ Institute of BC (PBIBC) was created and funded by the BC government through the HPO to work with BC Housing on implementing and administering a new system. Work also started to create the regulations necessary to implement the new system.

Identifying competencies

In addition to the increased professionalism sought by the industry and enhanced consumer protection, identifying competencies and a means to obtain them provides an important opportunity to set a clear career pathway for newcomers to the sector.

As mentioned previously, the role of the licensed residential builder in BC requires an emphasis on management competencies in addition to technical knowledge. By increasing the level of management skills in the sector in the future, along with more traditional technical knowledge, there is an excellent opportunity to increase both productivity and quality in the next generation of builders. These two general areas are complemented by the work done so far by the national Canadian Home Builders’ Association in identifying 11 benchmarks considered critical for a successful residential builder in Canada:

1. Business planning and management
2. Human resource planning and management
3. Marketing and sales
4. Financial planning and management
5. Project management and supervision
6. Legal issues in housing
7. Building codes
8. Construction technology
9. Safe work practices
10. Customer service
11. Communications

It is expected that, through the relationships established between government and industry, the development of specific competencies as well as the adjustment to those competencies over time, will continue. This collaboration between government and industry will draw on industry’s technical expertise and government’s responsibility to protect the public interest, including consumer protection and housing availability.

COMPETENCY EVALUATION

The approach to evaluating the new competencies will be critical to the success of the system, both in terms of licensee acceptance and actual results. The HPO is currently working closely with the industry institute to develop policies and processes that meet our needs and address some of the challenges noted previously.

Existing home builders

The industry task group proposed to government that current licensees in the home builder category be deemed qualified without having to undergo an assessment upfront. However, it is proposed that existing and future licensees undergo annual, continuing professional development in order to retain their licence. It is also proposed that a residential builder may lose their licence or have licence conditions imposed if a review of their business activities (perhaps prompted as a result of a complaint) results in an objective assessment that the licensee is not proficient, to the required standard, in one or more areas of competency. Thus, the existing licensees’ businesses would be minimally disrupted provided they continued to operate to the minimum qualification standard prescribed by regulation. Most builders who do not meet the standard would have an opportunity to upgrade their skills and continue working in the sector. Although lifelong learning requirements are fairly typical of any regulated profession, some existing licensees may need to be convinced of the value of any new requirements. The key to successful implementation will be simplicity and flexibility.

New home builders

It is important that new home builders applying for a licence have a clear career path and assessment model available to them. The industry task group proposed the use of a competency-based framework, where there would be a variety of accredited programmes available to achieve qualification and the inclusion of work experience requirements in the assessment.

However, it is recognised that in residential construction, individuals and companies obtain expertise through a wide variety of experiences. Both the industry and government agree that those experiences should be captured and recognised in a flexible and straightforward way.

Prior learning assessment

One of the key recommendations proposed by the industry task force was the establishment of a prior learning assessment and recognition (PLAR) process for the evaluation of home builder applicants for licensure. The adoption of PLAR is critical to meeting our needs in terms of inter-provincial and international mobility. Given our immigration patterns and inter-provincial movements, an evaluation based on PLAR may ultimately be a more common method of obtaining licensure than through a traditional knowledge, skills and experience model.

PLAR was originally a process used by colleges and universities globally to evaluate learning acquired outside the classroom for the purpose of assigning academic credit. It is now being used more extensively to evaluate learning through education, experience and examination in diverse employment sectors, including the construction industry. Most professions in Canada and around the world are now grappling with the assessment of international credentials in some way. PLAR terminology varies from country to country and is also referred to as acquired prior learning (APL) in the UK and as recognition of prior learning (RPL) in the Netherlands. In many European Union countries, as well as in the UK and Australia where promoting cross-border recognition and mobility in the employment sector is necessary, PLAR has been implemented for its flexibility, transparency and fairness.

The HPO and the industry institute are investigating various models for PLAR. The first step was an investigative research report to determine the existence of PLAR programmes in the building/construction sector or related industries in Canada. However, with only two other provinces in Canada currently licensing residential builders; neither using PLAR; and much of the construction industry trades being unregulated, the study found that the results for any form of acquired learning assessment and recognition were limited to some initial policy development work within the regulated construction sector in Canada.

Further research focused on Europe and Australia and found that PLAR related programmes had been developed and implemented in the UK, the Netherlands, a number of European Union countries, Australia and at the international level by UNESCO. Some of the advantages of PLAR are that it is equitable and flexible, and promotes a positive learning culture where the equivalency obtained through the process is not considered inferior to traditional assessment methods. Online methods of evaluation can be used, making it ideal for remote areas to participate. Some of the drawbacks are that the process and language used (which can be laden with acronyms) may be overly complex. PLAR looks at experience and demonstration of competency through methods such as practical assignments, interviews and reviews of evidence portfolios containing relevant certificates, witness statements, job documents and reports, videotapes and photographs of projects.
Other lessons learnt are that a successful PLAR process requires buy-in from stakeholders (both builders and consumers); an effort to raise awareness; a rigorous but fair assessment process with minimal bureaucracy and clear information; and adequate support to applicants. Results need to be clearly defined and guaranteed (i.e. objective rather than discretionary), and assessors must be competent, impartial and independent.

CONCLUSION

In developing a strategy to increase the professionalism of residential builders in British Columbia, a strong collaborative approach has been taken. We are focusing on meeting the opportunities and challenges inherent to our province, such as workforce development and labour mobility needs. Fortunately, most of our challenges are not unique and much can be learnt from other jurisdictions and applied to our situation. In turn, our experiences can be shared and our processes improved upon. It is, perhaps, an ideal opportunity to partner within our sector and across other sectors and jurisdictions to solve common problems.
ABSTRACT

This paper describes the development and test results of lightweight, cold-formed section, portal-frame structures for use in small-span building construction. It is expected that these structures will offer a new approach to the development of buildings for industrial, residential and agricultural applications. With suitable structural forms, components and joints, appropriate structural systems are designed which will embody all the advantages of cold-formed sections. All frame components are simple to assemble and erect with minimum scaffolding. Such a simple structure will offer owners the opportunity to construct their buildings with minimum professional help.

INTRODUCTION

Significant demand for steel-framed houses exists in South Africa and the rest of the region. Steel-frame buildings offer several benefits compared to conventional buildings. A house frame made of steel cannot be surpassed in terms of quality by any building material. Steel frames are manufactured to pre-determined high quality control standards, adhere to strict dimensional tolerance, making it easy to achieve first-class interior finish, and are free from attack by termites, dry rot or borers. The frames are easy to transport, store and erect, and can be handled with ease by a few people. These systems can also be assembled in wet conditions, unlike timber and concrete. Completion of a steel-framed structure is normally 20% faster than traditional building. Since strength-to-weight ratio is high, superstructure loads are reduced thus bringing down the cost of foundations. In addition, steel is a reusable resource.

Numerous structures have already been successfully built in South Africa and house a great variety of enterprises. Some of these systems are briefly described below:

The Mobi-kaya

The Mobi-kaya, developed by G Lombard and manufactured by Apollo Steel (Steel Construction, 1991a) for low-income housing, is a factory-built galvanised steel unit, which may be transported to site for immediate occupation. Each Mobi-kaya is manufactured on a fully welded steel chassis. The framework consists of 50x50mm tubular square sections, formed from 0.6mm, galvanised sheet metal. These are filled with lightweight concrete to give the unit a sturdy structure. The infill panels are made from 300U panelling, which consists of 0.6 galvanised external sheets and a Duffaylite insulating panel with gypsum internal panels. Individual units are joined together to form larger structures for use as site buildings and schools. In 1991, factory built, galvanised steel houses were being produced at the rate of 20 houses per month.

The Symodule

The Symodule, developed by Abacus Technologies (Pty) Ltd and manufactured by the Symo Corporation (Steel Construction, 1991b), consists of pre-fabricated interlocking steel-clad panels, with gypsum interior panels, fitted to a framework which incorporates the roof trusses, and is built onto a cast concrete slab or steel-base frame. Various configurations are available to suit individual demand. The system is suitable for a variety of applications, including construction site offices, agricultural buildings, single-storey houses, spaza shops, double-storey houses, schools, offices, university laboratories and clinics. In 1991 Abacus Technologies supplied accommodation modules for 1 200 workers at Sun City’s leisure development.

Kit-of-parts concept

The Kit-of-parts concept steel-framed housing system was developed by Improhome and is manufactured by Hennwill Engineering (Steel Construction, 1992). Fabrication of the kits takes place in a workshop environment while the components are assembled on site. A unique feature of the concept is the pre-assembly of window and door components in three-dimensional units, which are situated at the corners of the dwelling. The units are manufactured from specially rolled cold-formed sections bolted together on a concrete ground beam. No roof trusses are used as the roof sheeting is continuous over the centre cranks, spanning as a pinned arch.

Balaton Building System

The Balaton Building System, developed and manufactured by the Iscor subsidiary Balaton Holdings (Steel Construction, 1995) is a modular hot-rolled steel framework which is bolted together on site and then filled in with conventional, non-load bearing, single skin brick walls or wall panels. Columns and rafters are IPE 120x64mm and 160x82mm sections, while purlins are 60x60x6mm hot-rolled angles. The basic module of the system is 3m long and either 7.23m or 6.23m wide. Any size structure can therefore be erected in multiples of the rectangle produced by these dimensions. This system is well suited to structures such as houses, classrooms, community halls, storage facilities and utility buildings. Some 300 schools and about 150 houses were constructed using this system in the then Northern Transvaal before 1995. Frames for 200 houses were also supplied by Balaton to the Namibian government at a cost of US$125 700.

Light steel-frame building

The Southern African Institute of Steel Construction (SAISC)’s light structures division (Southern African Light Steel Frame Building Association, SASFA), has developed a light steel-frame building (LSFB) industry in South Africa, with a view to creating a viable export business in the region.
Light steel-frame building consists of frames and roof trusses, manufactured from cold-formed light gauge galvanised steel sections. Exterior cladding can consist of a single skin brick wall or fibre cement board, fixed to the wall frames. Services — electricity and plumbing — are installed in the wall cavity created by the light steel frames, as is the insulation material. Gypsum board, fixed to the light steel frame, is typically used for internal wall cladding and ceilings. While this method of building has been used in many leading countries such as the United States, Europe, Australia, and New Zealand for decades, it has only recently been introduced and accepted in South Africa.

**Growth of the LSFB industry**

The key to the success and rapid growth of LSFB worldwide lies in a seamless interface between computer-based design and the computer-controlled manufacturing facilities. Advantages of LSFB compared with conventional building include time saving of up to 30% when compared with conventional building, and a mass saving of up to 90% compared with a double-skin brick wall, and an extra 4% floor space owing to reduced thickness of external walls. Thus, while the materials in themselves may not be less expensive than bricks and mortar, there are savings to be made in the construction process and, of course, the quality of the entire structure ends up significantly better than a conventional one.

The fact that these systems have been used successfully in low-cost housing and other structures confirms the acceptance of lightweight steel-framed buildings. Rural housing construction can be accelerated in many cases by the use of steel-framed classrooms, offices and houses. Hollow concrete blocks can be made on site and used to fill in an existing steel frame. This method was used extensively in Zimbabwe just after independence to expedite the education programme.

**Proposed structures**

The proposed structures are lightweight, portal frames that can easily be fabricated and constructed without using sophisticated machinery. The structures are to be erected mainly by unskilled labour, using only site aids such as lightweight scaffolding, ladders and spanners. Thin sections are used so that the members can be lifted into position. The rafter and column members are formed from single channel sections, which are bolted, back-to-back at the eaves and apex joints, and connected to the foundation through angle irons. The spans of the frames investigated ranged from 5m to 14m, with a constant eaves height of 3m and a pitch of 10°. The portal frames will be delivered to site in sections cut to length and with connection holes pre-punched at the factory as part of the manufacturing process. The investigation shows that cold-formed steel portal frames can be a viable alternative to traditional hot-rolled I-sections, especially for spans less than 15m. The product developed in this investigation provides greater flexibility in structural composition without the requirement of a sophisticated workshop, employing only standard commercially available cold-formed steel profiles. A typical frame built from a 300x75x20x3 cold-formed channel (SAISC, 2005) is shown in figure 1 and the corresponding connections are given in figure 2.

The base connection shown in figure 2(a) is made relatively simply by connecting an angle cleat to the flanges of the channels (two bolts on each side) and the foundation (one bolt on each side). Since the effect of the moment is far more influential than axial load in determining the size of the base and holding down bolts, the size of the angle cleats is estimated based on a proportion of the eaves’ moment of resistance (i.e. 50% of the eaves’ moment capacity). The tensile force required to maintain equilibrium is provided by the holding down bolts. The action can be considered analogous to that in a reinforced concrete beam, the bolt in this case corresponding to the steel reinforcement.

![Figure 1: Portal frame](image)

![Figure 2: Portal frame connections](image)
TESTS

A comprehensive testing programme is carried out to determine the performance of the structures. Particular attention is paid to the strengths (resistance to moment), modes of failure and possible plastic behaviour of the joints. Full-scale testing of the portal frames is abandoned because of the associated complexity and cost. The investigation focused on the eaves joint since this is the region of greatest moment under vertical downward loading. Vertical downward loading is frequently the critical load case for low-rise structures in South Africa and the rest of the Southern African region. The eaves region represents the portion on the bending moment diagram in a complete portal frame of known dimensions and loads from the knee joint to the point of contraflexure on either side of the joint. Variables in the tests include the number and size of bolts in the connection, the points of contraflexure, the width of the channel flanges, the strength of the channels and the extent of continuity of the purlins. A list of these variables and the corresponding structures are given in Table 1. The ends of the members are jacked together, simulating real loading on a portal frame joint, using a hand operated jack (see figure 3).

Table 1: Variables in the structures

<table>
<thead>
<tr>
<th>Structure</th>
<th>Frame section</th>
<th>No of bolts</th>
<th>Size of bolts</th>
<th>Angle section</th>
<th>Eaves-inflexion distance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Column</td>
</tr>
<tr>
<td>Structure 1</td>
<td>300x75x20x3</td>
<td>4</td>
<td>M20</td>
<td>100x75x6*</td>
<td>1500</td>
</tr>
<tr>
<td>Structure 2</td>
<td>300x75x20x3</td>
<td>8</td>
<td>M20</td>
<td>100x75x3</td>
<td>1500</td>
</tr>
<tr>
<td>Structure 3</td>
<td>300x65x20x3</td>
<td>4</td>
<td>M16</td>
<td>100x75x3</td>
<td>2000</td>
</tr>
<tr>
<td>Structure 4</td>
<td>300x50x20x3</td>
<td>4</td>
<td>M16</td>
<td>100x75x3</td>
<td>2000</td>
</tr>
</tbody>
</table>

* Mild steel angle section

Figure 3: Test set up

The tests demonstrate the considerable ductility that is achieved in the back-to-back bolted connections, which should be sufficient in many cases to accommodate plastic analysis of the portal frames (Dundu & Kemp, 2006a). In this project adjacent column and rafter channels are oriented in opposite directions to take advantage of the counter-balancing moments and forces in the back-to-back connections. This system is important in enhancing the lateral buckling strength of the channels. Three modes of failure were observed (Dundu & Kemp, 2006b) namely: local buckling of the compression zone of the flange and web of the channels, lateral torsional buckling of the channels between points of lateral support and bolts in bearing. The source of failure in all structures was local buckling of the compression flange and web. This occurred after considerable rotation of the channel sections within the eaves connection. Local buckling was made more critical by stress concentrations, shear lag and bearing deformations caused by back-to-back bolted connections.

Although the longer leg (rafter) did not ultimately fail due to lateral-torsional buckling there was considerable lateral movement and twisting of the leg. This was more evident in frames with narrower channels (structures 3 and 4) and where the points of contraflexure were moved further away from the eaves connection (structures 2, 3 and 4) to promote lateral-torsional instability. Structures 1, 3 and 4 showed considerable bolt-bearing distortion around bolt-holes. This type of failure was more pronounced at the inside lower bolt-hole, where bolt-holes were distorted significantly. Bearing deformation of bolt-holes is important in that it provides the required ductility necessary for moment redistribution.

An innovative method is proposed for connecting the purlin to the rafter/column (Dundu & Kemp, 2006a). The frame is restrained laterally and torsionally by the purlins through a cold-formed angle, connected to the web of the frames, shown in figure 4. This removes the idea of having fly-bracings, as is normal practice to reduce torsional instability. Importantly with this system, tests were carried out with the real purlin-rafter connection in place, unlike many previous tests where the knee joint was tested horizontally on the floor with arbitrary restraint systems. Experiments have shown this system to be capable of restraining the frames from failing due to lateral-torsional buckling.
Recent tests have shown that the base connection in figure 2(a) is also capable of transferring the load from the column into the foundation (Dundu & Kemp, 2008; Dundu & Maphosa, 2010).

**SERVICEABILITY**

It is imperative that an analysis at the serviceability limit state be carried out to check deflections at both eaves and apex. Although the service loads are notably smaller than the ultimate loads on a structure, the magnitude of deflections of a structure under service loads may be as important a design consideration as the strength of a structure under ultimate loads. The check is required, not only to ascertain whether deflections are excessive, but also as a check to ensure that the deflections and accompanying frame movements can be accommodated by the building envelope without undue cracking of any brick or tearing of metal cladding sheets at fixed positions.

The South African standard (SANS 10160, 1989) gives a gravity load for the serviceability limit state as 1.1DL + 1.0LL. For cold-formed steel sections under bending, it is generally accepted that the relationship between load and deflection can be assumed to be linear for loads up to 80% of the ultimate load (Lim, 2001). Since serviceability loads (73% of ultimate loads) are less than 80% of the ultimate load, it is justifiable to use elastic frame analysis to determine the deflections. Based on the serviceability loading combination given above an elastic analysis of the three frames was carried out using PROKON software to determine the theoretical eaves and apex deflections. The deflections obtained from this software are given in tables 2 and 3.

Limits of deflections were taken from the literature, Eurocode 3 and SANS 10162-1 and are also reflected in Tables 2 and 3. Although the limits in the Steel Construction Institute (SCI, 1991) document are for both live and wind loads, the limits are compared to the combination of loads applicable to South Africa and the rest of Southern Africa. The recommended limits that are provided by SANS 0160 and 0162-1, for horizontal deflection of vertical members and vertical deflection for members supporting elastic roof cladding are storey-height/100 and span/180 respectively. Eurocode 3 provides more stringent deflection limits of h/150 and L/200 for horizontal deflections at the top of portal-frame columns without gantry cranes and vertical deflections of roofs respectively. Applied eaves deflections are compared to absolute deflection limits only since the bay spacings are equal. All deflections for the three frames are found to be within the limits provided in the literature and by the two codes.

**Table 2: Deflection of frames and deflection limits obtained from literature**

<table>
<thead>
<tr>
<th>Frame</th>
<th>Channels</th>
<th>Calculated deflection (mm)</th>
<th>Deflection limits of the eaves (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Eaves</td>
<td>Apex</td>
</tr>
<tr>
<td>1</td>
<td>300x50x20x3</td>
<td>4.05</td>
<td>23.73</td>
</tr>
<tr>
<td>2</td>
<td>300x65x20x3</td>
<td>4.89</td>
<td>28.61</td>
</tr>
<tr>
<td>3</td>
<td>300x75x20x3</td>
<td>6.06</td>
<td>35.36</td>
</tr>
</tbody>
</table>

**Table 3: Deflection of frames and deflection limits obtained from codes**

<table>
<thead>
<tr>
<th>Frames</th>
<th>Channels</th>
<th>Calculated deflection (mm)</th>
<th>Deflection limits of the eaves (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Eaves</td>
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<td>3</td>
<td>300x75x20x3</td>
<td>6.06</td>
<td>35.36</td>
</tr>
</tbody>
</table>

**CONCLUSION**

The investigations showed that cold-formed steel portal framed buildings can be a viable alternative to traditional building structures, especially for spans less than 15m. The product developed provides greater flexibility in structural composition without the requirement of a sophisticated
workshop, employing only standard commercially available cold-formed steel profiles. A comparison of the theoretical eaves and apex deflections of the three frames and the deflection limits provided in the literature (Woolcock & Kitipornchai, 1986) and the two codes of practice (Eurocode 3, 1996; and SANS 10162-1, 2005) show the applied deflections to be much smaller than the deflection limits. The deflected limits suggested are, by their nature, likely to be conservative. In practice, designers rely on their experience when deciding on the deflection limits of a portal frame.

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A SOLUTION TO INCREASING HOMELESSNESS IN METROPOLITAN CITIES

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ABSTRACT

Delhi, the capital city of India, began contemporary comprehensive planning in the 1960s through the integrated Master Plan for Delhi (MPD) in an effort to meet current and future developmental challenges. The document is modified every two decades, with the current plan being MPD-2021. This plan sets out the vision to make Delhi a ‘global metropolis and a world-class city’ and was named a Project of Excellence by the International Society of City and Regional Planners, Netherlands (ISOCARP) in 2008.

Delhi currently has a population of 17 million people – a figure that is expected to grow to 23 million people by 2021. The city has a sizeable population of lower income earners (55%), of which about 35% are classified as economically weaker section (EWS) citizens who are unable to afford any kind of shelter.

This challenge is being addressed in a number of ways. These include cross-subsidising land and construction costs using land as a resource; redeveloping pockets of land that have been encroached on by squatters; rehabilitating this land through planned developments; and constructing night shelters for the homeless through public agencies.

BACKGROUND

Generally the level of urbanisation within a country corresponds with its economic development, as measured by gross domestic product (GDP) per capita. To this end it can be said that urbanisation – though a long-term process – actually transforms a country’s economy as it moves from a rural to an urban base. Experience indicates that this level of urbanisation, which fluctuates in developing countries, will steadily increase as per projections, leading to high concentrations of urban populations in and around metropolitan areas.

India is emerging as a powerful urban economy in the global context, with a particular shift in GDP contribution from agriculture to industries within the secondary and tertiary sectors. Due to this high economic growth and low urban base, cities are growing rapidly. India currently has the second largest urban system in the world, with 310 million urban people and 5161 cities and towns. Forecasts are that by 2011 urban areas could contribute as much as 65% of GDP and that by 2021, the share of urban population could reach 40%. The availability and quality of basic infrastructure, therefore, will be key in sustaining this growth. Assuming current trends in population growth and migration continue, India’s urban population is expected to reach 575 million people by 2030. A number of factors are responsible for such urban population increases. These include natural population increases, which reflect the demographic momentum/population force; net migration, which is relatively proportionate to potential economic growth; changes in classification due to encroaching, surrounding urban centres; and the extension of the urban boundaries of cities into rural hinterlands.

According to India’s 2001 census, the number of million-plus cities – those cities with populations of a million or more inhabitants – almost tripled from 12 to 35 between 1981 and 2001. About 37% of the total urban population lives in these cities, which continue to grow rapidly. While the level of urbanisation in India is still low compared to many other developing countries, urbanisation here is often described as over-urbanisation due to the virtual collapse in urban services that accompanies this growth.

Urbanisation in India is as a result of the increasing population, migration due to poverty, and the scenario of urban pull/rural push. Unprecedented increases in urbanisation are largely focused around the cities of Delhi, Mumbai, Bangalore, Chennai, Hyderabad and Kolkata. These cities are characterised by widespread poverty, poor urban infrastructure and environmental degradation. Less than 60% of households in these cities have access to sanitation facilities, less than half have tap water, and it’s estimated about one third live in slums. The urban system has become distorted due to the significant clustering of large-sized settlements, and the disproportionate distribution of these settlements nationally.

HOMELESSNESS IN DEVELOPING COUNTRIES

Homelessness is a major challenge for India. Scarcity employment opportunities due to technological advancement; a lack of skills; under-employment; limited jobs in the tertiary sector; the high cost of land; high living costs; and limited, if any, access to financing institutions all contribute to this situation.

Despite their growing prosperity, countries like China, India, Thailand, Indonesia and the Philippines face mounting challenges on this front as a result of migrant workers who battle to secure permanent homes. It’s estimated around 600 million people live in life- and health-threatening homes in Asia, Africa and Latin America.

The burgeoning population in Indian cities has put housing, and space for housing, under pressure, with slums having now become an inevitable part of major cities. In absolute terms, the amount of people living in slums in the cities has increased from 30 million to 47 million people. The slums of Delhi house 2.4 million people, accounting for 28.6% of the city’s entire population.
AFFORDABILITY OF EWS AND THEIR CAPACITY BUILDING

The migration of the rural population is over-burdening the already stressed infrastructure of cities. This, combined with these urban areas’ inability to meet employment expectations has led to a steadily increasing informal sector that is characterised by unskilled workers, low wages, temporary employment and even the exploitation of these workers.

As such, urbanisation could be seen to be broadening the social rift and economic inequalities and to some extent, preventing the urban poor and homeless from accessing financial resources from relevant institutions. With low repayment capacities and in the absence of guarantors, these institutions remain wary of providing funds to people in this socio-economic group.

But by using land as resource and upgrading areas through the construction of in-situ developments (constructed on-site, in the slums), the Indian Government plans to provide low cost housing to the homeless and at the same time, fulfil its objective of ridding the country of slums. These developments comprise blocks of flats, where each flat is a minimum of 28 square metres. The flats are made available to the homeless through low, cost-effective loans and are not permitted to be transferred or sold for seven years from the date of allotment without government’s permission.

CASE STUDY OF DELHI, INDIA

As the national capital, people from both the region immediately surrounding the city and from across the rest of the country are constantly drawn to Delhi. Because of this, planning has not been limited to within the city’s administrative boundaries. There is a virtual urban continuum between Delhi and the surrounding rural and urban areas that lie in other states, such as Uttar Pradesh and Haryana, which have their own controls on land and land use. With the imperatives of growth and development, Delhi’s problems have become complex – which can be viewed as both a challenge in terms of the pressures of regular and floating in-migration as well as an opportunity in terms of planning and development in a regional context.

Delhi is one of the 15 major urban agglomerations in the world. As per the 2001 census, Delhi had a total population of 13.8 million and was highly urbanised with 93.18% of its population living in urban areas against the national average of 27.81%. During the period from 1991 to 2001, the urban population of Delhi increased at an annual growth rate of 3.8%. Should this trend continue, Delhi’s projected population by 2011 and 2021 will be 18.2 million and 22.5 million people respectively. It is against this backdrop that land requirements and the provision of infrastructure and transportation for the city are being planned for a projected population of 23 million people in the integrated Master Plan for Delhi 2021.

The National Capital Territory of Delhi has been divided into 15 zones from A to H and J to P, of which eight zones are urban, one contains the River Yamuna and its basin, and the remaining six are rural. In terms of these zones, the area has the potential to accommodate a maximum of 15.3 million people. It has been suggested that the remaining population of just under 10 million people, as per the 2021 projections, will be accommodated in the proposed urban extensions.

One of the most important aspects of planned development is to make provision for housing for various income groups and in particular, economically weaker section (EWS) citizens. The quantitative and qualitative deficiencies in this regard were assessed in formulating the MPD-2021. Together with the planned development of new areas, a major focus has been on incentivising the rejuvenation of old, dilapidated areas. The plan also contemplates a mechanism for the restructuring of the city based on mass transport. At city level, a gross density of 225 people per hectare is proposed after conserving natural areas such as the River Yamuna and other water bodies, and wildlife sanctuaries.

According to the 2001 census, Delhi has 2.45 million houses that are classified residential and ‘residence cum other uses’, containing around 2.55 million households. This reflects a net housing shortage of about 100 000 units. The households are accommodated in a variety of housing types including different categories of planned, built housing; squatter settlements; unauthorised colonies; traditional areas and villages.

Based on the projected 2021 population figures, MPD-2021 estimates an additional housing requirement of about 2.4 million units. The plan also suggests that around 40% of the housing need could be potentially satisfied through the redevelopment or upgrading of existing areas in Delhi. This would be confined to the existing urban limits, with the remaining 60% of the requirement coming from 1.44 million new housing units to be constructed in new areas within the urban extensions.

The proposed housing strategy incorporates specific approaches for the development of new housing areas, and for upgrading and re-densification through the redevelopment of existing housing areas, including unauthorised colonies, villages and old city areas. Looking at the possible distribution of housing types, the future requirement of shelter provision will be dominated by small housing units. In view of the limited availability of land, plotted residential developments would be discouraged. A multi-pronged housing strategy for the provision of housing stock and for delivery of serviced land, involving the private sector as partners in development, is being proposed.
MPD-2021 provides for the restructuring and upgrading of existing areas, as a large number of these are old and characterised by structurally poor buildings; suboptimal utilisation of land; congestion; poor urban form; inadequate infrastructure services; and a lack of community facilities. The housing stock in both planned and unplanned areas could be enhanced through various approaches such as the redevelopment of old plotted/group housing and intensive development in existing low density housing areas.

For purposes of the plan, ‘urban poor’ would mainly comprise inhabitants of squatter settlements and informal service providers, such as domestic workers, hawkers and vendors, and low paid workers in the industrial, commercial and trade/business sectors. This includes both the existing population and future migrants. In terms of the city’s housing requirements, this is the single biggest challenge and requires a mix of approaches and innovative solutions.

Existing squatter settlements located on land earmarked for development are to be shifted and housed in built-up flats of 28 square metre units. Those settlements located on previously unreserved land will remain there, but will be transformed through the provision of similar 28 square metre housing units. Here the concerned implementing agency or corporate body will conceptualise schemes for collective community rehabilitation and will explore the possibility of involving private sector or slum cooperatives, with these developments being based on existing rehabilitation scheme guidelines and incentives.

Further, MPD-2021 stipulates that new housing for the urban poor should be in the form of one or two room units, developed through public and private agencies or through cooperative societies of slum dwellers. For this purpose, adequate land would be earmarked and developers would have to ensure that a minimum of between 15% and 35% of the units (in terms of two different standard measures), is constructed for the EWS category. The costs to acquire and develop the land would be borne by the rest of the project. The flats are to be constructed and given free of charge to public agencies for allotment to eligible families, whereas reserved lands are to be handed over to a designated agency that will promote housing for low income earners. The pattern of EWS housing will be oriented towards ensuring the optimal utilisation of land, in a sustainable manner. For that purpose, multistorey housing is the preferred option. Apart from the mandatory provision for EWS housing in all group housing projects or schemes, the primary responsibility for creating adequate housing stock for the urban poor will be borne by project developers.

Night shelters will be provided for beggars, with special provision being made for the homeless and women and children, including the disabled, orphans and the aged. Multi-purpose use of existing facility buildings will be allowed, with alterations being undertaken to modify the buildings into suitable shelters. To ensure the financial viability of such projects for local bodies, innovative concepts such as integrated complexes with commercial space on the ground floor and night shelters on the first floor, are being explored.

CONCLUSION

In most metropolitan cities in the world, particularly in developing countries, a large portion of the population survives in substandard environments, brought on by poor economic conditions, limited employment and little or no support from public and financial institutions. Against this backdrop, innovative approaches to housing – such as the tripartite agreement being used in Delhi – are required to improve these groups’ standards of living and ensure adequate access to civic amenities and social infrastructure.

Land can be used as a resource to cross-finance housing units by pledging the property under the tripartite agreement, and by enlisting the help of project developers and public agencies, and the financial support of financial institutions. The scheme is made more meaningful by prohibiting the transfer or sale of the properties for the first seven years. Ownership rights are preferably made in the name of the female head of household to ensure greater family stability. The properties are made even more affordable by the fact that the owners only begin to make repayments once they have taken occupation.
ABSTRACT

An interactive, accessible, web-based knowledge approach is fast becoming the new paradigm for providing affordable, professional services. Nowhere is this more necessary than in the realm of architectural service delivery and life cycle home development. This paper introduces a new service, a virtual reality smart staging tool called home vision. The paper presents the service, illustrates the building information technology used, and demonstrates the benefits of the service via a case study. Home vision is an affordable, risk management tool for homeowners and property agents and can play a key role in consumer education and protection.

STATUS QUO

South African homeowners lack easy access to affordable professional design services and coherent building information, and struggle to understand and visualise the potential of a property. A homeowner wanting to know what he can do with a property, how much it will cost and the associated process will find existing online home plan markets of little use. Design professionals simultaneously find that their services are perceived as being too expensive and as such, are bypassed. Many of these professionals are now looking for ways to create new markets for their services. Property agents, on the other hand, face a slow real estate market and new consumer protection laws. They too are looking for new ways to remain competitive and add greater value to their services.

A NEED FOR NEW APPROACHES

The challenge is to make architectural services affordable, accessible and interactive for South African homeowners. Cape Town-based HOMEVISION™ aims to create a new marketing platform for architects’ services and provide a value-added service to property agents’ existing offerings. To this end HOMEVISION™ has pioneered a unique, affordable architectural service – home vision. Home vision is an essential risk management tool and helps homeowners save money. It empowers homeowners and the development team to make informed decisions upstream in the development process, and demonstrates risk to the finance institution.

HOME VISION AS RISK MANAGEMENT TOOL

HOMEVISION™ follows an integrated system approach to home development, and has formed strategic partnerships with home development experts across the home development life cycle to assist in formulating home vision.

This knowledge-intensive product helps potential and existing homeowners explore, analyse and visualise a home’s development potential prior to buying, selling or building. Using professional architectural skills and the latest CAD technology, we develop a complete interactive information model of a house’s development potential in virtual reality.

A home vision or ‘smart staged project’ demonstrates the feasibility of a home building project in terms of the status quo, legal limitations, aesthetics, cost, energy consumption and building process.

Figure 1: The HOMEVISION™ service
Home vision is modelled on the concept of staging. According to the home staging guru Debra Guild1, “a house is a product that has to be packaged and marketed to the right target audience at the right price. Home staging will help any home stand out from the competition and sell more quickly, and at a higher price, than without staging.” A home stager presents and decorates a house to sell. HOMEVISION™ introduces virtual reality (VR) smart staging or as we call it, a home vision. A home vision speaks to a homeowner’s logic and his emotions. It contains a vision of the home's development potential – a 2D plan showing how functions could be changed; a 3D picture illustrating the renovated look; and a VR model of the house to walk through. It also includes the hard facts, such as an architects’ report on the current state of the house; information on council regulations; a preliminary quote from a reputable local building contractor; a summary report on energy efficiency; and contact details of a recommended project team that can make it all happen. Once a homeowner is satisfied with the home’s requirements, HOMEVISION™ further assists homeowners to implement their visions by developing detailed plans for approval and overseeing the building project to completion.

**Status quo inspection report**

At a staged home, buyers often wonder what is hidden behind the newly painted wall of a property on sale. Home vision allows the buyer to view the property as is (see figure 2), while also seeing its future potential.

South Africa's new Consumer Protection Act came into effect on 1 April 2011. Section 55 of the Act suggests that estate agents may be held responsible for ensuring that home buyers are fully informed regarding the condition of the property. The ‘as is’ or so-called voetstoots clause in an offer to purchase may no longer apply. This means estate agents may not be protected from the risks of non-disclosure. In effect, agents may need to provide full disclosure upfront to potential home buyers.

**Figure 2: A house in Houtbay, as is, prior to home vision by HOMEVISION™.**

HOMEVISION™ assists estate agents in this regard by outsourcing the upfront inspection to Inspect-a-home2, which prepares a full and independent inspection report of the property. Everyone in the recommended project team receives a copy of the report, which provides an honest reflection of the building as is. The architect’s vision addresses any issues to reassure the buyer.

**Regulations**

A potential buyer may think he is buying the bargain of the year, but when he eventually arrives with an architect on his dream stand, he may learn that the dunes behind his property are protected and unstable and that a 10 metre building line from the boundary is in force with six metre building lines on the sides. Further, he may be limited to a single storey dwelling and may end up with a six by six metre area to build on. A home vision ensures that such misunderstandings are avoided.

**2D architect’s plan**

A HOMEVISION™ accredited architect visits the existing house, studies the existing plan and proposes changes, which are kept to a minimum. The aim is to solve problems and improve the resale value of the house in the future. The house is designed to satisfy generic buyer requirements, for example an impressive entrance foyer, minimum three bedrooms, two bathrooms, open plan living area, laundry, double garage, entertainment veranda, light airy spaces and adequate storage. Keeping building and maintenance costs low is a key requirement. Changes are also designed to be done in phases as the buyers’ budget allows.

**VR model**

Most buyers know what they want in a house, but struggle to visualise potential. Most also struggle to read a 2D architect’s plan. A HOMEVISION™ accredited architect uses the latest building information modelling and presentation software, ArchiCAD3, to present concepts to homeowners. After studying the inspection report and council regulations, a VR home information model is built for the homeowner to walk through (figures 3 and 4).

1 www.stagingdiva.com
2 www.inspect-a-home.co.za
3 www.graphisoft.com
Preliminary cost estimate

Once the buyer knows what his future home looks like, the next question is, ‘what will it cost?’ HOMEVISION™ has established a referral partnership with cost estimators Build-Aid® to provide a preliminary cost estimate. This helps buyers understand costs upstream in the development process.

Energy efficiency report

HOMEVISION™ supports integrated project design, a key requirement for sustainable projects. All homes are designed with internationally recognised sustainable design or ‘green’ principles top of mind. To this end, and in anticipation of an SA Green Rating for Homes System, we refer to the SANS204/10400 standards; the US LEED for Homes Rating system; and the Australian Green Star Rating system as adopted by the SA Green Building Council (GBCSA) to guide our thinking. HOMEVISION™ will seek to obtain professional green accreditation from the GBCSA in 2011.

Our report on a home’s green status suggests design options for a socially and environmentally responsible home, i.e. energy and water efficiency; materials and resource efficiency; indoor environmental air quality; and maintenance solutions. We also provide an energy balance evaluation report, which summarises the home’s expected energy consumption and carbon footprint and provides a monthly energy balance graph.

Recommended project team

Finding an architect and a reputable building contractor remain challenges for most homeowners. HOMEVISION™ assists buyers to put together their ideal project team. We carefully evaluate each project and through our network of designers and building contractors, suggest a project team.

Recommended suppliers

Not only does HOMEVISION™ build a VR model of ideas to enable homeowners to visualise potential, but we also build a complete home information model. This means, for example, the kitchen cupboards in the presentation are linked to a supplier who designed the kitchen specifically for that project and who can assist with a quote and installation, immediately if required. The same holds true for the timber decks, windows, doors, roofs, furniture inside the house and lighting.

Home finance

HOMEVISION™ assists buyers and sellers to make contact with a suitable home finance partner.

CONCLUSION

A home vision presents all the necessary property information a homeowner would need to buy, sell or build, in a form that is quicker, easier and more affordable to access and interact with than conventional offerings.

HOMEVISION™ is currently investigating new markets for its service and is keen to form strategic partnerships with key industry role players in South Africa.

Our aim is to establish the proposed service as the de facto value-added home development service for South African homeowners.

REFERENCES


Küsel K & Conradie D & Holm D (2000). The Development of Web-Enabled Knowledge Based Systems for the SA building &

4 www.build-aid.co.za


LOW AND ZERO CARBON TECHNOLOGY UPTAKE IN THE NEWLY BUILD HOUSING SECTOR – A UK PERSPECTIVE

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ABSTRACT

House builders in the United Kingdom are being challenged to significantly enhance the environmental performance of the homes they produce. The government has laid down new building requirements, a key one being that all new homes will have to be carbon neutral by 2016. In response to this requirement, house builders are having to select and incorporate new low and zero carbon technologies into their products.

A number of house builders were recently surveyed to identify and explain the types of low and zero carbon technologies being used now and those likely to be used in the future. The paper reports on 61 of the responses. The results of the survey showed that solar technologies (solar photovoltaic systems and solar thermal hot water systems) were the most common. Their frequent selection appears to be influenced by their high degree of compatibility with current house designs and production techniques.

INTRODUCTION

In 2006 the United Kingdom (UK) Government launched the Code for Sustainable Homes (the Code), with the objective of reducing the carbon emissions of all new residential buildings to an as of yet undefined ‘zero’ level by 2016 (DCLG, 2006). This is part of the government’s endeavour to meet its legally binding targets of reducing CO₂ emissions by 50% (compared to 1990 levels) by 2050 (DECC, 2008).

The Code presents significant, systemic, technical and organisational challenges for housing developers. To meet the higher performance requirements, developers are producing various combinations of innovative fabric and low and zero carbon energy solutions. The focus of this paper is to present the interim findings from an Engineering and Physical Sciences Research Centre (EPSRC)-funded collaborative project between the Zero Carbon Hub, the National House-building Council (NHBC) Foundation and the University of Reading. The first phase of this project was to develop a more detailed picture of the types of Low and Zero Carbon (LZC) technologies being selected by UK housing developers, and their experiences in integrating these technologies into their homes.

The interim findings, based on a survey of 61 housing developers, show that solar photovoltaic (PV) and solar hot water systems are the most commonly used LZC technologies. The principal rationale for the selection of these technologies appears to be that they offer integration advantages, relative to other technologies, because they are more compatible with current design and production processes. This emergent technological trajectory, therefore, appears to be driven by incremental innovation considerations rather than whole-life cycle energy efficiency and maintenance concerns.

This paper is structured as follows: first, the Code is briefly described with a particular focus on the requirements that are fuelling the need for low and zero energy solutions. Then the idea of incremental and radical innovation is offered as a framework to collate and understand the results. This is followed by a description of the survey methodology that was used and the key interim findings. Finally, conclusions are drawn, along with future research directions.

CODE FOR SUSTAINABLE HOMES

The Code lays down a path for homes that conform to higher levels of performance, with the energy requirement enforced through a progressive increase of relevant parts of the building regulations. The Code is performance-based and assesses houses against nine areas (DCLG, 2010) namely energy/CO₂; pollution; water; health and wellbeing; materials; management; surface water run-off; ecology and waste.

The Code uses a 6-star or level rating system, with each level having a point threshold that must be reached. How developers achieve the threshold is flexible, but there are minimum standards for each of the Code levels in the areas of energy/CO₂, water and materials. These levels are indicated both as a percentage reduction on Part L (conservation of fuel and power), 2006 Building Regulations (DCLG, 2008), or target emission rates, and as an absolute carbon compliance limit (ZCH, 2011), as shown in table 1. In the UK, compliance with building regulations is mandatory. Current 2010 Part L Building Regulations satisfy up to, and including, level 3 of the Code relating to CO₂ emissions.

Table 1: CO₂ emission reduction targets as set out in the Code relative to the target emission rate based upon 2006 Part L Building Regulations.

<table>
<thead>
<tr>
<th>Code level</th>
<th>Minimum percentage reduction in dwelling emission rate over target emission rate</th>
<th>Carbon compliance (kgCO₂/m²/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (★)</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Level 2 (★★)</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Level 3 (★★★)</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Level 4 (★★★★)</td>
<td>44</td>
<td>14</td>
</tr>
<tr>
<td>Level 5 (★★★★★)</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Level 6 (★★★★★★)</td>
<td>Zero carbon home</td>
<td>-20</td>
</tr>
</tbody>
</table>
Level 5 refers to a dwelling that has zero regulated CO₂ emissions (space heating, lighting, white goods etc.) while level 6 refers to a dwelling that actively mitigates the regulated emissions plus those from the unregulated ‘plug load’ (i.e. televisions, radios, computers etc.).

INNOVATION IMPLICATIONS OF THE CODE

The UK housing sector is highly concentrated, with large-volume developers basing their business models on relatively standardised procurement, design and production routines. Compliance with the Code requires new solutions that could well conflict with developers’ well-established practices. This is causing uncertainty among housing developers and brings into sharp focus the question, ‘how do developers respond to the Code in an effective and efficient fashion?’

One major aspect of uncertainty surrounding the delivery of new low carbon homes is the selection, incorporation and use of LZC technologies. Developers are currently unsure of which technologies are likely to become dominant across the housing sector and therefore, legitimate in the eyes of key role players such as planning authorities and home buyers.

Dominant technologies emerge through the interplay between radical and incremental innovation (Tushman and Anderson, 1986). Incremental innovation tends to be the gradual development of performance and/or cost features of an existing technology that builds upon the skills and competencies that exist within housing developers and their supply chains. In contrast, radical innovation brings a whole new technology to bear with significantly changed performance and/or cost attributes that often require new skills and competencies. The Code’s energy/CO₂ requirements demand the use of LZC technologies, which may necessitate radical innovation within housing developers.

Housing developers face a number of scenarios that are, as of yet, not fully clear. The least disruptive scenario is for developers to ‘bolt on’ new LZC technologies to mainly unchanged housing designs (incremental innovation). The most disruptive would be an introduction not only of new LZC technologies, but a significant change in developers’ overall business models, designs and production processes (radical innovation). It is this broader innovation perspective that underpinned the design of the survey methodology described in the next section.

SURVEY METHODOLOGY

A web-based survey approach was used. The design of the survey was based on Rogers’ (1995, p.14) criteria for the uptake and diffusion of new technologies. These criteria were:

- **Relative advantage** – the degree to which a given LZC technology is perceived by the housing developer as being better than other LZC solutions.
- **Compatibility** – the amount to which an LZC technology is perceived as consistent with the housing developer’s existing capabilities and the needs of potential users.
- **Complexity** – the level to which an LZC technology is perceived as relatively difficult to understand and use compared to other LZC solutions.
- **Trialability** – the extent to which an LZC technology may be experimented with on a limited basis compared to other LZC solutions.
- **Observability** – the degree to which the results or benefits of an LZC technology are visible to others compared to other LZC solutions.

The survey contained both open and closed questions to establish the current use of LZC technologies. For the purposes of this survey, LZC technologies were defined as any technologies, additional to the fabric of the building envelope, that generated or recovered energy. The LZC technologies selected for this study were those identified in the NHBC review of microgeneration and renewable energy technologies (NHBC, 2008). The effect of site type (greenfield, brownfield and conversion); dwelling type (house, apartments and mixed); and the location on which technologies were selected, were all questioned. A series of questions underpinned by Rogers’ criteria was then asked to interrogate each of the technologies. Finally, respondents were probed on what they felt the future LZC technological trajectory would be.

The sampling strategy aimed to gather opinions of industry experts, as they are the most likely role players to guide which LZC technologies are adopted into the mainstream. This approach has the strength of providing robust insight into the use of these technologies. The output from the survey does not give a statistic representation of the sector.

The survey was distributed to those people on the NHBC membership list who had registered for the council’s e-news bulletin and who had expressed an interest in sustainability. This paper reports on the first 61 replies of this ongoing work. The survey captured a wide range of views from different parts of the sector, including large and small housing developers (both in terms of number of employees and units built per year); different regions in the UK; different job roles; and different seniorities. Respondents participated through self selection. This sampling strategy has the potential weakness of not being representative of the wider population but is suitable, in cases like this, for exploratory research.

FINDINGS

Interim findings are reported in this paper and are limited, therefore, to emerging key themes.

TECHNOLOGY SELECTION AND SITE TYPE

Solar-based technologies were identified as the most common solution across greenfield, brownfield and conversion sites. A greenfield site was defined as undeveloped, virgin land; brownfield as land that previously had been developed (where any existing structures would be or would
have been demolished prior to redevelopment); and conversion sites as land that contained an existing building (i.e. a warehouse, barn or church) where redevelopment would include retention and reuse of part of the existing structure. Table 2 shows the percentage of house builders who used each technology for a given site type. Only those who develop on a particular site type were given an opportunity to answer for that type, so the number of responses (n) is given.

Table 2: Percentage of developers who use an LZC technology on a given site type.

<table>
<thead>
<tr>
<th>Low or zero carbon technology</th>
<th>Greenfield (n=37)</th>
<th>Brownfield (n=48)</th>
<th>Conversion (n=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass systems</td>
<td>30</td>
<td>29</td>
<td>25</td>
</tr>
<tr>
<td>Solar photovoltaic systems</td>
<td>68</td>
<td>71</td>
<td>63</td>
</tr>
<tr>
<td>Solar hot water systems</td>
<td>65</td>
<td>79</td>
<td>63</td>
</tr>
<tr>
<td>Wind power systems</td>
<td>5</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Ground source heat pumps</td>
<td>38</td>
<td>35</td>
<td>29</td>
</tr>
<tr>
<td>Air source heat pumps</td>
<td>49</td>
<td>48</td>
<td>33</td>
</tr>
<tr>
<td>Absorption heat pumps</td>
<td>0</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Small-scale hydroelectric systems</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Micro combined heat and power systems</td>
<td>8</td>
<td>21</td>
<td>29</td>
</tr>
<tr>
<td>Renewable combined heat and power systems</td>
<td>14</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Fuel cells</td>
<td>3</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Heat recovery (i.e. mechanical ventilation and heat recovery – MVHR)</td>
<td>43</td>
<td>56</td>
<td>50</td>
</tr>
</tbody>
</table>

Solar photovoltaic (PV) and solar hot water systems were the most common solutions across all three site types with approximately two thirds of developers using them. Heat recovery systems and air source heat pumps were moderately common with around half of the developers using them.

To establish how ‘radical’ LZC technologies were perceived to be against standard designs, each of the respondents was asked how much they agreed with the following statement: ‘We would have to change the way in which we design our homes a great deal to incorporate this technology.’ Agreement (or not) was ranked on a five point scale from agree to disagree. Table 3 presents this data. Disagreement with this statement indicates that the respondent believes that the technology is compatible with current designs. Agreement indicates the respondent believes it is not compatible.

Table 3: Number of responses indicating each technology’s compatibility with current design approaches.

<table>
<thead>
<tr>
<th>Low or zero carbon technology</th>
<th>Disagree</th>
<th>Somewhat disagree</th>
<th>Neither agree or disagree</th>
<th>Somewhat agree</th>
<th>Agree</th>
<th>Do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass systems</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>15</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Solar photovoltaic systems</td>
<td>12</td>
<td>12</td>
<td>3</td>
<td>13</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Solar hot water systems</td>
<td>13</td>
<td>12</td>
<td>5</td>
<td>11</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Wind power systems</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>9</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Ground source heat pumps</td>
<td>5</td>
<td>7</td>
<td>6</td>
<td>14</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Air source heat pumps</td>
<td>3</td>
<td>8</td>
<td>8</td>
<td>15</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Absorption heat pumps</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Small-scale hydroelectric systems</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td>Micro combined heat and power systems</td>
<td>2</td>
<td>7</td>
<td>5</td>
<td>10</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Renewable combined heat and power systems</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>10</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>Fuel cells</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Heat recovery (i.e. MVHR)</td>
<td>5</td>
<td>9</td>
<td>9</td>
<td>14</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

For most of the LZC technologies there was a general agreement with the statement that designs would have to change to accommodate the technology. For PV and solar thermal, however, this was not as clear. For these two technologies, more than half the respondents indicated that they ‘disagreed’ or ‘somewhat disagreed’ with the statement. This may suggest that the incorporation of these technologies does not require change in designs. It was also interesting to note that for biomass, PV, solar thermal and wind technologies, none of the respondents indicated ‘do not know’. This perhaps indicates a higher level of awareness of or experience with these technologies.
A similar question was asked addressing changes in production techniques. Table 4 presents the response data for this question. Respondents were asked to reply on the same five point scale as to how much they agreed with the following statement: ‘We would have to change the way in which we build our homes a great deal to incorporate this technology.’

**Table 4: Number of responses indicating each technology’s compatibility with current building processes.**

<table>
<thead>
<tr>
<th>Low or zero carbon technology</th>
<th>We would have to change the way in which we build our homes a great deal to incorporate this technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disagree</td>
</tr>
<tr>
<td>Biomass systems</td>
<td>3</td>
</tr>
<tr>
<td>Solar photovoltaic systems</td>
<td>9</td>
</tr>
<tr>
<td>Solar hot water systems</td>
<td>11</td>
</tr>
<tr>
<td>Wind power systems</td>
<td>6</td>
</tr>
<tr>
<td>Ground source heat pumps</td>
<td>4</td>
</tr>
<tr>
<td>Air source heat pumps</td>
<td>3</td>
</tr>
<tr>
<td>Absorption heat pumps</td>
<td>1</td>
</tr>
<tr>
<td>Small-scale hydroelectric systems</td>
<td>2</td>
</tr>
<tr>
<td>Micro combined heat and power systems</td>
<td>0</td>
</tr>
<tr>
<td>Renewable combined heat and power systems</td>
<td>0</td>
</tr>
<tr>
<td>Fuel cells</td>
<td>0</td>
</tr>
<tr>
<td>Heat recovery (i.e. MVHR)</td>
<td>7</td>
</tr>
</tbody>
</table>

It appeared that most technologies required a degree of change in current approaches in both design and building practices. However, those based upon solar technologies (PV and solar thermal) appeared to be more compatible with current approaches than other technologies. This was further substantiated when respondents were asked separately, for design and production, to name the three technologies that were most compatible with current approaches. Table 5 shows the total frequency for each technology.

**Table 5: Number of responses indicating the top three technologies most compatible with current approaches.**

<table>
<thead>
<tr>
<th>Low or zero carbon technology</th>
<th>Design</th>
<th>Build</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass systems</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Solar photovoltaic systems</td>
<td>37</td>
<td>35</td>
</tr>
<tr>
<td>Solar hot water systems</td>
<td>38</td>
<td>37</td>
</tr>
<tr>
<td>Wind power systems</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ground source heat pumps</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Air source heat pumps</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Absorption heat pumps</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Small-scale hydroelectric systems</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Micro combined heat and power systems</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Renewable combined heat and power systems</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Fuel cells</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Heat recovery (i.e. MVHR)</td>
<td>22</td>
<td>20</td>
</tr>
</tbody>
</table>

This data lends support to the observations in tables 3 and 4 that PV and solar thermal systems are most compatible with current approaches.

Respondents were given the opportunity to select which technology they believed would be the most influential leading up to the full carbon neutral scenario of 2016. A total of 31 (n=43) respondents thought that a solar-based technology (PV or solar thermal water) would be the most influential.

**DISCUSSION**

A wealth of factors will shape and inform which LZC technology becomes dominant in the new build housing sector in order to meet the energy efficiency/CO₂ requirements of the Code. The results so far suggest that solar-based technologies (PV and solar thermal) are more common, and that the degree of compatibility with developers’ current design and production routines is higher. This appears to be consistent with the position that compatibility is a key consideration in innovation uptake (Rogers, 1995).
From this study, it is difficult to tell if the selection of PV and solar thermal systems was because they were the most compatible, or if their current compatibility was a product of the experience gained to date causing, as it were, a virtuous circle of selection and use. It is possible that PV and solar thermal systems were selected based upon some other attribute (for example, price or performance) and after this selection a process of technological ‘lock-in’ occurred. Indeed, it is an empirical question as to whether or not the cycles of technological lock-in is precluding the consideration of other LZC solutions.

A number of the qualitative responses in the survey also hinted at the fact that LZC technologies were selected on the basis of incremental innovation logic. With PV and solar thermal systems, for example, respondents commented that they were ‘bolt-on’ technologies that offered minimum disruption to current approaches. Similarly, there were signs that support and information networks were being formed around the more common LZC technologies. One of the developers, for instance, referred to the ‘...good knowledge on installation, maintenance and back up support’ for photovoltaics. House developers appear to seek such support structures when making LZC technology selection decisions and, in so doing, further stimulating network development.

**FUTURE RESEARCH**

This collaborative project between the Zero Carbon Hub, the NHBC Foundation and the University of Reading will progress as follows:

1. Full analysis of the complete survey dataset to produce a more comprehensive picture of LZC technology selection.
2. The survey findings will then inform a set of 6-10 in-depth interviews with architectural practices and housing developers.
3. Running parallel with the investigation of technology selection from the perspective of the housing developer, occupants within homes that contain a range of LZC technologies will be observed and interviewed. This will produce a rich picture of how users respond to low carbon homes.

**ACKNOWLEDGEMENTS**

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**REFERENCES**


ABSTRACT

The decision to design and construct new homes has material-intensive implications that are economically significant. Furthermore, inordinate quantities of pollutants are released worldwide over the life cycle of building materials. The focus of improvement efforts is currently on household energy efficiency and this has influenced South African research and development trends. However, improving the environmental and cost-related performance of South African subsidised housing needs a more material-focused approach. This paper reviews two CSIR Built Environment (BE) research projects that adopted such an approach. The paper concludes that to optimise home building costs and significantly reduce resource use, greenhouse gas (GHG) emissions and delivery lead time, research should prioritise the major building materials and substitute conventional with innovative, less polluting and resource-efficient material technologies.

INTRODUCTION

The decision to design and construct new homes has material-intensive implications that are economically significant. Furthermore, the building material life cycle is responsible for releasing vast amounts of air and water pollutants and solid wastes at thousands of locations worldwide.

In 2006, the construction of new residential buildings in South Africa accounted for about 25% of the total national building and construction budget of R158.6 billion. In the Medium-Term Expenditure Framework (MTEF) period from April 2007 to March 2010, the South African public sector allocated about 10% of its annual infrastructure budget (about R10 billion per annum) towards housing development (CIDB, 2007). When the input costs of home building are analysed, materials typically account for 60% of the costs while labour accounts for the remaining 40%.

The key building materials in the South African residential building sector are cement and steel. In 2006, the split in cement demand between building and construction works was 65%:35%. In the building sector, the split between residential and non-residential buildings was 68%:32%. Although figures are not available to confirm the split in market share between residential and non-residential buildings, cement-based materials account for about 57% of the total market for masonry. In 2006, the split in carbon steel sales between building and construction works was 57%:43% (CIDB, 2007).

The manufacturing of building materials accounted for 18 Mt CO₂eq emissions in 2006, which is about 5% of the nation’s GHG emissions. Of this, the manufacturing of cement, cement-based masonry and steel-based products accounted for 14.4 Mt CO₂eq or 80% of the emissions (UNEP/CIDB, 2009:23). Based on public sector investment trends, building-related GHG emissions are likely to double by 2050 if allowed to continue unchecked. An urgent need therefore exists to address energy efficiency and the reduction of GHG emissions at two distinctive levels (UNEP/CIDB, 2009), namely the whole building level (operational energy) and the materials level (embodied energy).

But to date, international research and development (R&D) efforts aimed at lowering the cost and environmental burden of home building have focused primarily on household energy efficiency. This is a valid priority, given that when the operational energy² and the total embodied energy³ of a home are compared, the former typically accounts for 80-90% of total life cycle energy while the latter accounts for the remaining 10-20% (Kotaj et al, 2003). These international efforts are driving trends in the local building and construction sector.

Thus, the Energy Efficiency Strategy for South Africa – which sets an overall national policy target of energy efficiency improvement of 12% by 2015 (DME, 2008) – is relying primarily on internationally tried and tested operational energy efficiency best practices. These include awareness-raising campaigns to communicate the cost benefits of energy efficiency in the home; energy efficiency standards for buildings; solar water heaters and energy efficient lighting to achieve building sector-specific targets. The Energy Efficiency Strategy sets energy demand reduction targets of 2% and 1% per annum respectively for cement and steel, thereby acknowledging the important role of these two building materials in the overall performance of the building and construction sector. However, the R&D opportunities to avoid or lessen potential upstream costs and environmental effects associated with the building material life cycle are not elaborated.

Measuring the economic and environmental performances of a residential building requires a life cycle perspective. As with every economic sector, the residential building sector’s purchases of materials sets into motion a chain of processes from raw materials extraction and processing, through materials manufacturing, transportation, distribution, on-site construction, building operation and maintenance to finally, demolition and/ or dismantling at the end of the service life (figure 1). All of these processes have upstream costs and associated environmental burdens in terms of resource use⁴ and the associated emissions to air, land and water.

Further to this, the living standard of a low-income household demands relatively limited amounts of operating energy. The low-income residential sector represents approximately 50% of South African households but accounts for only 10% of the residential sector’s electricity use. Despite the

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1 Mega tonnes.
2 The operational energy of a home is the energy used to heat, cool, ventilate, light, provide hot water and run various electrical appliances such as a cooker.
3 The total embodied energy of a home is the sum of the energy embodied in all the material used to construct and maintain the home, and dispose of building materials at the end of the life cycle.
4 Resources as used here means energy, materials and water.
substantial backlog in subsidised homes, which currently stands at about 2.2 million units, and government’s commitment to provide free, basic electricity, the electricity demand of the low-income residential sector is expected to remain low due to affordability issues (UNEP/CIDB, 2009).

A University of Cape Town research study has concluded that about 44% of South African households use fossil fuels such as wood, paraffin or coal for cooking instead of electricity. The study further found that for several days each month, many low-income families may rely solely on wax candles for lighting – a situation that fosters frequent fires in poor communities. Reliance on energy sources other than electricity is also known to contribute to poor air quality and human health problems in the low-income sector. The planned electricity price hikes of about 25% every year for the next three years is likely to put electrical power supply even further beyond the reach of low-income households.

By contrast, the energy-intensive nature of the major building materials coupled with the large housing backlog suggests that the electrical energy demand associated with the delivery of low-cost housing will increase substantially as a result of building materials manufacturing and use. Therefore, achieving reductions in costs and improvements in the environmental performance of South Africa’s low-income residential sector may necessitate a departure from the mainstream approach, which is concerned with operational energy, towards an R&D approach that is more material-focused.

This paper reviews two CSIR Built Environment (BE) research projects: ‘Prioritisation of building materials research and development for South Africa’ and the ‘Advanced Construction Technology Platform’; both adopted such an approach. The paper discusses the lessons learnt in respect of prioritising building materials research to optimise costs and delivery lead time and improve environmental performance.

**IDENTIFYING BUILDING MATERIALS RESEARCH AND DEVELOPMENT PRIORITIES**

**Introduction**

Building materials R&D priorities are discerned from completed and/or ongoing research in a country or countries during a given timeframe, and include subject areas that may benefit many countries. This arises from the scattered nature of the building industry, its dependence on different local resources and the technical characteristics of raw materials that are never the same for all countries. This in itself compels countries to conduct research previously undertaken in other countries (with similar raw materials). Such repetition familiarises developing countries with up-to-date techniques and prepares them for the introduction of new production methods and products. Building materials research direction is guided by a national agenda, but may be influenced by common global research trends such as the need to contribute to energy-efficient or green building by lowering the embodied energy of the major building materials.

The R&D of building materials involves two main categories – products and processes. Much of the research and development of processes (technologies) is closely linked to research on products. Thus, the trends that are valid for building materials R&D are often also valid for the building methods. The prioritisation of building materials research areas, which is closely linked to that of the building methods, cannot be done globally but rather, for a given country and timeframe. This requires (Mapiravana, 2010):

- The identification of potential building materials for research; and
- A method of comparing and ranking competing building materials research themes.
Method

The study reviewed and compared the status of building materials R&D globally and in South Africa to enable the identification, prioritisation and scoping of building materials R&D that must be explored afresh or further to significantly reduce the life cycle cost and delivery lead time of building infrastructure in a sustainable way. The study aimed to answer the following research questions:

- What are the R&D priorities for both conventional and innovative building materials?
- What are the overall R&D objectives for both conventional and innovative building materials?
- What new developments have been achieved from research on both conventional and innovative building materials, and what has been the impact on cost and delivery lead time?
- What should be the R&D priorities for both conventional and innovative building materials for maximum impact on cost reduction and minimisation of delivery lead time?

The building materials R&D areas in South Africa were prioritised on the basis of expected impacts on cost reduction and minimisation of delivery lead times for housing and other building infrastructure. Global and local studies, research papers and reports on building materials R&D were reviewed to answer the research questions posed. The conventional building materials investigated in the study were cement; mortar; concrete products such as solid building blocks; burnt clay products such as bricks, quarry tiles and pipes; glazed ceramic tiles; ceramic sanitary ware; glass; timber; steel; non-ferrous metal alloys; cast iron; ferro-enamels; minerals and rocks; refractories and plastics such as poly vinyl chloride (PVC). The innovative building materials which were investigated included recycled and reused waste-based materials; composites; nanomaterials and photochromic or chameleon type energy conservation pigments.

The study prioritised building materials R&D areas in accordance with the approach of the 2007 CIDB building materials study, which ranked and grouped South African building materials in consideration of their rand market share. As per table 1, the eight most widely sold and used South African building material groups in order of importance are cement and reinforced concrete; carbon steel; concrete and clay masonry; wood; wall tiles, floor tiles and sanitary ware; plastics; non-ferrous metals and glass.

Table 1: Market share of the major building material groups in South Africa (Mapiravana, 2010).

<table>
<thead>
<tr>
<th>Material group</th>
<th>Rand market share</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement and reinforced concrete</td>
<td>35%</td>
<td>1</td>
</tr>
<tr>
<td>Carbon steel</td>
<td>23%</td>
<td>2</td>
</tr>
<tr>
<td>Concrete and clay masonry</td>
<td>12%</td>
<td>3</td>
</tr>
<tr>
<td>Wood</td>
<td>10%</td>
<td>4</td>
</tr>
<tr>
<td>Ceramic wall and floor tiles and sanitary</td>
<td>9%</td>
<td>5</td>
</tr>
<tr>
<td>Plastics</td>
<td>4%</td>
<td>6</td>
</tr>
<tr>
<td>Non-ferrous metals</td>
<td>4%</td>
<td>7</td>
</tr>
<tr>
<td>Glass</td>
<td>3%</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

The study concluded that to significantly reduce building materials-related costs and environmental burdens in South Africa, R&D efforts need to be focused on the following material groups:

- Cement and concrete
- Lightweight steel construction
- Smart tiles\(^5\) (for modular and façade type construction)
- Composite materials (as substitutes for cement, carbon steel, conventional concrete, bricks, blocks and wood)

Nanotechnology could also be used to enhance materials properties and/or functionality where possible. Industrialised or advanced construction that uses panels or modules made from the cheaper and smarter materials developed will reduce the delivery lead time and life cycle cost.

The study also established the following R&D agenda for the major building material groups:

Cement

For cement, there should be a focus on its partial to total replacement through the research and development of:

- Novel binders such as geo-polymers
- Cement extenders and cementitious materials such as the recently developed cheaper, carbon negative magnesium-based cement
- Lightweight cement-based products
- Novel admixtures (for improvement of cement properties)

Concrete

For concrete, research should focus on alternative reinforcement to the more expensive steel to increase fracture surface energy and fracture toughness. For example, by second phase toughening an enhancement of the interfacial bonding strength, strength, porosity reduction and increase of Young’s Modulus, can be reached.

This approach derives from the Griffith equation (Griffith, 1920) and empirical strength-pore fraction (Duckworth, 1953; Ryshkewitch, 1953; Coble and Kingery, 1956; Knusden, 1959; Dutta, et al. 1988; Pickup, 1997) and Young’s Modulus-pore fraction relationships (Wagh, et al. 1991; Spriggs,

\(^5\) Smart tiles are ceramic tiles that are self-cleaning, kill germs and are thermochromic and photovoltaic, and can be used to conserve and generate energy for buildings.
1961; Mackenzie, 1950; Dewey, 1947; Hasselman, 1962). The Griffith equation suggests that the fracture strength (σ) of a body under uniform stress depends on its fracture surface energy, its Young’s Modulus (or stiffness) and the size (c) of strength limiting flaws in it. For polymers, the degree of chain entanglement is an inverse measure of the strength limiting flaw size. Empirical strength-pore fraction and Young’s Modulus pre-fraction relationships show that porosity determines stiffness, which appears in the Griffith equation for strength.

Continuous grading of concrete aggregate particles minimises pore fraction, and increases Young’s Modulus and concrete strength. Thinner, lighter and stronger concrete products can be derived from research and development activities based on strength enhancement through a fracture mechanics approach. Reuse of thinner, high performance concrete structures will also reduce the embodied energy and GHG emissions of the building and construction industry.

**Steel**

Lightweight steel construction research should focus on the rolling of even thinner and stiffer steel plate and the widening of the application of structural light steel sections in building and construction. Intensifying lightweight steel construction will reduce the tonnage and cost of steel used in construction, and permit rapid delivery of buildings and structures.

**Ceramic tile**

The mass production of glazed ceramic tiles through pressing and extrusion techniques is well developed. Research should focus on making smart tiles. Further possibilities of using tiles as part of modules and panels for construction should also be explored.

**Composites**

Composite material research offers a wide range of possibilities for the research and development of building and construction materials. A fracture mechanics approach to the improvement of strength and toughness is also recommended for composite material development. The development of structural polymer matrix (oil-based and renewable bio-based) and cement matrix composites incorporating toughening nano-particles; natural and/or man-made fibres; self-cleaning features and other smart functions will be a major step change in the development of construction and building materials and methods in South Africa.

**Recycling**

Building materials research programmes should also incorporate the notion of recycling and the reuse of other industry waste materials. This could include plastics; bagasse; metallurgical slag from smelters; gypsum from lime-based sulphur dioxide scrubbers and phosphoric acid manufacture; cellulose fibres from paper mills; and fly ash from coal-fired power stations and fluidised-bed coal combustion boilers.

**CSIR BE ADVANCED CONSTRUCTION TECHNOLOGY PLATFORM (ACTP)**

**Introduction**

In 2008, CSIR BE initiated the Advanced Construction Technology Platform (ACTP) — a multi-year research project aimed at identifying and solving the science-based problems impeding the shift to innovative technologies in the South African building and construction sector. Subsidised housing was chosen as a suitable context to develop, test and implement innovative technologies aimed at improving the performance of homes and contributing to sustainable human settlements.

Achieving a better quality of life for all South Africans through the provision of subsidised housing is a major government focus in the post-apartheid era. Government expressed its commitment to housing for all as a basic human right under Section 26 of the Constitution, Act 108 of 1996, and through the Reconstruction and Development Programme (RDP) that started in 1994. Regrettably, housing delivery is not on target and the backlog is estimated to grow by about 200 000 units a year due to population growth and urbanisation.

According to CSIR BE research, the reliance on conventional material, production and assembly technologies may be a major constraint to subsidised housing delivery. The lack of technological progress contributes directly to the poor performance characteristics of the sector such as a steep, annual rise in the costs of materials and labour (30% per annum); sluggish building methods; and poor thermal performance (which has a knock-on effect on the health and safety of building occupants).

**Method**

The ACTP research project was carried out on the basis of two experimental houses — a subsidised house (SH) and a CSIR house (CH), both of which were built on the CSIR Pretoria test site. The buildings were identical to each other in that each one was based on the 40m² standard plan approved by the NHBRC for subsidised housing. The buildings were, however, distinguished from each other due to differences in the technology (production and assembly) of the building materials. SH served as a reference building against which the performance of the new, improved version, CH, could be measured. SH was therefore built in accordance with NHBRC specifications. The conventional material technologies that characterised SH were:

- **Substructure**: Concrete strip foundation on hard core fill, solid concrete block foundation walls and 75mm concrete floor slab on hardcore fill
- **Superstructure**: Solid concrete blocks
- **Finishes**: 25mm thick floor screed and StippleCrete to external walls
The innovative material technologies that distinguished CH from SH included:

- Substructure: CSIR 50mm thin concrete raft foundation on stabilised fill
- Superstructure: Modular, hollow concrete blocks and precast concrete window frames (applied to four out of seven windows to minimise thermal bridging)
- Finishes: Insulated ceiling board and thermal (perlite) plaster to external walls

Three studies were carried out to assess and compare the environmental and cost performance of SH and CH. The results are reported and discussed in the sections below.

**ACTP STUDY 1: COMPARATIVE STUDY ON THE RESOURCE USE AND GHG EMISSIONS OF THE SUBSIDY HOUSE AND THE CSIR HOUSE**

This study relied on a life cycle assessment (LCA) methodology to compare SH and CH on the basis of resource intensity (energy, material and water consumption) and contribution to GHG emissions. The study found that the switch from conventional technologies, as represented by SH, to innovative technologies, as represented by CH, resulted in the overall improved environmental performance of a typical subsidised home (Ampofo-Anti, 2010):

- The initial construction of CH required about 35% less material resource input by weight compared to SH. The significant reduction in materials use was due to savings on concrete blocks, substructure concrete, substructure mortar and floor screed. Despite the similarity of maintenance requirements of CH and SH over a building service life of 50 years, CH required about 50% less maintenance materials input by weight due to the use of lighter finishing materials.
- Compared to SH, the innovative technologies used to construct and maintain CH contributed less to climate change. The potential savings were about 700 kg CO₂ equivalents. When these savings are scaled up in the context of subsidised housing delivery targets of 200 000 to 300 000 units per annum, it translates to substantial savings in the form of reduced national GHG emissions.
- Compared to SH, the innovative technologies used to construct and maintain CH contributed more to the embodied energy of a subsidised home. The potential increase in embodied energy was about 70kg oil equivalents. The embodied energy of CH could potentially be reduced to be equivalent to, or lower than, that of SH by substituting cement-based materials applied at substructure and superstructure levels with less energy-intensive materials, and substituting the thermal plaster and wall paint of CH for more durable finishes that do not require maintenance.
- Compared to SH, the innovative technologies used to construct and maintain CH contributed less to the water demand of a subsidised home. The potential savings were about 19.7m³ of water. The concrete and cement-based materials groups accounted for at least 80% of the contributions in the pre-use phase, suggesting that building contractors have a key role to play in conserving water. The water demand of CH could therefore be lowered further by minimising the use of concrete, mortar, screed and plaster.

**ACTP STUDY 2: COMPARATIVE STUDY ON THE OPERATIONAL ENERGY AND THERMAL PERFORMANCE OF THE SUBSIDY HOUSE AND THE CSIR HOUSE**

To save costs, the standard subsidised house plan of the NHBRC does not make provision for roof, ceiling or wall insulation. SH was therefore subject to large, daily variations in temperature. It is common practice for the occupants to burn coal or wood inside the dwelling for space heating, but as the building envelope has a limited ability to retain heat, very little can be done to maintain a reasonable interior temperature on the coldest days and nights of the year. The resulting cold conditions and prolonged exposure to smoke lead to increased sickness levels, placing a financial burden on the poorest section of society.

The following measures were applied to improve the energy and thermal performance of CH:

- Appropriate north-south orientation.
- Appropriate roof overhang combined with north-facing windows.
- Cavity walls (modular, hollow concrete blocks).
- Insulated ceiling (Lambdaboard).
- Insulated external walls (thermal plaster).

The study used computational modelling to quantify and compare the thermal performance of SH to that of CH. The study found that (Osburn, 2010):

- CH needed only 40% of the operating energy of SH to maintain a comfortable indoor thermal environment.
- CH would require active heating on the coldest days of the year however, the variations in the indoor temperatures were much lower (the indoor temperature did not exceed 25 degrees Celsius on the warmest days, which is a comfortable temperature for most individuals).
- The thermal performance of SH could be improved considerably by the addition of a carpet on the floor and the provision of ceiling or wall insulation.

**Table 2: Energy loading of the subsidy house and the CSIR house (Osburn, 2010).**

<table>
<thead>
<tr>
<th>House type</th>
<th>Heating load (GJ)</th>
<th>Cooling load (GJ)</th>
<th>Total load (GJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidy house (SH)</td>
<td>12.32</td>
<td>6.78</td>
<td>19.10</td>
</tr>
<tr>
<td>CSIR house (CH)</td>
<td>7.66</td>
<td>0.00</td>
<td>7.66</td>
</tr>
</tbody>
</table>
A switch in the subsidy house design from SH to CH would therefore translate into a number of economic and environmental benefits, including savings on the energy bill for poor families; improved air quality and human health due to the avoided emissions; an overall decrease in the operational energy demand of the low-income residential sector and a corresponding decrease in the GHG emissions of the sector.

**ACTP STUDY 3: COMPARATIVE STUDY ON COSTS OF THE SUBSIDY HOUSE AND THE CSIR HOUSE**

The costs of labour and materials for SH and CH were monitored and documented throughout the building process. The results showed that compared to SH, CH cost R18 856.11 or 41.43% more to build. The substructure and services components of CH cost less than the equivalent components for SH. However, the labour and materials costs for the superstructure, roofing and finishes of CH all cost more than the equivalent components of SH.

**Table 3: Comparative costs of the subsidy house and the CSIR house (De Villiers, 2011).**

<table>
<thead>
<tr>
<th>Ref</th>
<th>Work description</th>
<th>Subsidy house (SH)</th>
<th>CSIR house (CH)</th>
<th>CH as % of SH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Labour cost</td>
<td>Material cost</td>
<td>Total cost</td>
</tr>
<tr>
<td>1</td>
<td>Substructure</td>
<td>2 710.35</td>
<td>7 078.44</td>
<td>9 788.79</td>
</tr>
<tr>
<td>2</td>
<td>Superstructure</td>
<td>3 237.00</td>
<td>13 960.69</td>
<td>17 197.69</td>
</tr>
<tr>
<td>3</td>
<td>Roofing</td>
<td>1 485.00</td>
<td>7 157.04</td>
<td>8 642.04</td>
</tr>
<tr>
<td>4</td>
<td>Finishes</td>
<td>2 697.50</td>
<td>4 514.10</td>
<td>7 211.60</td>
</tr>
<tr>
<td>5</td>
<td>Services</td>
<td>1 391.25</td>
<td>1 281.20</td>
<td>2 672.45</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>11 521.10</td>
<td>33 911.47</td>
<td>45 512.57</td>
</tr>
</tbody>
</table>

As an experimental work, direct comparisons on time and labour may not be relevant. The building team erected SH without any need for instruction or supervision. Erection of CH, on the other hand, entailed training, demonstration and instructions throughout. A later attempt to build CH on the CSIR Kleinmond site showed that all the walls could be built in one day, suggesting that additional costs due to labour could be easily addressed with appropriate training. The higher materials cost for CH was partly due to the thermal plaster and insulated ceiling board that were added to CH but not to SH, and partly due to the higher cost of the modular, hollow concrete blocks. The increase in time and cost should also be viewed against the considerable gains in environmental performance discussed in the previous sections of this paper (de Villiers, 2011).

**CONCLUSION**

The CSIR investigations presented in this paper lead to the conclusion that, to significantly reduce embodied energy, GHG emissions, the cost of materials and delivery lead time, building materials research and development in South Africa should prioritise cement and concrete; lightweight steel construction; smart tiles; composite materials and mining and industrial waste recycling with the goal to achieve the already stated overall research objectives. Nanotechnology materials should be developed for property enhancement. The innovative building materials developed should be modularised and/or panelised for rapid construction.

This conclusion was put to the test in the context of low-cost housing, for which the major material group was cement and concrete. Three modelling studies, based on experimental buildings, were carried out to evaluate life cycle resource use and GHG emissions; operational energy demand and thermal comfort; and initial building costs. Each of the three studies compared conventional technologies as represented by the NHBRC subsidy house (SH), to innovative technologies as represented by a new, improved version, the CSIR house (CH). The results of the studies suggested that potentially:

- The mass of materials used to build two units of SH could build three units of CH. CH was also likely to require about 50% less maintenance materials by mass when compared to SH.
- The embodied energy of CH was likely to be higher than that of SH. However, the material-intensity, water demand and GHG contributions of CH were all likely to be lower than that of SH. The embodied energy of CH could be improved by reducing the cement content of the sub and superstructure materials and selecting finishes that are highly durable or maintenance-free.
- A switch in technology specification from SH to CH would translate into a number of economic and environmental benefits because CH would need only 40% of the operational energy of SH to maintain a comfortable indoor environment.
- The initial building cost would be higher, but CH could be erected faster than SH. The increase in cost should be viewed critically against the environmental benefits and shorter lead times highlighted by the three studies.

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ABSTRACT

Building or renovating a house is one of the most expensive experiences consumers may face. Regulatory frameworks generally aim to protect both consumers and builders while regulating for safe, healthy and sustainable building outcomes. For the sector to deliver both safe building and satisfied consumers, the responsible agency – the regulator – needs to be impartial and respected by both parties. The industry deals with highly technical issues (standards, ratings, material performance and insurance), which are often poorly understood by the consumer. This paper identifies key success factors and suggests control points to deliver the best outcomes for both consumers and builders.

CONTEXT

The delivery of safe, healthy and sustainable buildings in Australia rests with regulators who report to State or Federal ministers. The regulation of the domestic building sector occurs in an environment where consumers are often poorly informed when making a major binding financial decision, according to a 2006 inquiry into housing regulation in Victoria (VCEC, 2006).

The main focus of this paper will deal with managing risk in order to get the best outcome for consumers. This is closely linked to innovation and climate change and how to achieve sustainable housing while dealing with political and affordability issues.

To carry out its responsibilities the regulators deal with the different audiences, issues and pressure groups to deliver safe (and sustainable) dwellings and satisfied consumers. However, governments ultimately take responsibility in the event of dissatisfied consumers when the market or its regulator fails.

In Australia the regulators are ultimately responsible to government to meet the obligations as set out in legislation and regulation. Depending on the regulatory structure, performance is judged by: the minister responsible; an appointed board; government in response to inquiries it initiates on industry performance; industry groups; and the media.

GOALS

The public policy goals set by governments in the domestic building sector for safe building and satisfied consumers relate to:

- appropriate building standards
- qualified professional practitioners
- compliance with building standards
- realistic consumer expectation
- dispute resolution and reduction
- warranty risk management
- sustainable building practices.

In most countries the regulatory framework flows from a Building Code, which prescribes nationally consistent building codes, standards regulatory requirements and regulatory systems. The Building Codes are generally developed and updated through a process overseen by a board representing industry and appointed by government. Building standards are developed and other regulatory requirements set. Who has responsibility for this function may vary. The regulatory framework generally prescribes requirements for: registration and licensing; minimum requirements to be met in the domestic building contract and compliance regimes; dispute resolution; enforcement; warranty requirements; and sustainability. Information on the Australian Building Codes Board (ABCB) can be found on their website.¹

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¹ See www.abcb.gov.au

Figure 1: The regulatory hierarchy

Federal

State
Criteria

Criteria are set to meet the government’s public policy goals for safe healthy and sustainable buildings. The regulator is directly or indirectly responsible for meeting the criteria, which may include:

- safe buildings outcomes
- professional practitioners’ conduct, including compliance with a contract
- mandatory checks
- increased consumer awareness and satisfaction
- effective dispute resolution
- responsive warranty
- sustainable building standards, for example 5 Star.

Depending on the regulator’s reporting and monitoring regime, performance is measured in different ways:

- Some may be very public and are reported to parliament, and/or in annual reports and surveys on websites – these may include reporting on financial performance, numbers of registrations, compliance, disputes and consumer satisfaction.
- Others are monitored and reported on by third parties, including lobby groups and industry associations. The media through, television, radio and newspapers, is the most usual source used by the lobby groups to communicate their points.

Industry risk profile

There are several risks endemic to this industry. Generally, consumers have little technical knowledge about building regulations, compliance and performance of materials. Equally, building professionals need access to quality and timely information and regulators need to ensure that builders comply with all building requirements. Should there be evidence of a systemic problem builders need to be informed and trained or advised on what is required to address these problems.

Internationally there have been reports of major systemic problems in the industry. Their causes and remedies have become case studies for regulatory regimes to identify potential risks and mitigate against them. The experience in Australia is that many disputes in the domestic building sector relate to both contractual and technical matters. Lack of compliance with certain contract conditions or lack of understanding by the consumer of exactly what is included in the contract is often central to a dispute.

This is clearly a complex and risky industry. In Australia the market for domestic building, and the risk profile, varies quite considerably even amongst states, as demand, affordability, market concentration and requirements for warranty differ from state to state.

In Australia regulators must comply with prescribed legislative and regulatory requirements. Each state has its own regulator, for example in Queensland the Queensland Building Services Authority2 and in NSW the Office of Fair Trading.3 In Victoria, the Building Commission4 and Consumer Affairs Victoria5 provide consumers with information on: builder registration and ability to check if builders are registered; the role of the building surveyor; warranty requirements; dispute resolution; and contracts.

Politicians are responsible to all voters to deliver the safe, healthy sustainable buildings outcomes as per the Building Code. However, politicians are lobbied by interest groups with different agendas. The regulator is set up to serve the public interest and manage the compliance regime with all aspects of the regulatory framework. One could argue the regulator is, or should be, the impartial party to deliver the best outcomes for all parties.

In summary, the major risks in the industry include:

- the highly technical nature of the sector
- asymmetry of information = technical experts v uninformed consumers
- professionals’ performance is varied
- limitations of warranty product
- media power and its ability to influence
- lack of attention to domestic building contracts.

PARTICIPANTS IN DOMESTIC BUILDING SECTOR

The key participants in the domestic building sector are consumers, the industry (builders, developers, industry associations, products and material providers), and insurers. Industry participant groups or associations represent their stakeholders and their needs, which can be in conflict with each other.

Each group will lobby to influence politicians to respond to their needs.

Figure 2 shows the likely impact on industry of successful lobbying by consumer versus developer/builder.

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2 See QBSA website www.bsa.qld.gov.au
3 See website www.fairtrading.nsw.gov.au
4 See website www.buildingcommission.com.au
5 See website www.consumers.vic.gov.au
As noted in Figure 2, differing stakeholder expectations will have different consequences. There needs to be a balance between the roles, power and influence of the consumers, the industry and insurers. Who has the power, and how this power balance changes over time influences industry outcomes. Any one group with too much power can ultimately disadvantage those with less power.

Consumer demands if unchecked may lead to:

- higher costs, as they are likely to demand more protection, flexibility, better building outcomes, for example, quality and finish
- poor regulation, for example, exemption, variations, less expense
- reduced sustainability – both standards and compliance.

Builders and developers, on the other hand, can expect to lobby for outcomes to reduce costs and potentially building standards while not in favour of sustainable building outcomes if there is no advantage to them.

Below are some examples of the power and influence some key participants have and the results that their lobbying and decisions have had on the industry:

- Lobby group (builder and consumer) succeeded in having mandatory warranty insurance removed in Tasmania.
- Insurers withdrew from the warranty markets in NSW and Victoria in 2010 leaving states’ governments to underwrite this class of warranty.
- Leaky building problem in NZ occurred after changes in 1991 to allow less prescriptive sets of regulations and other events effecting industry performance (Mumford, date unknown).
- Industry associations in Australia lobbied to influence introduction of energy efficient building and design standards.
- The impact of the Canadian leaky condo problem on consumers. This occurred during a time of excessive building demand and a change in relationship between owners and buildings (owning a unit in a complex building structure rather than a stand-alone house).

Individual consumers are unlikely to know to anticipate the impact of most of these events. Consumers can, however, inform themselves of many of the risks associated with their building project and take due care to minimise and avoid disputes and loss. Acting within the law will provide the greatest level of protection to consumers. Regulators have a role to play as do local planning authorities, industry associations, industry consultants (architects and draftspersons) and finance providers to inform consumers and, where possible, assist and direct them to minimise risks and act within the law. Consumers can minimise risks by:

- using registered/qualified builders and obtaining information about their builder or building company performance
- checking with the appropriate planning authority to obtain the required planning permits
- checking that warranty insurances are in place before signing their contract
- communicating regularly with their builder and discussing issues of concern
- complying with payment schedules in their contracts
- amending contracts to reflect any changes they make during the project
- seeking assistance early in the event of a dispute with their builder.

Media coverage of unsatisfactory building experiences do not necessarily assist consumers or builders to avoid or manage their building process. By the time disputes make media headlines the parties are often in an advanced stage of conflict. As a result many parties enter contracts assuming they will have an unsatisfactory experience. However, regular surveys in Victoria show that overall consumer satisfaction with their building experience is increasing. In 2010 over 80% of consumers were satisfied or very satisfied with their building experience. 6 The consequences for the parties of a major dispute can be high. A builder can lose a licence and/or be fined and the consumer can incur significant costs and stress.

**THE BALANCING ACT**

Consumers want the best possible outcome at the lowest possible cost and are influenced by market promises (expectation) and by what they hear from other consumers’ experiences. In some markets consumers have considerable power over politicians and the media. However, the

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builders, their associations, and the developers equally have much power. All the parties will use the media to make their cases and influence politicians and voters, especially close to elections.

Reducing technical building faults, i.e. identifying problem areas quickly and providing information, training, and notes to builders to correct systemic problem areas are some of the ways to reduce disputes and stress to consumers. Gathering data in a systematic and consistent manner, analysing it and responding to the findings is key to identifying and dealing with technical and other matters, which may relate to failure in materials, design or workmanship.

A comprehensive system is required to deliver the goals, as noted at the beginning of this paper. However, every environment in every country is different, including attitudes to compliance with building standards, the value of a contract and how it is used to manage the project outcome, the compliance regime, the qualifications and professionalism of builders, dispute resolution and warranty. The Australian experience is clearly different from other countries.

**Figure 3: The pendulum swings**

**Figure 4: Getting the balance right**

**Getting it right**

The following is a checklist of some of the important issues to get right:

- A regulatory regime to register, monitor, enforce compliance and educate builders while also providing easy access to consumers – an impartial regulator respected by both consumer and builder.
- Early access by the regulator to consumers planning a building or renovation. Target and provide information to a consumer when planning a building or renovation project through the planning authority, a finance institution, an architect or draftsperson, etc.
- Target information on regulatory control points and the purpose, for example builder registration regime, how to check out your builder’s performance, the role of the inspector/surveyor and mandatory checks, a plain language contract and a guide on how to use it.
- Access for both consumers and builders to a dispute resolution service.
- A dispute reduction strategy based on quality information on the causes of problems and a quick response to reduce them.

**REFERENCES**

Mumford PJ (date unknown). Enhancing performance-based regulation: Lessons from New Zealand’s building control system.

REPAIR TECHNOLOGY OF CONCRETE SLABS

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ABSTRACT

Steel plates are bonded to the tension side of slabs as a post-strengthening technique in South Africa. The technique is used in bridges and multi-storey buildings to enhance the flexural capacity of slabs and beams. This method can also be used in houses with concrete slabs to increase their flexural and shear capacity, and to control deflection and cracking of the slabs. An epoxy adhesive is used as the bonding material. Composite action between a concrete slab and a steel plate can only occur if there is sufficient transfer of the horizontal shear from the concrete into the steel. Currently the shear strength of the epoxy adhesive is unknown in South Africa and investigations are underway to determine the strength of the adhesive. This paper reviews international research on similar adhesives. Variables in the study included the plate thickness and bonding length.

INTRODUCTION

When reinforced concrete structures, for example slabs of houses, are not designed or constructed properly, or when the function of the structure requires loads that are higher than those for which the structure was designed, the need often arises to strengthen the structure before considering the worst case scenario of demolishing it.

This topic is especially relevant now, considering the number of RDP houses and mass-scale produced cluster houses that require repair. Several techniques have been used in the past to achieve improved performance. These include replacing non-structural toppings with structural toppings, introducing extra supports and adding extra reinforcement by stapling and guniting. Such methods are disruptive and costly, and may require the building to be evacuated during repair.

A non-intrusive and inexpensive way to strengthen a structure is to externally bond steel plates underneath existing concrete elements using epoxy adhesives. This method can increase the flexural and rigidity capacity of a slab or beam, consequently reducing the deflection of the slab. It has also been realised that when a steel plate is bonded underneath a slab, crack propagation is arrested. The technique requires minimal preparation and materials compared to conventional strengthening methods, and advantages include minimal effect on headroom, low cost, ease of maintenance and the ability to strengthen part of the structure while still in use. The technique can be applied to structures ranging in size from double-storey houses to multi-storey buildings.

It is important that if this technique is going to be used in an effective manner, the strength of the epoxy adhesive needs to be properly understood. In addition, the bonding properties and the execution of the bonding work need to be properly investigated.

EXPERIMENTAL RESEARCH

To investigate how shear was transferred from concrete to bonded steel, researchers previously used either a single (Täljsten, 1997) or double shear test (Van Gemert, 1980; Barnes & Mays, 2001; and Muller, 2010). The single shear test involved bonding a single plate to the side of a concrete block, while the double shear test involved bonding two plates to opposing sides of a concrete block. In each case the concrete block would then be restrained while a tensile force was applied to the plate(s). This tensile force would translate into a shear force in the interface between the concrete and plate. The double-lap shear specimen is preferred to a single-lap specimen because it is symmetrical and therefore the state of stress under load approaches pure shear. This reduces the effect of eccentricity, thereby cutting down on the complexity of introducing moments into the joints. Figure 1 shows a typical double shear specimen.

Concrete block dimensions ranged from 70x70x280mm (Barnes & Mays, 2001) to 200x200x1200mm (Täljsten, 1997) while compressive strengths ranged from 23.68MPa (Muller, 2010) to 56MPa (Van Gemert, 1980). Several other parameters that varied between researchers included bond length, plate width, plate thickness and adhesive thickness. These parameters will later be discussed in more detail.

Failure was found to occur in a region of concrete parallel to the adhesive and not in the adhesive layer itself (Barnes & Mays, 2001). This was because the concrete, in most cases, had inferior shear properties to the epoxy material used, and proved to be the weakest link in the system. The loaded end of the plate proved to be the most stressed end of the plate, with the stress reducing exponentially towards the unloaded end of
the plate (Täljsten, 1997; Barnes & Mays, 2001). Cracking started at the loaded end of the plate and propagated towards the unloaded end as the load increased. This caused the most stressed region to shift from the loaded end to the unloaded end of the plate as cracking occurred. Figures 2 and 3 show that the most stressed region was closest to the loaded end (denoted by distance of zero) of the plate. Furthermore, figure 2 also shows a shifting of the most stressed region as loading increased on a steel specimen.

Figure 2: Strain versus position of a steel specimen (Täljsten, 1997).

The shear strain under loading (figure 2) is not distributed evenly along the whole length of the bonded region. This means that the front length of the bond would initially resist the load. When cracking commenced, and as the crack spread, the bond length would shift towards the unloaded end of the plate.

This brought about the idea of an effective bonding length (Van Gemert, 1980; Täljsten, 1997; Barnes & Mays, 2001 and Muller, 2010), meaning that at any one point only a section of the total bonded area carried the shear stress, and this section shifted and activated new parts of the bond as cracking occurred. It was also shown that an effective bonding length existed beyond which no further increase in loading capacity was achieved.

**FACTORS AFFECTING BOND STRENGTH**

**Effective bond length**

The effective bonding length depends on the material properties and bonding arrangements used in the system. Effective bond length values found in research ranged from 130mm (Barnes & Mays, 2001) to 300mm (Van Gemert, 1980), and were found to depend on the properties of the concrete and plate thickness and width.

Figure 4 shows the load-slip curve for a plate 80mm wide and three bonding lengths, namely 100mm, 300mm and 600mm. The loads at which slip was encountered for both the 300mm and 600mm bond lengths were almost the same (approx. 70kN), whereas the 100mm bond length experienced slip at 40kN. This indicated that the 100mm bond length was less than the effective bond length and could not reach the ultimate loads of the plates with bond lengths of 300mm and 600mm. The 600mm bonded plate in contrast was bonded beyond the effective bonding length, thus the maximum load did not exceed the one achieved by the 300mm bond length plate. This indicates that 300mm is the effective bonding length for the plated arrangement.

Figure 4: Load-slip curve for plate width 80mm (Täljsten, 1997).
**Plate thickness**
An increase in plate thickness led to a general reduction in peak stress levels and an increase in total bond capacity (Barnes & Mays, 2001).

**Plate width**
An increase in plate width, while keeping bonding length and plate thickness constant, provided a greater failure load (Van Gemert, 1980).

**Epoxy thickness**
Epoxy thickness produced higher loads at 3mm and 5mm thickness than 1mm thickness, however the values between 3mm and 5mm produced little difference (Barnes & Mays, 2001).

**Bond surface preparation**
Bonding between epoxy and concrete was best when the concrete substrate had been exposed and all loose particles and dust removed. Steel plates should be finished to a Swedish standard SA 2 for best bonding.

**SHEAR BOND STRENGTH**

The shear bond strength values are summarised in Table 1. Steel plates produced bond strength values of 0.96-5.28MPa. The difference between the lowest and highest values is significant. Reasons for this include:

- Different concrete strengths.
- Different epoxy adhesives.
- Different material preparation prior to bonding.
- Different bond lengths.
- Different specimen dimensions such as plate width, plate thickness and adhesive thickness.

**Table 1: Summary of shear bond strengths from literature**

<table>
<thead>
<tr>
<th>Author</th>
<th>Steel (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Gemert, D. (1980)</td>
<td>1.08-1.45</td>
</tr>
<tr>
<td>Täljsten, B. (1997)</td>
<td>0.96-5.28</td>
</tr>
<tr>
<td>Sharma, Mohamed Ali, Goldar &amp; Sikdar (2006)</td>
<td>1.8-4.52</td>
</tr>
<tr>
<td>Muller, W.S. (2010)</td>
<td>3.38-4.43</td>
</tr>
</tbody>
</table>

**CONCLUSION**

A study of the literature available for a steel plate to concrete bond using epoxy adhesive indicates that the concept of effective or critical bond length is perhaps the most important. All authors covered in this review proved the existence of a bond length beyond which no significant increase in load carrying capacity is found. The bond length is linked to the specific material properties of the concrete substrate and dimensions used. Both investigations found the most stressed part of the plate to be closest to the loaded end of the plate, with the stress decreasing exponentially towards the free end of the plate. Once initial cracking started at the loaded end of the plate, the stress would shift towards the free end of the plate. The bond would then be activated at the free end of the plate so as to maintain the effective bonding length between the loaded and free ends of the plate. The shifting of the bond zone would continue until complete failure occurred. This process would happen almost instantaneously, which means that any bond longer than the effective bonding length would not add to the ductility of the system or produce greater resistance to loads.

In order to create a holistic understanding of the bond interface between concrete and the bonded plate, it is important to research the effect of all varying parameters – those aforementioned and others – that might impact on the bond strength of the system.

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CLAIMS REGARDING FAULTY CONCRETE FOUNDATIONS – QUÉBEC, CANADA

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ABSTRACT

The Quebec Home Builders Association is the sole shareholder of La Garantie des Maisons Neuves (GMN), a government sponsored mandatory warranty programme in the province of Québec, Canada. GMN enrols approximately 20 000 units per year. Claims usually hover around $7.5 million annually.

In 2009, GMN was hit with a number of claims for faulty concrete foundations. As of today, 607 claims have been received and 88% of those inspected have been declared valid. GMN is now looking at repair costs of $65 million over the next five to six years, in addition to the claims that can normally be expected every year.

This paper presents a brief account of circumstances related to this specific group of claims and the consequences of this event.

SUMMER 2009

Claims for faulty concrete in the Trois-Rivières region began to appear in the summer of 2009. Numbers soon increased and GMN has to date received 607 claims. The situation was covered extensively in the local press, with homeowners being encouraged to protect their warranty rights by filing claims within the required timeframe, usually with the encouragement and support of the home builder. Approximately 88% of claims investigated thus far have been deemed valid.

The media is projecting 1 000 possible cases, including hundreds involving self-built homes not under the provincial mandatory warranty plan as well as several commercial projects.

LEGAL BASIS

The five-year guarantee with respect to major defects incorporates, by reference, the definition of such defects as set out in the Québec Civil Code. The Civil Code states that major defects are those that lead to the 'loss of the work'.

THE PROBLEM

The identification of the specific cause was a lengthy process requiring six weeks of careful laboratory analysis. During this period, speculation about watered down concrete at the site and poor site selection (swampy site) was rampant. In November 2009, GMN’s experts – the engineering firm of Inspec-Sol – determined that the problems were caused by the presence of deleterious material in the aggregate, more specifically pyrrhotite, a close mineral relative of pyrite (fool’s gold). The aggregate used for the concrete also included pyrite and chalcopyrite, but in lesser amounts. In the presence of humidity and oxygen, pyrrhotite aggregate swells, causing the concrete to crack and ultimately fail as it loses its structural properties.

The Canadian standard for concrete, CSA Standard A23.1, states that:

"Aggregates that produce excessive expansion in concrete through reaction other than alkali reactivity shall not be used for concrete unless preventive measures acceptable to the owner are applied.

Note: Although rare, significant expansions can occur due to reasons other than alkali-aggregate reaction. Such expansions might be due to the following:

a) the presence of sulphides, such as pyrite, pyrrhotite and marcasite, in the aggregate that might oxidize and hydrate with volume increase or the release of sulphate that produces sulphate attack upon the cement paste, or both…”

Figure 1: The trademark web-like cracks associated with construction problems.

Construction problems show up as web-like cracks, as seen in figure 1.
GMN uses a simple classification method (0, 1, 2, and 3) to grade the level of apparent deterioration. Under this system:

0 = No evidence of deterioration
1 = Capillary cracks
2 = Opened cracks
3 = Cracks of 3mm or more

Conservation work is carried out by GMN on affected concrete (grade 3) for the purpose of slowing the rate of deterioration and reducing the risk of water infiltration. Membranes are applied locally on affected works to reduce contact with oxygen and water. Periodic visual inspections of houses enable GMN to reclassify repair priorities of houses as the deterioration continues to progress.

The warranty plan’s decision-making process essentially relied on the opinion of an expert. All buildings constructed during the suspected troublesome years were bored to extract samples of concrete for testing purposes. Three possible outcomes would follow:

1. Clearly problematic – repairs needed.
2. Clearly not problematic – no repairs needed.
3. Not clear – additional time needed, both to let the problems clearly arise and to allow the Centre for Research on Concrete Infrastructures (CRIB) to more precisely research the chemistry of pyrrhotite and its more problematic levels.

Foundation walls of homes are usually built with 15-20 MPa concrete, which is weaker than concrete used for institutional or commercial work. Cracks developed approximately three to five years after construction. It is believed that similar problems will occur in buildings constructed of stronger concrete, but that the process will simply take more time to materialise.

**WHAT IT MEANS FOR HOMEOWNERS**

In a 2004 TV show, homeowners saw how a small group of houses (12) with similar pyrite problems had been repaired. Houses were lifted off their foundations and suspended in the air while concrete was demolished and repaired. Temporary stairs provided access to the house and temporary services were connected. Despite the restorative process of the exercise, it brought with it major disruptions.

Homes were also significantly devalued as repair costs were often as high as the homes’ original selling prices. The City of Trois-Rivières granted a significant real estate tax reduction, reflecting the houses’ loss of value.

**QUÉBEC, A MINING ELDORADO**

The deleterious aggregate is found in the geological province of Grenville, a huge region mainly north of the St. Lawrence River. It is known for its iron and ilmenite (FeTiO3) mines, industrial mineral potential and, to a lesser extent, its common metals.

It is believed that the aggregate that caused the problems in the Trois-Rivières area came from a single source (the area of the municipality of Saint-Boniface). Once the source was identified, a modification to the BNQ (Québec Standards Board) Standard 2611-905 was introduced in April 2010 to prohibit the use of aggregate from the Anorthosite rock formations in the Saint-Boniface area in the production of concrete.
SCALE OF THE SITUATION

GMN has tried to identify specific years when the aggregates would have been used in construction—around 2004 to 2006/7, and perhaps even later. Based on early projections involving 400 cases, GMN quickly understood it was dealing with a situation of an unprecedented scale and that required dedicated resources.

Solutions came in the form of:
- Creating a classification system to determine repair priorities.
- Assigning one person as decision maker on inspections and decisions to be taken (less risk of incoherence in the process).
- Mass mailings to inform the group of beneficiaries of the process underway.
- Public meetings to explain the problem, coverage and repair process in simple terms.
- A dedicated website (www.dossierbeton.com) to present information on the problem and to allow individuals to access their personal file and its status.
- Allocating repair contracts by lots of 15-80 homes with similar features.

BEFORE THE COURTS

The case is already before the courts with a local judge taking on its management as a ‘particular interest or special care’ issue. The same judge had been involved in a similar, but much smaller, group of cases between 2004 and 2006, and had applied the same management method. At regular intervals the judge convenes all the parties involved for administrative hearings. Here, issues such as the designation of a single expert by the defendants for the evaluation of damages, and the disclosure of information on insurance coverage are dealt with. GMN was also granted permission to make its exhibits available on a dedicated website rather than forward colossal quantities of paper—nearly 4 000 exhibits on 50 000 pages—to some 50 opposing lawyers.

TYPICAL QUÉBEC HOUSES

Most houses in Québec are built on 2.5m concrete foundation walls, half buried underground and half aboveground. The basement space is insulated and commonly used for bedrooms, playrooms and bathrooms. New home prices generally range from CAD$150 000 to $350 000. Construction is wood frame with exterior cladding made of vinyl or aluminum and generally one masonry façade.

![Figure 3: Examples of typical Québec houses](image)

REPAIR WORK

Remedial work involves demolishing faulty concrete, including footings, and installing new concrete foundations. Repair priority is determined by the state of deterioration. In the summer of 2010, 70 houses were repaired, with work on 126 units planned for this year. Costs per unit vary from $80 000 to the warranty limit of $260 000. GMN is now looking at an expense of $65 million, less any recovery from builders, suppliers and insurers.
Figure 4: The repair process, from preparation to completion.
GOVERNMENT HELP

The local homeowners’ association, La coalition proprio-béton (http://www.propio-beton.qc.ca), exercised continuous pressure on both GMN and the government to increase GMN’s financial contribution and obtain financial assistance from the government for portions of work not covered by the warranty. The provincial government is currently bolstering the consumer protection provided by the mandatory warranty plan, a major revision that should be in place in 2012. Both federal and provincial governments have announced they will contribute funds towards work not covered by the warranty plan and for self-built homes. The provincial contribution should be $15 million and the federal portion $5 million. The homeowners’ association is demanding an extra $10 million from the federal government and $3 million from the City of Trois-Rivières.

RISK REDUCTION

It has become clear that 0% pyrite or pyrrhotite in aggregates is not achievable from most, if not all, of the existing quarries producing aggregates for concrete in Québec. GMN has proposed that research on the acceptable level of pyrrhotite in aggregate be undertaken. For the moment, the only known limit is found in a European standard that calls for a maximum of 0.1% pyrrhotite for aesthetic reasons (staining and surface popping of the aggregate).

GMN and the two other warranty plans have adopted common construction guidelines for concrete used in the Trois-Rivières region. For a start, aggregates must be sourced from one of seven recognised quarries. With the expertise of Inspec-Sol, GMN undertook the characterisation of quarries for the purpose of identifying sources deemed acceptable. Quarries participate voluntarily in the annual process. Concrete supplied in the Trois-Rivières region must now meet the requirements as outlined in table 1, including the issue of concrete delivery slips indicating the source of the materials, the percentage of sulphur in the cement or the source of the cement paste.

Table 1: Warranty programme requirements for concrete in the Trois-Rivières area.

<table>
<thead>
<tr>
<th>Builder</th>
<th>Concrete supplier</th>
<th>Quarry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order concrete and obtain delivery slips:</td>
<td>Supply delivery slips confirming:</td>
<td>Annual report by geologist on:</td>
</tr>
<tr>
<td>• Compliance with CSA A23.1 standard</td>
<td>• Conformity to CSA A23.1</td>
<td>• Examination of exploited rock facies</td>
</tr>
<tr>
<td>• Aggregate certified from approved quarry (name of quarry)</td>
<td>• Aggregate certified from approved quarry</td>
<td>• Extraction of samples for testing</td>
</tr>
<tr>
<td>• Add superplasticiser</td>
<td>• Add superplasticiser</td>
<td>• Complete petrographic analysis</td>
</tr>
<tr>
<td>• Check max. slump at delivery (80mm ±10mm)</td>
<td>• Check max. slump at delivery (80mm ±10mm)</td>
<td>• Percentage of pyrrhotite and pyrite</td>
</tr>
<tr>
<td>• Code requirements: Mpa, percentage air, water/cement ratio</td>
<td>• Code requirements: Mpa, percentage air, water/cement ratio</td>
<td>• Percentage of sulphur</td>
</tr>
<tr>
<td>• Indicate percentage of sulphur or source of cement paste</td>
<td>• Indicate percentage of sulphur or source of cement paste</td>
<td>• Quality certification as DB Rock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Synthesis of the preceding elements</td>
</tr>
</tbody>
</table>

The proposal to investigate and set an acceptable limit on pyrrhotite and pyrite levels was supported by the Régie du bâtiment – the provincial government authority regulating building and warranty plans. A three-year study is now being undertaken by the CRiB at Laval University in Québec City. The CRiB is one of the foremost authorities on concrete research in Canada. Hopefully, results from this study will serve to update the CSA A23.1 standard on concrete.

Discussions are still underway with government authorities to allow for the creation of a special reserve for catastrophic events based on a contribution of $300 per unit. The reserve would serve to cover claims originating from such unforeseeable and damaging events as claims arising from the use of concrete containing pyrrhotite.

THE FUTURE OF GMN

GMN continues to operate but changes have been made to plan for possible future occurrences. One of these puts GMN at risk of losing its authorisation to administer a warranty plan, in the event of negative actuarial projections. GMN is currently solvent, based on the number of cases, repair costs and reasonable projections for recovery. Also possible in the future is the implementation, by the Government of Québec, of legislative changes requiring sturdier reinsurance arrangements and asset capitalisation. Should this occur, the smallest of three authorised administrators (La Garantie des Maîtres Bâtisseurs) would be unable to comply.

Association provinciale des constructeurs d’habitations du Québec inc. (APCHQ) negotiated a buyout of one of its competitors, La Garantie des Maîtres Bâtisseurs. It has subsequently registered all GMN home builders and new units in the newly renamed warranty company, La Garantie Abritat inc.
With this new arrangement, APCHQ separates past liabilities and new ones into two distinct companies, each authorised to administer the mandatory warranty.

**CONCLUSION**

Three years ago, we at GMN attended the Edinburgh Conference confident that we had achieved a high level of trust in our risk management practices and claims projections. Today, the pyrrhotite problems have deeply modified our view of warranty plan exposure.

Warranty plans stand alone; government will lend a sympathetic ear but will not necessarily act, industry will distance itself from problems, and builders will simply start anew with a new corporate shell. Events such as this one are also fertile ground for consumer lobby groups.

It is our opinion that a reserve for catastrophic events such as the one currently under discussion with the Québec Government is an absolute necessity.
THE QUESTION OF INTEGRATED DEVELOPMENT PROJECT VERSUS INTEGRATED COMMUNITY: A CASE OF COSMO CITY MIXED-INCOME HOUSING DEVELOPMENT, JOHANNESBURG, SOUTH AFRICA

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ABSTRACT

The goal of this paper is to appraise a case study of a mixed-income housing development. The case study is of Cosmo City, located north of Johannesburg, which emerged out of an urgent need to provide accommodation for the informal settlers of Zivenfontein and Riverbend who had been illegally occupying privately-owned land 25km north-west of the Johannesburg central business district (CBD). These informal settlements were characterised by substandard living conditions, low levels of income, high unemployment, low levels of education and limited access to basic services. The development of Cosmo City as a mixed-income housing project in South Africa is aimed at addressing these complex and peculiar circumstances, as compared to other international experiences. The paper concludes with the findings that the integration of the poor into the urban system is achievable with effective and efficient public-private partnerships. In addition, for mixed-income housing developments to be successful and sustainable there is a need for interactive participation of the end user or beneficiaries. And finally, that integration along social and racial lines can be achieved through appropriate housing typology.

INTRODUCTION

Housing is generally considered a valuable asset, both for homeowners and society. For households and society, houses are a social, economic and financial asset (Rust, 2008). As a social asset a house enhances identity and security, helps to build social networks and allows a household to access a range of social services and amenities. As an economic asset, housing can help a household generate an income through home-based enterprises or by providing rental accommodation. In theory, a house can also be used as collateral for finance, or as a tradable asset and a foothold into the property market.

Access to quality, affordable housing in cities has been an ongoing challenge for those living in poverty, and a persistent and contentious public policy issue that centres on the extent to which having a ‘decent home’ is a basic right of all South Africans, as enunciated in the Constitution of the Republic of South Africa, 1996. Section 26 of the Constitution states that ‘everyone has the right to have access to adequate housing’ and it is the duty of government to ‘take reasonable legislative and other measures, within its available resources, to achieve the progressive realization of this right’. This is reinforced by the Freedom Charter, 1955, which prescribed that ‘There Shall be Houses For All’. However, since independence in 1994 the provision of housing has been a major contentious issue in South Africa. This is especially the case in a country where the housing backlog is currently estimated at about 2.7-million households (DoH, 2005). The backlog has worsened in Johannesburg, in particular (SACN, 2006).

‘Mixed-income housing’ refers to developments that combine market-rate and public-assisted units, for people with income levels ranging from above-moderate income to very low. ‘Inclusionary housing’ requires that a certain percentage of new residential development be set-aside for the occupancy by families of very low and moderate income levels. ‘Inclusionary zoning’ is when mandatory inclusionary requirements are incorporated in the zoning code or housing element of a local authority and obtaining building plans is made contingent on the developer’s agreement to provide affordable housing. For the purpose of this paper we shall use the term ‘mixed-income housing’ to represent any or all the types of initiatives defined above. This is because the literature rarely differentiates between these initiatives.

Mixed-income housing development strategy has attracted the attention of many scholars and also features in many policy documents (DoH, 2005; Fraser & Nelson, 2008; Hoek-Smit, 2002; Huchzermeyer, 2005; Marshall, 2005; Milligan et al, 2004; Smit & Purchase, 2006). These scholars point out that mixed-income housing development is an innovative approach to housing delivery that provides a mixture of housing products to suit low-income earners, middle-income earners as well as high-income earners. Proponents of mixed-income housing at another angle posit that economic diversity within neighbourhoods would automatically enhance community interaction and improve neighbourhood characteristics (Cole & Goodchild, 2001; Joseph, 2006; Kleinhans, 2004). Early studies on mixed-income housing initiatives were guided by the general hypothesis that enhanced neighbourhood conditions –physical, political, and socioeconomic – translate into public goods that were broadly distributed across all households (Fraser & Nelson, 2008). Studies have shown that mixed-income housing does not automatically produce these hypothesised neighbourhood- and household-level outcomes, either in the developed or developing countries (Collins et al, 2005; Kleit, 2001; Popkin et al, 2004; Salama, 1999; and Varady et al, 2005).

DeFilippis & Fraser (2008) in reaction to these findings question the premises on which mixed-income housing and neighbourhood (MIHN) policy were always based on the above stated reasons, as they found themselves attracted to the ‘ideal’, in theory, but frustrated by its reality in ‘practice’. According to their research, these policies tend to ‘leave poor people in places without the social networks and informal social support of prior neighbourhoods’ (DeFilippis & Fraser, 2008). Poor urban neighbourhoods are noted to have dense networks of social support, which have been created out of necessity because services that are commodities in wealthy neighbourhoods (childcare, for instance) must be negotiated as non-commodified when the participants do not have money. They noted that mixed-income policies have failed to create social mixing, networks, interaction or institutional services and capacities.

Being in close proximity need not engender interaction, and when it does, that interaction may mean conflict as much as anything else. It is unclear whether or not the physical proximity of the rich and poor will lead to the rich even acknowledging, let alone understanding or trying to understand, the poor (DeFilippis & Fraser, 2008). Using the example of the United States Department of Housing and Urban Development’s (HUD) HOPE 1V program, Fraser & Nelson (2008) noted that mixed-income developments can reduce the incidence of social problems related to
concentrated poverty, while providing opportunities for low-income households to gain access to better neighbourhoods. Placed-based mixed-income housing initiatives, they argue, can play a role in creating a foundational environment in which other poverty ameliorating strategies can be more successful (for example, Welfare to Work, Jobs Plus).

Schwartz & Tajbaksh (1997) found that mixed-income housing represents the current direction of US housing policy, but caution that little is actually known about its social benefits, its costs, and the preconditions for its viability. According to their findings, research on mixed-income housing is necessary to determine the extent to which reducing the concentration of poverty can also reverse the social problems connected to poverty. Mixed-income housing is created through four different contexts, namely: density bonuses and other land-use regulations; special public housing programmes and initiatives; state and local housing programmes; and non-programmatic mixed-income housing (private individuals and organisations building and sustaining mixed-income housing outside of any institutional framework that specifically promotes such housing) (Schwartz & Tajbaksh, 1997:17).

Mixed-income housing development according to some analysts can have an important role in getting additional affordable units built, ensuring high quality housing and deconcentrating poverty. Notwithstanding the benefits, they further noted that mixed-income housing is not the silver bullet to overcome the difficult challenges faced by families seeking to escape from poverty or realities of housing markets. This is because mixed-income housing developments are complex, present unique risks, and often house fewer needy families than other types of development. Contextual factors at local, state and federal levels all impact mixed-income housing development as these projects typically involve complicated multi-level coordination (Fraser & Nelson, 2008).

In analysing the Malaysia government’s affordable housing policy, Smit & Purchase (2006) noted its intention to be a component of a broad framework of social development, as outlined in their Seventh and Eight Plan Period, spanning from 1996 to 2005. According to their study the public and private sectors have developed a business partnership venture whereby the state provides the land for the development of affordable housing units and assists developers in technical and administrative aspects; while the market provides the financing, implementation and delivery of housing units. Government regulations require that each house has a minimum area of 48 to 60m², and compromise three bedrooms, a living room, kitchen, bathroom and toilet. An inclusionary housing quota of 30%, and a defined ceiling price of MYR25 000 (US$8 351), is imposed on all private developers when a certain threshold size of development is reached.

Smit & Purchase (2006) noted that the 30% quota is imposed in line with the government’s objective to provide opportunities for greater interaction amongst various ethnic groups as well as eradicate poverty. Hence, restructuring the society in such a way that economic functions and race would no longer coincide. Notwithstanding these good policy intentions, Malaysia faces many challenges in relation to affordable housing delivery. Some of the houses meant for the lower end of the market are standing empty; the provision of low-income housing is being guided and regulated by 22 policies and it takes up to five years from the day of purchase of land until the approval of all the development plans (Smit & Purchase, 2006). In proposing the need and objectivity of inclusionary housing in South Africa, Smit (2007) recommends that it should be meant to:

- make a contribution towards achieving a better balance of race and class in new residential developments
- provide accommodation opportunities for low-income and lower-middle income households in areas from which they might otherwise be excluded because of the dynamics of the land market
- boost the supply of affordable housing (both for purchase and rental)
- mobilise private sector delivery capacity to provide affordable housing
- leverage new housing opportunities off existing stock at the same time as contributing to the densification of South African cities
- make better use of existing sustainable human settlements infrastructure.

This paper looks at how a particular integrated development project, Cosmo City, has integrated the resident community using a mixed-income housing development strategy, and unpacks hidden challenges and gaps in the approach in relation to the South African context.

THE RESEARCH AND PROBLEM STATEMENT

Attempts by low-income families to reside close to centres of economic opportunity have reinforced the proliferation of informal settlements, established without legal right or tenure. Support for the development of informal settlement as human settlement falls into a gap in South African housing policy and implementation (Huchzermeyer, 2004). Informal settlements are not simply ‘dormitories for employed households’ (as are most formal neighbourhoods), which need to be improved as mere shelter. Rather, they are places of residence and socioeconomic activity, in which the inhabitants pursue a variety of livelihood strategies. This paper looks at an attempt by the City of Johannesburg (Col) to co-opt residents of informal settlements into formal neighbourhoods through a mixed-income residential development strategy. Research shows that isolation and poverty combine to produce other disadvantages for neighbourhood residents leading to a host of negative outcomes (Coulton et al, 1996; Ellen & Turner, 1997; Jenks & Mayer, 1990; Land et al, 1991; Taylor & Covington, 1993). Although the term ‘mixed-income housing development (inclusionary housing)’ is becoming widely used, there remain certain gaps and many open questions about how best to

implement it, what the expected outcomes are, and how it can improve the quality of life and prospects of low-income families? In line with these questions, this paper attempts to:

- look at the rationale behind the mixed-income housing development strategy and the extent it has contributed to the integration of communities along both economic and social lines
- examine the shift in urban development strategy with a focus on informal settlement upgrade and inclusive city strategies using mixed-income housing typology
- recommend how ‘not in my back yard (NIMBY) syndrome’ concerns over property value and crime can be overcome through the mixed-income housing development strategy.

**WHAT IS THE IDEA BEHIND MIXED-INCOME HOUSING DEVELOPMENT?**

The mixed-income housing strategy in South Africa is still in an embryonic stage of development, and as such, this research was carried out at the right time to provide early informed insights. The reasons behind the promotion of mixed-income housing development varies greatly in both their content and strategy. According to Joseph et al (2007) and Joseph (2007) there are four reasons why the mixed-income housing development strategy is driven, namely:

- The improved social network/social capital of poor people who live in mixed-income housing development neighbourhoods.
- The increase in social control and improved social organisation the poor will have if living near middle and upper class people.
- The importance of middle class and wealthy people on the behaviour of the poor in terms of presenting role models for the poor.
- The improved services and goods available to the poor once upper income people live nearby (the political economy of place).

The first of these four has its roots in Putnam’s understanding of social capital as enunciated by DeFilippis & Fraser (2008) who noted the thinking behind this is that poor people lack social capital and placing them in proximity to wealthy people will increase the quality and quantity of their social networks, thereby enabling them to improve their incomes and quality of life. The second and the third have their roots in Wilson’s ‘underclass’ perspective and Lewis’s ‘culture of poverty’ — the distinction between the two (Wilson and Lewis) being increasingly irrelevant from the point of policy. Brophy & Smith (1997 cited in DeFilippis & Fraser, 2008) bluntly put it that ‘physical concentration of poor households in multifamily projects causes severe problems for the residents, including joblessness, drug abuse, and welfare dependence. A mixture of income levels will reduce the social pathology caused by concentration’.

Though there is little empirical evidence to support the first three reasons, as it will be shown in this paper, Schwartz & Tajbakhsh (1997, cited in DeFilippis & Fraser, 2008) reiterated that it is ‘largely on faith and on dissatisfaction with the previous thrust of low income housing policy’. Secondly, there is confusion between space and society. The recognition that the spatial concentration of poverty may, in many cases, lead to a worsening set of experience of poverty, is not at all the same thing as saying that spatial concentration causes poverty. But what has happened is that mixed-income housing development has used space to displace the issue of poverty. Implicit in this understanding is the unstated assumption that the middle class or wealthy people do not have anything to gain from the proximity of poor people. Poor people, in much of this language, come to be simply, ‘a problem that we need to spread out’.

**South African housing delivery strategy post-1994**

The cornerstone of the post-1994 housing policy was a new Housing Subsidy Scheme with a once-off capital subsidy targeted at the ‘poorest of the poor’ (Tomlinson, 2006). The government housing subsidy is a grant that the South African government gives to citizens or permanent residents who need help to get a house of their own. Beneficiaries are not expected to pay it back, but it is not money in their hands. The money goes to the developer or builder to help them pay for the land or house. A developer can be a private company, the local authority or a community organisation. The housing subsidy scheme is divided into different categories, namely: project-linked subsidies; individual subsidies; consolidated subsidies; institutional subsidies; rural subsidies; and people’s housing subsidies. Many housing practitioners consider South Africa’s housing programme to be one of the most successful of any country (Gardener, 2003). The publicly stated target was to develop 1-million subsidised houses within five years. On average 470 housing units were delivered in South Africa every day between May 1994 and May 2002 (Rust, 2003), affecting the lives of over 6-million people. According to one analyst, nowhere in the developing world have countries committed such vast resources to providing free or subsidised houses to the poor (Sunday Times, 2007).

**Breaking new ground**

This is a comprehensive housing plan for the development of integrated sustainable human settlement introduced by the government in September 2004 in view of oversight by the government in promoting the residential property market. Slow delivery on new government-subsidised low-cost housing is often put forward as the cause of the continuous persistence of informal settlements. It is an approved government housing programme in the next five years that includes the development of low-cost housing, medium-density accommodation and rental housing, as well as stronger partnership with the private sector; social infrastructure and amenities. Building multicultural communities in a non-racial society also aims to change the spatial settlement pattern through state housing. This national policy on informal settlement upgrading was developed in response to international campaigns (Huchzermeyer, 2004). Key strategic priorities are to:

- accelerate housing delivery
- improve the quality of housing products and environment to ensure asset creation
- ensure a single, efficient formal housing market
- restructure and integrate human settlements.

While the above comprehensive housing programme notes the continued relevance of the state housing programme introduced in 1994, it flags the need to redirect and enhance various aspects of policy, and commits the Department of Housing (DoH) to meeting a range of specific objectives, which is the creation of sustainable human settlement (DoH, 2005:4).

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MIXED-INCOME HOUSING DEVELOPMENT IN COSMO CITY, JOHANNESBURG

Cosmo City emerged out of an urgent need to provide accommodation for the informal settlers of Zevenfontein and Riverbend who had been illegally occupying privately-owned land 25km north-west of the Johannesburg central business district (CBD). These informal settlements were characterised by substandard living conditions with limited access to basic services (Cowden, 2006). The socioeconomic profile of both communities is based on low-income levels, high unemployment rates and low educational levels, amongst other headline issues. The idea was that Cosmo City would create jobs and stimulate local economic activity for these people. It is located north of the R512 road and falls under peri-urban land-use zoning. The choice of the location for the mixed-income housing project has been found to be of central importance for economic viability. Finkel et al (2008) note that if a site is convenient and attractive, higher-income residents will be drawn to the newly built residence, especially if there is availability of homeownership options.

Cosmo City is very accessible and well located. It is a greenfields development commissioned by the CoJ in conjunction with the Gauteng Provincial Housing Department (Cowden, 2006:1). The project was conceptualised to stand out as a mixed-income residential development where people of different income groups live in the same area utilising similar amenities. The projects have been driven with many difficulties, especially from surrounding neighbours who waged a series of legal battles believing that the development would devalue their properties. The delay in this project also centres on the NIMBY syndrome, which plagues spatial distribution of human settlement throughout South Africa (Luc-Limacher, 2009). The project was announced in 1997, but only commenced in 2005. Cosmo City tends to demonstrate that the supply-led approach to housing delivery can be as slow as compared to the demand-led approach. The objectives of the development are to:

- be the first greenfield development that will endeavour to comply with integration and sustainability principles as per government policies and legislation
- assist in meeting the pressing demand for housing in the north-western part of the CoJ resolving the conflict between environmental and economic considerations and social responsibility
- make a statement towards integration along racial and social grounds and negative perceptions that exist around such integration
- make a political inroad in the access of the poor to the formal urban system.

Development cost and planning

Based on rates applicable in 2008, the total development value of Cosmo City was calculated to be R3.8-billion (Luc-Limacher, 2009). This comprises of:

- 13% from the local authority CoJ (land, link and bulk services, enhanced internal services to low-income area and community facilities)
- 21% from provincial government (subsidy for 9 000 units, schools and clinics)
- 66% from the private sector.

The Cosmo City development set a precedent as the first mixed-use urban residential development (Cowden, 2006). It addressed a number of principles for sustainable housing, notably: urban integration; land use and design; income generation and affordability. The development goes a long way in creating a sustainable settlement comprising a mixture of Reconstruction and Development Programme (RDP) houses, finance-linked houses, bond houses, and social housing components.

Project description and planning

The project is located on 1 100ha of land with vast wetlands and the Zandspruit River cutting through it. Work started on site in January 2005 and due to the vast size the project was divided into phases. It comprises:

- 5 000 low-income houses (income group R0 to R3 500) with 1 504 completed; each unit is 36m2 of floor space and consists of two separate bedrooms, bathroom space with a flush toilet and a living area; this is known as RDP houses
- 3 000 financed credit-linked houses (income group R3 501 to R9 670) with 702 completed; subsidies are provided for people earning up to R7 000. First National Bank (FNB) is a partner to this section of the project providing 'step up' loans and the DoH will provide the subsidy
- 1 000 social housing rental units (income group R1 500 to R9 670) still under construction
- 3 300 bonded houses (open market)
- 12 schools
- 40 sites for churches, clinics and crèches
- 43 parks and recreational sites
- 30 commercial and retail centres
- 40ha of industrial park
- 300ha environmental area.

THE LEVEL OF COMMUNITY INTEGRATION IN COSMO CITY

Social benefit effect of the development

In looking at Cosmo City some of the questions that are always asked regard the social benefit: Does the project benefit the life chances of low-income residents? and What is the social interaction of the various income groups residing here? Although shortcomings of public housing and other projects have been noted in the literature, little research is available on the social benefits of residents of mixed-income housing developments (Schwartz & Tajbaksh, 1997). In Cosmo City there are three schools: two primary and one high school with recreational facilities. These schools cater for both low-income and middle-income earners, as well as residents living in the 5 000 RDP ‘give away’ housing units, plus high-income earners living in bond houses and social housing schemes. Sibongile, a low-income resident of Cosmo City, stated that ‘My children

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3 See www.worldbank.org/southafrica
living with me in RDP house are going to the same school with other children from rich family living in bond houses’. The three parks, equipped with various recreational facilities for children, such as a basketball court, swings and cricket nets, serve the whole community. The Hotel School is one of the unique social institutions in Cosmo City. There is also a housing support centre that provides information and assists the community.

Social amenities
The development has ample space for parking on site, 5% of the subsidies allocated to this project is reserved for the disabled and 5% for right-sizing. The three schools have been handed over to the Department of Education. The literature shows that the provision of attractive, on-site amenities and services will assist in drawing a critical mass of upper-income residents. One amenity that researchers find as a pre-requisite for drawing upper-income residents with children to mixed-income developments is access to safe and high-quality schools (Varady et al, 2005). Johannesburg City Parks funded the three parks. An informal trading area is provided in the vicinity of the low-income areas to allow members of the community to continue with income-generating activities. There is a site designated for the establishment of churches and a Catholic Church is already functioning in Extension 0. However, Cosmo City does not have a functional police station and presently utilises the services of the nearby Honeydew police station.

Community participation
One of the successes of Cosmo City is the level of community participation, as each of the extensions is governed by an elected leader who represents the interests and/or concerns of his/her ‘community’ at meetings with the managing developers. At such meetings issues affecting various extensions are discussed and problems are resolved. House rules, as they apply to regulations, rights and obligations of all residents, are communicated to these representatives. This umbrella group of extension leaders forms an important instrument to help monitor and report important issues that the developers might not notice in their routine site checks.

Challenges
One of the challenges of the project is the proliferation of informal sectors resulting from lack of availability of sufficient land to accommodate big chain stores. Another problem relates to the lack of a central taxi rank, but work is currently on going to erect one. The proliferation of informal activities poses many challenges and if not properly regulated might lead to ‘slum’ developments with adverse impacts on the sustainability of the project. The series of budgetary cuts to the project is also a major concern to the project team.

CONCLUSION AND RECOMMENDATIONS
The issue of ‘not in my back yard’ with the highly contested opposition to stop the project from residents in this north-western Johannesburg area was addressed through careful planning and implementation. Private sector participation in housing development should be encouraged, as most local authorities are struggling in terms of finance to address socioeconomic issues and service delivery. The idea behind the project has succeeded in creating an integrated community without compromising and infringing on people’s comfort. There is a need to strengthen the inclusion of mixed-income (inclusionary housing) as a policy to form part of the housing code. Mixed-income housing has the ability to deal with South Africa’s highly segregated built environment, as access to land is a very big issue and to acquire prime land for the location of the RDP houses is very difficult. The success of Cosmo City is the CoJ’s appropriation of land from private developers, which brought down the development costs.

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BREAKING THE CYCLE OF HOMELESSNESS: INNOVATION AND PARTNERSHIPS

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ABSTRACT

This paper highlights innovative approaches and partnerships undertaken by the Province of British Columbia, Canada, and BC Housing to break the cycle of homelessness. Outreach services provide immediate assistance to literally help homeless people get off the street. In the short-term, emergency shelters provide an effective gateway to services and housing. A ‘housing first’ approach and supportive housing are key to providing permanent solutions to homelessness. Breaking the cycle also requires cross-government collaboration and partnerships with all levels of government, health authorities, non-profit housing providers, private landlords, community-based service agencies, the private sector and people who are homeless.

INTRODUCTION

Purpose

The purpose of this paper is to highlight several innovative approaches and partnerships being undertaken by the Province of British Columbia and its crown corporation, BC Housing, to address homelessness. These initiatives range from short-term interventions that address immediate needs to longer term programmes and strategies that provide permanent housing for people who are homeless in British Columbia.

Context

Most people in British Columbia are housed successfully in the private market. However, about 16% need some form of housing assistance. Households spending 50% or more of their income on rent for adequate housing are considered to be most vulnerable and most at risk of economic eviction or homelessness.

It is estimated that about 6 000 people are homeless on any given day.1 About 70% of them suffer from substance abuse and/or mental illness. Aboriginal people are over-represented in the homeless population. The proportion of Aboriginal people at risk of being homeless is estimated to be 41%, more than twice that of the general British Columbia population.

BC Housing was established in 1967 as a provincial crown corporation to fulfill government’s commitment to developing, managing and administering subsidised housing. It works to assist British Columbians in greatest need of affordable and appropriate housing by providing a range of options along a continuum. The housing continuum extends from emergency shelter and housing for the homeless to affordable rental housing and homeownership. In 2010, BC Housing’s mandate was expanded to provide consumer protection for new home buyers and foster continuous improvement in the quality of construction of new homes in the province.

That same year, Vancouver, British Columbia, hosted the 2010 Olympic and Paralympic Winter Games. Leading up to these events, the province — through BC Housing, along with the City of Vancouver and other community partners — was able to influence the Olympic Bid Committee to include provisions for a ‘socially inclusive’ Winter Games. As a legacy, the games catalysed the creation of new social housing in the province.

The BC government has made it a priority to break the cycle of homelessness, and leads Canada in the creation and funding of innovative housing programmes to address this challenge. This includes programmes to develop new housing units and acquiring existing buildings to preserve the stock of affordable housing. In addition, the provincial housing strategy, Housing Matters BC, identifies several goals to address homelessness, and guides BC Housing in its work.

In total, about 95 000 households in British Columbia are assisted through subsidised housing. The BC government funds about 59 300 units managed by non-profit societies and housing co-operatives. Another 7 200 units are directly managed by BC Housing. The government also provides financial assistance to about 28 500 households, to help increase the affordability of their rent in the private market.

BRITISH COLUMBIA’S HOMELESSNESS STRATEGY

The BC government’s homelessness strategy is geared towards breaking the actual cycle of homelessness. This involves taking a leadership role and working in partnership with other levels of government as well as health authorities, non-profit housing providers, private landlords, community-based service agencies and the private sector. In addition, it requires collaboration within government among different ministries and departments.

The strategy embraces a ‘housing first’ approach. This involves connecting people with permanent housing and the services they need and want to maintain their housing and regain self-sufficiency. The cornerstone of the strategy is a shift in focus from providing emergency shelters to providing permanent housing with health and social services support.

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1 This number is based on homeless counts conducted in different parts of the province, including Metro Vancouver, Victoria, Fraser Valley, Kelowna and Nanaimo.
The strategy identifies a range of initiatives. Some are geared towards providing immediate assistance and getting people off the streets and into some form of shelter or housing. In the short term, the province recognises the need to maintain shelters until more supportive housing is built. It also recognises that improving and enhancing shelter capacity is an effective way to link people with the services and housing they require. In addition, the strategy recognises a need for ‘places of change’, where individuals can move beyond temporary shelter to more secure housing, gain greater self-reliance and achieve appropriate employment. Finally, the strategy recognises that permanent, supportive housing is required for most homeless people to break the cycle of homelessness. Evidence from many jurisdictions shows that supportive housing (i.e. independent housing coupled with community mental health and support services) effectively reduces homelessness and stabilises the lives of people with severe addictions and/or mental illness.

EXAMPLES OF INNOVATIVE PROGRAMMES AND PARTNERSHIPS

This section of the paper provides examples of government-funded programmes that use innovative approaches and partnerships to effectively break the cycle of homelessness.

Homeless outreach programmes

‘Partnerships with government ministries, health authorities, community-based agencies and housing providers to get people off the street.’

BC Housing works in partnership with several government ministries, community-based agencies and housing providers in more than 49 communities across British Columbia to reach out to individuals who are homeless. The programme is client-centred, and engages those people not reached by traditional services. Community-based agencies delivering outreach services help clients access housing, food programmes, drug rehabilitation services, counselling, basic living skills, health care and other services.

Protocols are in place with the Ministry of Social Development that make it possible to house homeless clients within a day. For example, the ministry fast-tracks access to income assistance for people who are homeless, provides security/rent deposits, and may pay rent directly to landlords, if appropriate. Outreach workers continually build relationships with local landlords to secure rental units and problem solve if issues arise. Programme funding enables outreach workers to provide rent assistance as needed, on a short-term basis.

A separate Aboriginal Homeless Outreach Programme was created specifically to reduce the number of Aboriginal people who are homeless. A disproportionate number of homeless individuals are Aboriginal, and outreach workers have found it necessary to address this in a way that recognises the unique cultural and social needs of Aboriginal people. The programme provides outreach services for chronically homeless, urban and rural Aboriginal people who are living off-reserve. In particular, the programme focuses on individuals who have been homeless for longer periods of time, or the ‘street entrenched’. Services include providing direct access to immediate housing with linkages to the necessary support services. These outreach programmes have recorded significant successes since they were established in 2007. Nearly 3 000 people were housed under the programmes from April 2010 to March 2011 at a cost of $5.5 million for the outreach programme and $1.5 million for rent subsidies.

Emergency shelter programme

‘Transformation of emergency shelters to become a gateway to services and stable housing.’

BC Housing works in partnership with non-profit community agencies to provide emergency shelters. Over the last few years, the BC government has provided funding for most shelters to stay open 24 hours a day, seven days a week and provide a minimum of two meals a day. This has enabled shelters to evolve from simply providing a bed for the night to having the capacity to connect individuals with local support services and act as a ‘gateway’ to more stable forms of housing. Shelters are now able to provide on-site case management, life-planning services, referrals and linkages to off-site services such as income assistance; employee training; mental health and addiction services; primary health-care; and life skills training. More than 1 570 shelter beds are available year-round across the province. Between April 2010 and March 2011, provincially-funded shelters helped about 4 400 people secure housing at a cost of $65.7 million for the shelter programme.

http://www.realpeoplerealives.ca/Single room occupancy hotels

‘Partnerships to provide “places of change” where housing and on-site support services help people stabilise their lives.’

In a move to protect affordable housing for people most in need, BC Housing purchased 23 and leased three single room occupancy (SRO) hotels. The acquisition of these hotels has enabled the BC government to effectively protect them from being redeveloped into upmarket housing. This also provided an opportunity to renovate and upgrade the buildings to improve living conditions.
Experienced non-profit housing providers manage the hotels and provide support services to create a ‘place of change’ for the people who live there. The hotels are a step up for people who have been sleeping on the street or in emergency shelters. They provide individuals most in need with a private room with a bed and, most importantly, access to support services, which are provided on-site. The BC government spent $141 million to acquire and renovate the SROs, and spent $16.5 million in 2010/11 for support and operating costs.

In Vancouver, where most of the SROs are located, the province, Vancouver Police Department and the non-profit operators of the SROs are collaborating on a new initiative, Partners in Action. The goal of this initiative is to enhance communications and procedures that enable the government-owned SROs to provide an environment that is safe and comfortable for all residents. Beat officers are assigned to specific SROs so they can establish one-on-one relationships with the non-profit operators and residents.

Provincial Homelessness Initiative (PHI)

The BC government launched this programme (http://www.bchousing.org/breakingthecycle) as a result of the Premier’s Task Force on Homelessness, Mental Illness and Addictions. The task force included mayors from across the province, and recommended this initiative as a way to help homeless people move beyond temporary shelter to more secure housing, gain greater self-reliance and achieve appropriate employment.

The province allocates funding to developments that integrate subsidised housing with support services for people who are homeless or at risk of homelessness; people with mental illnesses and physical disabilities; people with drug and alcohol addictions; Aboriginal people; youth; and women with children fleeing abusive relationships. Since its launch in December 2004, the province has allocated about 2,025 PHI units (for phases 1 and 2) in communities across the province. The BC government provided $171 million in capital grants for these units and spent $9.2 million in 2010/11 for support and operating costs.

The Phoenix Centre in Surrey, B.C., is an example of a public-private partnership that received funding through the PHI. It opened in April 2007, and is the first development of its kind in British Columbia to combine clinical addiction services with transitional housing, employment and education services. The facility includes 28 early stabilisation addiction services beds and 36 units of transitional housing, and offers a number of programmes on-site. Through a partnership with Kwantlen University College, a unique learning programme has been developed to help individuals in recovery upgrade their education. The centre also provides space for an employment programme that offers career planning and coaching while an on-site community centre offers aftercare support to residents completing Phoenix Centre programmes.

Local government partnerships

‘Partnerships with local governments across British Columbia to develop permanent housing for people most in need.’

Homelessness affects communities across British Columbia, and requires that the BC government, local governments and communities work in partnership to ensure that the necessary housing and support services are in place. The province asked communities to get involved in breaking the cycle of homelessness. Municipalities have responded by proposing city-owned sites that can be developed, and non-profit housing operators are working to build relationships within their communities.

To date, the BC government has reached agreements with eight municipalities to build more than 2,300 social and supportive housing units for people who are homeless and at risk of homelessness. The agreements have been formalised in memorandums of understanding (MOUs), which outline the roles and responsibilities of each party in the development process.

The province will pay all costs from the design of the housing units through to the issuing of development and building permits. It will also arrange all capital and operating funding, and enter into operator agreements with non-profit societies to manage the housing units and provide on-site support services. In return, the municipalities will lease city-owned sites to the province for a nominal fee for 60 years, meet the costs of all development permit fees and designate staff members to expedite the approval process. In many cases, the cities will also exempt properties from property taxes as long as development provides housing and services for people who are homeless or at risk of homelessness. The province has committed to spending $22.5 million per year for support costs once all 2,300 units are operational.

In Vancouver, the province is partnering with the City of Vancouver to develop 1,575 new units of social and supportive housing on 14 city-owned sites. The City of Vancouver contributed the sites, which were valued at $64 million. A unique feature of this partnership is the participation of the Streethome Foundation, which brings together people from all sectors of the community – business, non-profit organisations, government and citizens – to address homelessness. Streethome was created in 2008 as a partnership between the Vancouver Foundation, City of Vancouver and Province of British Columbia to break the cycle of homelessness through prevention, creating new supportive housing and improving the quality of life for those in need. Streethome will raise funds to provide $20 million towards the development of supportive housing on eight of the 14 sites. Other partners include the health authority, which will play a significant role in supporting tenants with mental health issues. Non-profit housing providers are responsible for managing the buildings and providing support services for residents.

Supportive housing registry

‘Community partnerships offer a single application and central registry for people seeking supportive housing’

BC Housing, in collaboration with non-profit housing providers, the City of Vancouver, Vancouver Coastal Health and the Ministry of Social Development, created this service to manage the allocation of supportive housing units. The registry will offer applicants a single point of access
to apply for housing on the 14 city-owned supportive housing sites in Vancouver and the provincially owned SRO hotels operated by non-profit agencies. This simplified service ensures that applicants and the referral agencies supporting them submit only one application. Previously, applicants needed to apply to each separate organisation operating the various buildings. The goal is to expand the registry to serve other communities in British Columbia with supportive housing and SROs.

Homelessness Intervention Project (HIP)

‘Partnerships within the provincial government – inter-ministerial collaboration.’

The BC government launched the Homelessness Intervention Project in 2009. The objective was to make a single government ministry responsible for coordinating provincial and community social housing and support services, including health and income assistance, for the chronically homeless. The goal was to integrate service delivery and ensure that services for homeless individuals with severe mental illness and/or addictions were delivered in an organised, fiscally responsible and timely manner to reduce chronic homelessness. This initiative enabled the government to align several government ministries, health authorities, the non-profit sector and other agencies to address chronic homelessness in five communities. It was successful in bringing all the players together in a community, focusing the entire service delivery system on addressing the needs of people who were chronically homeless. It also enabled communities to develop creative and unique responses, tailored to their particular circumstances. More than 85% of people served through the initiative remain stably housed.

CONCLUSION

Addressing the issue of homelessness requires innovative solutions and partnerships with all those who are affected. This includes all levels of government, health authorities, non-profit housing providers, private landlords, community-based service agencies and the private sector. It also requires cross-government collaboration. No one level of government, government department or agency can solve homelessness alone. In addition, breaking the cycle requires leadership and a strategy backed by sufficient resources. It also requires listening to community stakeholders and the homeless themselves to find out what they think will work.

The Province of British Columbia believes it is possible to break the cycle of homelessness. We have found outreach services effective in providing immediate assistance to help people who are homeless get off the street. In the short term, and until enough supportive housing is built, emergency shelters can provide an effective gateway to services and housing. We have also found that the ‘housing first’ approach works, and that supportive housing holds the key to a permanent solution to homelessness.

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A STUDY OF EUROPEAN BUILDING INSURANCE SYSTEMS

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ABSTRACT

In 2008 the European Commission launched a study titled, ‘The liability and insurance regimes in the construction sector: national schemes and guidelines to stimulate innovation and sustainability.’

The consortium CEA-CSTB, comprising Centre d’Etudes d’Assurances (CEA) and Centre Scientifique Technique de Bâtiment (CSTB), was appointed to undertake the study under the name, European Liability Insurance Organisation Schemes (Elios) (www.elios-ec.eu).

The study demonstrated the existence of similar concerns and purposes through the diversity of the national regimes and underlined the tendency for insurers and insurance schemes to play an increasingly regulatory role. This has led to some concrete recommendations, which are currently being taken into account by the European Institutions.

KEY EVENTS IN THE STUDY TIMELINE

There were a number of important steps that facilitated the undertaking of the Elios study and the presentation of its findings. Key events in the project timeline included:

- The launch of the Lead Market Initiative for Europe, of which sustainable construction was a key focus area (21 December 2007).
- The launch of a pilot project by the European Parliament to, ‘facilitate access to insurance by building contractors, especially the self-employed and small firms, in order to stimulate innovation and the promotion of eco-technologies in the European Union.’ (Official Journal of the European Union, 14 March 2008).
- The European Commission calls for tenders for its research study, ‘The liability and insurance regimes in the construction sector: national schemes and guidelines to stimulate innovation and sustainability.’ (28 May 2008).
- The European Commission and the CEA-CSTB consortium sign a service contract (19 November 2008).
- The preliminary version of the final Elios report is submitted (28 February 2010).
- An Elios workshop is held, where the findings and conclusions of the Elios research are presented (18 March 2010).
- The final Elios report is published (30 April 2010).
- The European Parliament approves the budget (December 2010).
- A meeting is organised in the European Parliament by Mrs Estelle Grelier, MEP, with the participation of Mr Vicente Leoz-Argüelles and Mr Antonio Paparella, both members of the European Commission; stakeholders of the construction and insurance sectors; and the Elios team, to discuss the way forward (23 March 2011).

SCOPE OF THE STUDY

The study was aimed to:

- Review the national building insurance systems within the 27 member states of the European Union (EU-27).
- Assess the impact of insurance regimes on consumer protection; the competiveness and the sustainability of the construction sector; and the economics of the insurance market.
- Identify insurance schemes and good practices that could specifically help craft and small construction enterprises exploit innovative solutions for sustainable construction and adopt responsible management practices.
- Make concrete recommendations about the extent to which the European Commission should support the formation and the promotion of such insurance schemes in the member states.

DIVERSITY OF NATIONAL REGIMES

Overview

The first observation which imposed itself with respect to the general framework of construction regimes in Europe was the existence of an extreme diversity of liability and insurance regimes across the 27 EU member states.
This is as referenced by:

- The conclusions of previous European and international studies i.e. those of C. Mathurin, the Group of European Inter-Professional Building Associations (GAIPEC) and IGF-CGPC.
- The five main ‘families’ of countries (i.e. Roman law; Anglo-Saxon; Nordic; Germanic; and Central and Eastern Europe countries).
- The patchwork of various systems across Europe, including:
  - Liability governed by law or contractually
  - Various scopes and durations of liability (from one up to 20 years)
  - Insurance imposed by law, by contract or no widespread insurance requirements or practices

Examples of different systems

To get a sense of the varying systems currently in place in European countries, it’s useful to compare these countries. For illustrative purposes, the systems of France, Spain and Belgium have been compared.

In France, the law is called ‘spinetta’ and was introduced in 1978. It features a 10-year liability (article 1792 C.C. and following articles) and no-fault liability, with one criterion namely, unfitness for the intended purpose. It’s a double-trigger system of insurances.

In Spain, that country’s LOE law, as it’s called, was established in 1999 and provides a legal compulsory framework with three terms of liability – one year, three years and 10 years. This reformed law was largely inspired by the French system and is a compulsory insurance.

In Belgium, the liability rules were derived from the Napoleon Civil Code. The law, called ‘laruelle’, was introduced in 2006 and provides for a 10-year liability (articles 1792 and 2270 C.C.) and condemnation ‘in solidum’. Compulsory insurance applies to architects only.

SIMILARITY OF CONCERNS THROUGH THE DIVERSITY OF THE NATIONAL REGIMES

A functional approach

The Eios study adopted a functional approach in analysing the liability and insurance systems of the 27 member states. In comparative law it is possible to distinguish between the traditional method, called structuralist, which is concerned primarily with the concepts and legal rules from a point of view, and a more recent approach called functional, which focuses on the results achieved in relation to a specific problem. The latter approach focuses the attention on purposes of the legal systems and on solutions, which have been developed as a response to a factual situation.

In order to illustrate the difference between these two methods, it is possible to quote the examples of the liability and insurance systems existing in the United Kingdom and France.

A structuralist comparison would lead to a conclusion that the regimes in these two countries have nothing in common as common law is applied and almost no mandatory insurances exist in the first case whereas, in the second case, decennial liability governed by codified law and double legal obligation of insurance can be observed.

On the contrary, the functional approach highlights some points of convergence since in practice, more than 90% of buyers of new dwellings in the United Kingdom are covered by guarantee issued by the NHBC, which lasts for a period of 10 years starting from handover of the property.

A growing need for security and guarantees

Within the great diversity of the national regimes in Europe, it is possible to observe various manifestations of the same and general trend: a growing need for security and guarantee in the construction sector.

These manifestations include:

- Specific juridical frameworks governing the liabilities of constructors.
- Joint and several liabilities.
- The tendency to implement mandatory or widespread 10-year insurances, especially in the field of dwellings.
CONCLUSIONS
A strong tendency to implement home warranties and mandatory insurances leads to an increasingly regulatory role of the insurance schemes and of the insurers.

As a result, there is a need for:
- Information, particularly for small and craft enterprises providing cross-border services.
- Mutual recognition of signs of quality.
- An inventory of the difficulties encountered in connection with the use and implementation of eco-technologies.

Final recommendations
A number of concrete actions to be promoted by the European Commission were recommended. These included:
- Establishing a link with the member states in matters relating to construction insurance.
- A single point of contact for information about cross-border construction activities.
- A handbook of quality labels and indicators (at the European level).
- A European observatory and database of construction pathology relative to eco-technologies.
A CHALLENGE FOR MANAGERS OF GUARANTEE PLANS IN QUÉBEC

~Marc-André Roy

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ABSTRACT

Managers of guarantee plans for new residential buildings in Québec are facing a number of challenges related to the presence of the mineral pyrrhotite in the aggregate used in certain concrete. This paper describes this situation and proposes a governance model to effectively manage the risks associated with this type of problem.

AN OVERVIEW OF GUARANTEE PLANS IN QUÉBEC

In the mid-1970s, guarantee plans were offered on a voluntary basis to buyers of new homes in Québec. Since 1999, following government regulation, guarantee plans for new residential buildings have been required for buyers of new homes and condominiums built by contractors licensed by the Régie du bâtiment du Québec.

Three private administrators were authorised to manage the plans, namely La Garantie habitation du Québec inc. (Qualité Habitation) of the Association de la construction du Québec (ACQ); La Garantie des maisons neuves (GMN) of the Association provinciale des constructeurs d’habitations du Québec (APCHQ); and La Garantie des maîtres bâtisseurs.

In the early 2000s, 30 owners of new homes in the Trois-Rivières area, 140 kilometres east of Montréal, began experiencing problems due to concrete aggregate that had been produced using pyrrhotite. Pyrrhotite is an iron sulphide mineral that reacts strongly to humidity, air and oxygen by expanding, causing significant cracking of foundations and brick and stone cladding (Coalition Proprio-Béton). Neither the APCHQ, manager of the Garantie des maisons neuves responsible for the administration of guarantee plans for these 30 buyers, nor the Régie du bâtiment du Québec, could find solutions to this problem. Qualité Habitation, for its part, issued a directive from management not to recruit new members in this region of Québec.

In 2009, several new cases were reported, also in the Trois-Rivières region. To date, 700 cases of concrete containing pyrrhotite have been listed. Of these, 550 properties were protected by guarantee plans – 530 by the Garantie des maisons neuves of the APCHQ and 20 by Garantie habitation du Québec inc.

It is worth mentioning that the cost to repair the damage caused by the presence of pyrrhotite in concrete is equivalent to about 50% of the values of the house. In some cases, the repair amount could even equal the cost of building a new house.

In February 2011 the APCHQ purchased a competing plan, La Garantie des maîtres bâtisseurs, and renamed it La Garantie Abritat. This was necessary as this particular guarantee plan administrator faced a potential liquidity deficiency due to the pyrrhotite problem. As a result, it has been able to operate under a different name in order to meet the regulations of the Régie du bâtiment du Québec.

GUARANTEE PLANS – CONSUMER PERCEPTION

Following the emergence of the new cases in 2009, a number of homeowners affected by the pyrrhotite problem joined forces to seek compensation for the damage caused. The Coalition Proprio-Béton was established in the Mauricie region to represent such homeowners. Numerous demonstrations have since taken place in downtown Trois-Rivières in front of the Québec National Assembly building and at the Canadian Parliament Building in Ottawa to raise awareness around this issue, which has also been covered extensively in the local press.

In 2010, the government agency responsible for guarantee plans conducted an investigation into this mechanism and found that knowledge of the guarantee plan by condominium owners and condominium owners’ syndicates was generally good. But it also uncovered a level of dissatisfaction. Consumers affected by various problems complained about a range of issues related to such plans, including:

- The length of time it takes to resolve (sometimes urgent) issues.
- The inability by some contractors to meet the expectations of their customers in terms of corrective action.
- A lack of understanding by consumers regarding coverage provided by the guarantee plans and the inadequate dissemination of documentation.
- A misperception about the veracity of guarantee plans among consumers dealing with construction problems or condominium owners’ syndicates.
- That the administrators of guarantee plans are too close to the construction industry.
The pyrrhotite issue has begun affecting one of the guarantee plan administrators financially; the foundations of nearly 550 houses in the APCHQ’s new home warranty programme must be repaired in Trois-Rivières. About 20 claims have been lodged with La Garantie Habitation Québec for pyrrhotite problems.

Guarantee plans – reaction of the Québec government to consumer pressure and solution options

Government met with guarantee plan administrators and expressed its concern at the unfolding situation. In essence, it questioned the management of guarantee plans by the private sector. It proposed a number of possible solutions, including nationalising plan management and creating a single administration fund; appointing an ombudsman; and instituting government inspectors.

La Qualité Habitation, however, disagrees with the idea of a sole administrator of guarantee plans. It lists the following as the potential consequences of such action:

- Loss of any kind of contractor support and construction industry expertise.
- Loss of support and continuous training to contractors.
- Potential bureaucratic delays in processing claims.
- Healthy competition (in terms of costs) would be eliminated.
- Premiums would double.

GUARANTEE PLANS – REACTION OF ADMINISTRATORS TO CONSUMER PRESSURE AND SOLUTION OPTIONS

The administrators of the two guarantee plans have mutually agreed to tighten controls to prevent further problems, pending the results of a study that will establish a quality standard for concrete. The administrators now require daily management of the quality of concrete by inspectors and laboratories for each casting. The two administrators (competitors for the same market) are working together to find solutions and thereby protect the continuity of guarantee plans. Some of the suggestions being put forward (and undertaken) include:

- Improvements to the existing structure
- Increased monitoring and verification measures by the Régie du bâtiment du Québec regarding the management of guarantee plans
- The creation of a compensation fund to financially manage ‘forces majeures’
- The creation of an oversight committee comprising representatives of guarantee plans, government, financial institutions and consumers
- The hosting of regular meetings among plan administrators, contractors and consumers to find solutions to the pyrrhotite problem

Both administrators agree with government’s suggestion to appoint an ombudsman, and the two are currently helping to finance a study conducted by specialists from two universities that will lead to the definition of a quality standard for concrete.

GUARANTEE PLANS – POLITICAL ASPECT

In agreement with the APCHQ, Qualité Habitation has submitted a formal proposal to improve the management of guarantee plans. Qualité Habitation and the APCHQ have made numerous representations to government to tighten the Régie du bâtiment du Québec’s supervision of the activities of plan administrators; Qualité Habitation has made various recommendations to government; and meetings have been held with the labour minister. In addition, a roadshow has been held to meet with accredited contractors and members of boards of directors of affiliated associations (ACQ), and an awareness campaign initiated among Québec MNAs. Finally, a meeting has been scheduled with the Québec premier.

QUALITÉ HABITATION’S MODEL

As soon as it was established, Qualité Habitation’s mission was to institute procedures for guiding subsequent administrative activities; to be the benchmark for guarantee plans while working with the most qualified contractors. Some of the risk management mechanisms that have been in place since its founding include:

- Worksite inspection plans tailored to each contractor.
- The establishment and monitoring of quotas for the registration of new homes.
- The phase by phase approval of condominium projects.
- Personalised training with contractors to prevent problems.
- The establishment of a watch list for contractors in financial difficulty (during construction or after-sales service).
- The twice-yearly evaluation of operations.
- The monitoring of administrative documentation regarding the guarantee.
- Consumer satisfaction surveys.
- A support service to transfer condos to new condo administrators.

In 2010, Qualité Habitation recorded a customer satisfaction rating of 82%, where 0.12% of cases were referred for arbitration. Through proactive upstream management and close collaboration between staff of Qualité Habitation and its contractors, only 15% of premiums collected are paid out to make repairs as a result of claims, thus leaving more money available to develop management tools to increase the efficiency of contractors and construction quality.

CONCLUSION

This situation enabled Qualité Habitation to improve its visibility to government by demonstrating its years of sound administrative management. Consequently, the organisation’s credibility with government has been enhanced, as it has with partners who have been involved in the exercise. Our proactive approach to risk management has proved a success. Our collaboration with contractors at all stages of a construction project
contributes to their success, while providing the consumer with added protection. All employees of Qualité Habitation, whether inspectors, conciliators or representatives, have a role to play far beyond their basic job that entails working with contractors out in the field and closely monitoring work done. In this way, problems are identified early and resolved quickly.

Close collaboration with all partners, including our competitor, in managing this situation demonstrated Qualité Habitation’s determination to preserve guarantee plans. Moreover, several Qualité Habitation administrative processes have been incorporated into the recommendations made to government in order to keep responsibility for the management of guarantee plans within the construction industry.

Qualité Habitation believes that building contractors, by sharing their expertise and experience accumulated over the years, are best placed to manage guarantee plans. Qualité Habitation also believes it holds the key to proper administration of guarantee plans, whether through the continuous improvement of its management methods or through the guidance provided to its accredited contractors who meet strict evaluation criteria.

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La garantie des maisons neuves: www.gomaison.com
ABSTRACT

Low-cost social housing/dwellings in rural areas are often built without the necessary infrastructure, i.e. grid electricity, fresh/potable water supply, etc. This paper will introduce and describe a workable solution for a self-sustainable dwelling. This approach of a modular energy system minimises the dependence on infrastructure.

THE MODULAR UTILITY

UmzikaNtu Technologies and John Frazer Architects and Construction have designed an energy-utility unit, which could be added to current low-income houses in all areas. The unit consists of five modular spaces built onto the one side of a dwelling by conventional building processes, i.e. mortar and bricks:

- The first unit has a kitchen sink where the taps are connected to a water purifier. This utility will enable a household to utilise sources of water other than the purified water from the formal systems.
- The second unit is fitted with a liquid bio-gel stove, four plates (converted), with a ventilation system that will enable warm air from the stove to escape the dwelling during summer months, but be retained during colder winter months.
- The third unit is the fridge unit where recycled fridge doors and compressor cooling systems are used to construct a fridge.
- The fourth unit is used as a table top with space for kitchen cupboards below.
- The fifth space is used to store a deep-cycle battery with a charger unit. Lights may be operated from main line electricity, the battery or from the solar panels, depending on the availability of each. A low-pressure solar geyser with panels will be fitted onto the roof.

A typical low-cost house has been constructed on South African Bureau of Standards (SABS) premises for long-term sustainability testing (see figure 1).

OBJECT OF THE INVESTIGATION

Sustainable houses commonly generate their own electricity through the use of various technologies, such as solar cells. Water is typically collected from rain and then treated to be potable. The object of this investigation was to determine if:

- this energy utility unit, added to an existing house, would be sustainable
- the least possible energy from the formal grid could be used
- the inhabitants would be able to live in reasonable comfort.

Description of the house

The house was constructed on SABS premises. The dwelling consists of two bedrooms, one bathroom and a living/kitchen area. The energy-utility unit was added as part of the construction process.

NATURE AND METHODS OF TESTING

Low-pressure solar geyser system

The volume and water temperature of water from the geyser was measured at different times during the day. The solar geyser system functioned independently from any other source of energy supply. The normal water usage of four persons was simulated in order to determine the effectiveness of such a system in practice (see figure 2).
VENTILATION UNIT ABOVE LIQUID BIO-GEF STOVE

The temperature differences in summer and winter settings were measured and are shown in table 2. The mechanism of the ventilation system consists of a shield on tracks that could be easily turned between summer and winter settings. The winter setting will force warm air from the stove into the house and the summer setting will open a vent for the warm air to escape to the outside (see figures 3 and 4).

Fridge unit

The fridge unit was custom built and fitted into the space between the two wall extensions. The fridge door, insulating panels, motor and compressor were recycled and rebuilt from old fridges. The temperature inside this fridge was measured. It is important to note that this unit operates on grid energy. The energy has been measured and will be depicted in the results (see figure 5).
Deep-cycle battery and charging unit

The battery pack, charging unit plus the electricity distribution board were installed inside the fifth modular section. All the lights in the house could be supplied from the deep-cycle battery. The lights were left on until the battery ran down.

![Figure 6: Charger and battery pack](image)

WATER-PURIFYING UNIT

The water-purifying unit was installed under the sink unit. This unit will enable inhabitants to catch rainwater, which will then be potable after purification. The system can also be used to clean borehole water or water from small reservoirs.

![Figure 7: Water-purifying unit](image)

OBSERVATIONS AND FINDINGS

The following temperatures and electrical consumption were recorded for a period of approximately one month. The results for the water temperatures, corresponding to a volume of 124 litres, are depicted in table 1.

<table>
<thead>
<tr>
<th>Sunny clear days</th>
<th>Average temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>61°C - 66°C</td>
</tr>
<tr>
<td>Midday</td>
<td>75°C - 86°C</td>
</tr>
<tr>
<td>Afternoon</td>
<td>62°C - 88°C</td>
</tr>
<tr>
<td>Cloudy rainy days</td>
<td>52°C - 56°C</td>
</tr>
<tr>
<td>Morning</td>
<td>57°C - 64°C</td>
</tr>
<tr>
<td>Midday</td>
<td>57°C - 70°C</td>
</tr>
</tbody>
</table>

Temperatures in the vicinity of the stove during winter and summer settings of the ventilation system are depicted in table 2.

<table>
<thead>
<tr>
<th>Time</th>
<th>Average inside temperature, °C</th>
<th>Winter setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Summer setting</td>
<td>Winter setting</td>
</tr>
<tr>
<td>Morning</td>
<td>19 - 21</td>
<td>22 - 23</td>
</tr>
<tr>
<td>Midday</td>
<td>23 - 25</td>
<td>26 - 27</td>
</tr>
<tr>
<td>Afternoon</td>
<td>24 - 25</td>
<td>25 - 26</td>
</tr>
</tbody>
</table>

Temperatures inside the fridge units are depicted in table 3.
Table 3: Internal fridge temperatures

<table>
<thead>
<tr>
<th>Time</th>
<th>Average internal temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>11 – 16</td>
</tr>
<tr>
<td>Midday</td>
<td>11 – 16</td>
</tr>
<tr>
<td>Afternoon</td>
<td>11 – 16</td>
</tr>
</tbody>
</table>

Energy consumption from the main supply over a time period of one month (30 days) is depicted in table 4.

Table 4: Energy consumption, average

<table>
<thead>
<tr>
<th>Component</th>
<th>Energy consumption, kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fridge &amp; charger</td>
<td>180</td>
</tr>
</tbody>
</table>

The fully charged battery pack could provide energy to the five internal lights for at least 16 hours, which is equivalent to 1,66 kWh.

CONCLUSIONS

Four occupants, living in the house, were simulated for a period of at least 60 days and the following conclusions can be drawn from the experimental data:

- The warm water supply is adequate even during cloudy, cooler days.
- The fridge is functional, but care should be taken of where the compressor unit is placed. The cooling unit generates heat, which affects the fridge right above the unit.
- The fridge’s insulating panels should be more effective although it is functional.
- The battery pack could provide energy to the five inside lights, 104 watts, for approximately 15 hours. This is equal to 1,66 kWh.
- The energy consumption is very low and this system will ensure that the household will be able to be self-sufficient at most times.
- The temperature of the water in the geyser increases significantly during the day time and users of the system should be warned in order to avoid serious injuries, especially to little children and the aged.
- The winter/summer ventilator does have an affect on the temperatures surrounding the stove area that would eventually affect the ambient temperature of the dwelling, an increase in internal temperature when the winter setting is used and a decrease in temperature on the summer setting.

RECOMMENDATIONS

- It is recommended that a rainwater-collection unit be designed in order to provide water to the household through the purifying unit.
- The design of the fridge unit could improve by changing the position of the cooling unit. Currently it is blowing warm air onto the fridge unit, which makes it less effective.
- The warm air surrounding the fridge unit’s compressor and motor should be utilised for other purposes, for example heating the house during colder months.
- The tests were performed during summer and temperatures during winter may be lower than reflected in this paper.

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COMMUNITY PARTICIPATION TO LEAD SOCIAL UPLIFTMENT AS A SOLUTION TO SOUTH AFRICAN LOW COST HOUSING DEVELOPMENTS

– Colleen Avice Steenkamp¹ & Kevin Peter Whitfield²

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ABSTRACT

Essentially this paper suggests that while the issues surrounding true, honest and authentic sustainable development in housing is important, it seems somewhat extraneous when the social equity (concerning identity) of people is being disregarded. It is imperative therefore that those concerned with housing developments for the poor tackle the social issues of our time relating to architectural meaning, identity and culture.

This paper is not aimed at criticising the South African Reconstruction and Development Programme (RDP) or any similar developments, but is rather aimed at a possible solution to the loss of cultural identity within such housing developments. Addressing sustainable developments and sustainability – which includes social equity (which contains within it various related topics) – the paper will focus specifically the issues surrounding cultural identity, knowledge transfer and community participation as part of the solution.

INTRODUCTION TO IDENTITY

The architecture found within individual communities around the world is essentially and intimately related to the identity of the people within (Popeşcu, 2006). It is this narrative property found within mass produced architecture that has led to the loss of cultural identity and moral and ethical values, and the degradation of various other socio-economic issues. The Reconstruction and Development Programme (RDP) has engendered a loss of traditional, cultural and spiritual references, and cultural innovative practices, and this has led to an urgency to rediscover South African identity within the housing system.

Sustainability and sustainable development

Many have made a distinction between sustainability and sustainable development, where sustainability gives priority to the environment and sustainable development suggests an emphasis on development and economic growth (Dresner, 2002).

A ‘sustainable livelihood’ is a concept that has become increasingly important in the realm of development. This concept is central to poverty reduction, rural development and environmental management (Whitfield, 2010). Sustainable development can be viewed as the bridge to fully engage the world in a way that is empathetic, intuitive and aesthetic. The identity of indigenous people groups within the Republic of South Africa is vast, with a long heritage of artistic, mythical and sacred traditions that can provide us with a foundation on which to base our current endeavours and to address our sustainable responsibilities relating to social equity.

Social equity

Fathy (1986), whose worldwide reputation rests on his architecture’s ingenious inspiration from the local vernacular¹, said that architects are in a unique position to revive people’s faith in their own culture. Furthermore, he stated that “…if, as an authoritative critic, he shows what is admirable in local forms, and even goes so far as to use them himself, then the people at once begin to look on their own products with pride. What was formerly ignored and despised suddenly becomes something to be proud of. It is important that this pride (in a local skill, form and craftsmanship), involves products and techniques of which the local people have full knowledge and mastery (Fathy, 1986).

Cultural identity

Linking South African housing with the identity of the local people is not a factitious overture. In Building Dwelling Thinking, Heidegger (1971a [1954]) defines ‘dwelling’ as ‘mere existence on earth’. It is on this plane that South African communities have lost their identity. If the current housing systems being referred to (low cost housing) truly reflect the identity of the people, it speaks of an identity lost: traditional African housing should echo the traditions of the people. “(Architecture) connects forgotten and following ages with each other, and half constitutes the identity, as it concentrates the sympathy, of nations (Ruskin, 1901 p. 340).”

Identity within architecture is a vital concept of the modern era. Identity acquired this status due to the enormous changes that turned modernity into a powerful category: industrialisation, the perspective of history, and the pre-eminence of scientific thinking. These three factors brought with them unprecedented transformations, which were experienced as an immutable rupture that Hannah Arendt (1993 [1961]) defined as a ‘loss of tradition’. In this context, as Anderson (1991) observed, identity is constructed under the direct guidance of the binomial power and culture.

The binomial power and culture in the South African context refers to the political/ governmental power that drives the housing system and the culture or identity of the people within it (Foucault, 1980). With the ‘loss of tradition’ it becomes apparent that the binomial guidance suggested by Anderson is grossly unbalanced, with the governmental/political power¹ vastly overpowering that of the culture (the people), rather than working in partnership with it (De Meulder & Bouman, 1998).

¹ According to Lawrence (2006, p. 110), vernacular buildings are human constructs that are the results of interrelations amid ecological, economic, material, political and social factors. Furthermore, Ozkan (2006, p. 108) further described vernacular architecture as the highest form of sustainable building, as it not only uses the most accessible materials, but also employs the widest available technologies. Vernacular architecture comprises the dwellings and other buildings of the people. Related to their environmental contexts and available resources, they are customarily owner- or community-built, utilising a variety of traditional technologies. All forms of vernacular architecture are built to meet specific needs, accommodating the values, economies and ways of living of the cultures that produce them (AISayad, 2006; Asquith, 2006; Lawrence, 2006; Oliver, 1997; Ozkan, 2006).
In 1995, the strategic plan was to increasingly work in partnership with the informal sector to identify housing needs and simultaneously engage in capacity building – the transfer of skills from the formal to the informal sector. The challenge is to balance human development with delivery. The one is a prerequisite for long-term viability, the other for short-term stability (S.A., 1995 p. 9). The depletion of the cultural power that existed so richly in South Africa has not only led to the degradation of community structures, but also to a downward spiral of individual growth, moral values and ethical standards (S.A., 1996 p. 8).

In 1995 the term ‘holistic approach’ was used to describe the overall planning concept of the RDP houses: “…the plan not only should deal with the problems of housing and delivery systems, but also with the facilitation of a potentially strong community base and future living environment through careful design and management (Clarke, 1994 pp. 17-19).” When observing pre-demolished houses and townships it is obvious that the environmental concepts around sustainability were met: locally sourced materials, traditional construction methods, local craftsmanship, culturally mirrored designs and innovative solutions.

Vidal de la Blache (2006) gives a phenomenological analysis of the narrative ability of architecture, be it an individual creation or a whole settlement: ‘A city, a village, a house, is a descriptive element; however one thinks about their form and their material, or their adaptation to their way of life, be it rural or urban, agricultural or grazing, they enlighten the relationship between man and the soil’. Architecture and identity, individual and collective, appear to be essentially connected. This is true particularly for communities, since they identify themselves with the place in which they evolve.

It would follow that the ability to re-establish worth, ownership and identities of communities – and in so doing, social upliftment – lies in the hands of the housing developer, to design housing developments that positively reflect the identities of individual communities rather than treating all communities as a collective whole, regardless of the geographical location or cultural stem.

The issue of South African identities and cultures is therefore viewed as a volitional process, the significance of which is more noteworthy within a group, since collective identity is overtly constructed. The multiple manifestations engendered by this process have a common denominator: the aspiration towards identity. The diversity of manifestations is determined by the evolution of support for identification (ideological and/or aesthetic).

Knowledge transfer

Indigenous knowledge, according to Hirji (2002), is “a system of methods, customs and traditions developed over many generations, through a traditional way of life of an in-depth knowledge of a system or systems by local people (Hirji, 2002 p. 313).” Why has the indigenous knowledge of the South African people been largely overlooked by developers, the government and even by local communities themselves?

The knowledge, experience and skills of indigenous South African builders and craftsmen have an imperative contribution to make to the creation of sustainable communities, including the identity of individual groups. This is confirmed by Sawyer (1992 p. vii) who says that past and present indigenous knowledge plays a key role in sustainability. It seems necessary, then, that a housing precedent should be set where indigenous knowledge is integrated with modern innovative knowledge as was originally planned by the Reconstruction and Development Programme (Clarke, 1994), thus leading to the rebalancing of what Anderson (1991) termed the ‘binomial power and culture’.

This equally weighted binomial team could lead to the development of settlements and buildings that are both contemporary and modern, yet which build upon the characteristics of local and cultural traditions and knowledge, therefore amalgamating with the environmental and ecological context and simultaneously reflecting the identity of the local community. This would result in the upliftment of individuals and communities through education, traditional and cultural knowledge transfer, and the reimplementation of cultural traditions.

The suggested initiative which follows could be described as ‘mobilisation in an effort to achieve sustainable development and self-sufficiency’. The four-step strategy aims to include sustainable basic social services and infrastructures; job creation and the creation of regular incomes; and the upgrading of the livelihoods of the most vulnerable people. This would be achieved through the building and implementation of projects to stimulate cultural identity and knowledge transfer, therefore improving personal and community growth and hence, social equity.

Sustainable Development Strategy

Introduction

As architects and developers, one should seek to ensure that knowledge transfer through public participation needs to be integrated in all areas of development. The implementation of such a transfer system will lead to the ability to achieve ambitious goals, including appropriate social architecture for each region. This assertion stems from the basic lesson of development experienced around the world – that local communities need to implement projects that they believe effectively promote sustainable development (private-public partnerships, informed decision-making, flexible economy, and self-reliance). Within the design development, one should therefore encourage strategies that catalyse and facilitate community participation in development planning as well as transfer the needed skills to help communities within individual regions of South Africa manage such projects.
From this introduction then, one would translate this initiative into practical sustainability, integrated programmes and projects. The following strategies that promote public participation in local development should be considered for any housing initiatives action plan (adapted from Ben Meir, 2005). These strategies will help translate the initiative into reality for the benefit of the local people and serve as a model to effectively address the challenges and threats that face communities in South Africa.

The four-step strategy

Step 1: Training in facilitation
Development initiatives should begin a training period for members of the community in facilitation methods. It is imperative to include training in facilitation since it has been stressed that communities should embrace the development initiatives to ensure optimal implementation of the development underway. Community members who are typically young and eager to improve the social conditions in the villages they serve can be excellent facilitators of community development once they receive the necessary training. Facilitation techniques encourage broad community participation in local development. The interactive development experience creates mutually beneficial relationships and trust among the community participants as well as the developer. Typically, communities themselves can determine their specific development priorities. In the beginning, experts from both the public and private sectors could share and adapt priorities with local individual communities and counterparts.

Step 2: Establish community development planning and training centres.
Community development planning and training centres can play a key role in providing assistance to people most vulnerable to poverty and therefore, address a primary objective of housing initiatives. Planning and training centres located within communities and managed by community members would be able to assist local people in determining their priority goals and then, in the final design and implementation of the projects, their goals may be achieved. Community members should also be provided with training in management, facilitation, modern agriculture, traditional building techniques (for knowledge transfer), health and other skills desired by the local community to meet the necessary success.

The aim is to shape the method of development and rehabilitate sustainable community activity. Opinion leaders within the community can base the project on their constituencies’ self-described priorities, which will help achieve the community targets and increase their own prospect for success due to heightened local support. Community members and leaders who have acquired the skills and training to achieve collaborative development and have experienced the benefits of the training process could later prove to be excellent candidates for managing the scheme over an extended period of time. The community members described should understand that an effective social movement can begin with a series of community meetings where local people are given the opportunity to express their concerns and interests. They should realise too, that inclusive collaboration in the design and management of local developments will open the doors for the region and community to achieve its development potential. A local leadership will emerge that understands and is dedicated to addressing the real issues of concern to citizens.

Step 3: Assist in the creation of local associations.
Experiences around the world show that local associations are created (and civil society grows) when communities work together to accomplish their collectively defined development agendas. This impacts society’s ‘architecture’, as new tiers of cooperation form as neighbouring communities begin to implement projects beneficial to the entire region. An assessment ought to be made of additional reforms to further enable the initiative to promote an innovative civil society.

Step 4: Create a ‘team of coordination’
A ‘team of coordination’ is an administrative framework that organises the achievement of the previously described strategies. It has the flexibility to operate at local, provincial and national levels in order to negotiate partnerships (among communities, government agencies and NGOs) that promote local development.

Among the priority cases should be the inclusion of rural villages that neighbour each development. In many cases, these villages are statistically among the most isolated and poorest in the country. New income generated in these communities would reduce local dependence on the natural resources of the protected areas, which in turn advances nature conservation. In this way, economic development in itself furthers environmental goals. Thus the initiative should initially consider focusing its efforts in these areas and others that multiply benefits.

It is believed that for a relatively low cost, these strategies included in the development initiative’s action plan may turn out to be among the most effective ways of achieving goals. The strategies are, in a sense, natural extensions of the initiative and share its ultimate objective to “enable all members within the community, men and women alike, to avail themselves of a wide range of possibilities and opportunities (King Mohammed VI, 2005).” Public participation is the method that effectively attains this. The question that arises while initiating these steps is, will community participation across various regions, whereby local people design and manage projects that meet their unique needs, lead to social upliftment, cultural identity and sustainable communities?

CONCLUSION

As was noted by Ezaguire (1992, p. 19), local indigenous and technical knowledge within the building practice should never be overlooked. Local peoples’ knowledge about the specific conditions in which they live and work may be more exact than the knowledge of practicing individuals in the building profession. This is neither a failure within the building profession nor the idealisation of low-resource areas, but recognition of the division of labour between architectural research and the empirical knowledge that local indigenous people acquire in order to produce with available resources.
An approach that focuses on the active application of local technologies, methods (Fathy, 1973), forms and resources in a modern and development context will not be without its problems, challenges and setbacks, and will have to address themes and issues that so far have been largely disregarded in the field of local, indigenous and sustainable studies. For instance, as it will have to engage with – or indeed be part of – the so called development discourse (Grillo, 1997), there will be a need for critical discussions of the political and ethical dimensions of key concepts like sustainability, development, intervention and participation.

There already exists a long established, though still somewhat marginalised, discourse that focuses on the ways in which indigenous traditions and innovations may be integrated into contemporary building practices, as was summarised by Afshar and Norden (1997). At present, however, while concerns over sustainability and cultural identity continue to shed animosity over the processes of modernisation and globalisation, an alternative, innovative approach to development is continuously being sought. It seems more opportune and urgent a time than ever to incorporate the achievements of such research into contemporary practice.

Unfortunately, as was noted by Payne (1977), western models of planning and designs based on commercial land markets are penetrating most parts of our country. Perhaps in rural areas less so, but finding ways in which local and traditional knowledge and expertise may be integrated into urban contemporary building design and practice continues to be one of the main challenges one faces in the 21st century.

What is needed is the disposal of the stigmas of underdevelopment, poverty and the past that currently cling to the concept of indigenous traditional African architecture. Such research and education should focus on issues of process rather than product, and identifying general principles and concepts rather than basic facts and figures. More importantly, it should be critical and actively engaged in realities of the present, rather than remaining focused on the past. These ideals were further emphasised by Rapoport (2006) however, in order for the sustainable, innovative, indigenous and traditional architecture to teach lessons that are relevant to the future, a more problem-orientated, comparative and integrative stage that leads to explanatory theory needs to be entered.

Participatory approaches should become an integral component of the building culture as well as of development initiatives that aim to promote and establish sustainable supplies of locally available building materials (Marchand, 2006; Lawrence, 2006). Local appreciation for traditional architecture and building methods must be bolstered (Fathy, 1986), and its social, economic and ecological value recognised. The post-colonial dichotomy between tradition and modernity must be challenged. The popular association of tradition with stasis and ‘backwardness’, and the conceptual affiliation of modernity with concrete, corrugated iron and all things Western, must be debunked. Changing attitudes can only be achieved through educational processes that promote scholarly investigation, publications, public displays and open discussions (Marchand, 2006).

As long as the South African elites continue to conceive of traditional African “mud” architecture as the property of their poverty-stricken rural brethren, the truly African building tradition and African identity within South Africa, as well as the diversity of other building traditions and innovative designs throughout the county, will be progressively denigrated and may one day cease to exist (Marchand, 2006; Voss, 1992).

**BIBLIOGRAPHY AND REFERENCES**


(Endnotes)

1 Political/Governmental Power: The Reconstruction and Development Programme was all embracing, it started as the Redistribution Strategy elaborated by the COSATU. Numerous rounds of consultation eventually produced the RDP, which immediately became the ANC election platform, and was later converted into a government programme. The RDP office initially led the reconstruction directly from the President’s Office – a powerful and influential Power base.
ABSTRACT

The European Commission took the initiative to establish a legal instrument for European Contract Law. The implications of this initiative, in terms of the property law, are examined in this paper.

UEPC

The European Union of Developers and House Builders (UEPC), founded in 1958, is the umbrella organisation for federations of developers and builders in 10 European countries. Its members’ activities cover the entire real estate spectrum, including residential and commercial properties; the building and selling of new houses and apartments; and the holding of properties in portfolios.

The members of these federations are called upon daily, in the context of their activities, to sign contracts with private individuals, professionals (architects or engineers) and commercial/financial intermediaries. Typically the contracting parties agree freely to the conditions of contracts, although in some cases parties are subject to mandatory rules, e.g. consumer protection rules or certain types of contractual guarantees.

THE GREEN PAPER

The European Commission took the initiative to establish a legal instrument for European Contract Law and organised, in 2010, a public consultation on the green paper for potential actions. The UEPC has responded and formulated its position on this subject.

THE POSITION OF THE UEPC ON THE GREEN PAPER

Motivation

The green paper sets out a range of policy options geared towards building a European contract law for consumers and businesses. The aim is to facilitate a greater exchange of goods and services within the internal (European) market. It would thus be necessary to start the process by determining and quantifying the obstacles, sector by sector, to cross-border transactions that could present disparities in national legislation.

It would certainly be observed that the disparity in the standards or the usage in technical issues — arising from the design, nature or implementation of the material used — form a much greater obstacle to the internal construction and property market in general. Also, in most cases, harmonising the law would add nothing or very little to the internal property market because of the very nature of this sector.

Cross-border property

The object of property in contracts cannot be moved. The cross-border nature thus may only come from the parties to the contract.

Consumer protection

The issue of consumer protection is already the subject of a number of studies. It would appear that should European laws be harmonised, it would be a task of such enormous proportions that the solution would likely only be found through objective guarantees or assurances that would be removed from the general legal concepts that govern obligations and responsibilities.

Legal status of economic property players

Recent studies have highlighted the disparities that exist between national laws that establish the legal status of various players in property in general and in construction in particular, specifically through provisions that govern access to the profession. These laws are not without consequences on the obligations, responsibilities and guarantees of the contracting parties. Creating a legal instrument that does not account for these disparities would inevitably be incoherent.

Summary

If UEPC federation members welcome the European Commission’s initiative to establish a legal instrument for contract law in which they intend to participate, the nature and characteristics of the property sector that have been recalled (i.e. the natural absence of cross-border markets calling for the harmonisation of laws, the necessary protection of housing purchasers, the organisation of players in this sector, and the chain of contracts) speak in favour of “excluding property operations from the field of application of this legal instrument.”

EUROPEAN INSURANCE CONTRACT PROJECT EDIFS

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NHBRC HOUSING CONFERENCE 2011
A EUROPEAN STUDY ON THE LIABILITY AND INSURANCE SYSTEMS

Ellos

The consortium CEA-CSTB was appointed by the European Commission to study national liability and insurance systems, and to make recommendations on insurance schemes and good practices to stimulate innovation and sustainability in the industry.

Diversity of national regimes and growing need for security and guarantees

Within the framework of this study it has been concluded that, while on the one hand there is a great diversity of existing regimes of construction liability and insurance in EU member states, on the other, the functional similarities need to be highlighted as well. Whether a mandatory insurance law applies or whether the industry puts in place a quasi-mandatory insurance, there is a growing tendency in all countries to implement mandatory or widespread insurances.

CEA ON EUROPEAN LATENT DEFECTS INSURANCE AND HOME WARRANTIES

In the European context – with its recent evolutions and research studies undertaken in the field of construction (i.e. services directive, Ellos report, European Contract Law green paper, etc.) – the UEPC wanted to assess the conditions necessary to establish a standard European warranty contract. This would ensure the protection of the interests of property buyers as well as the sustainability of the property investments undertaken by members of its various national member organisations across Europe.

Centre d’Etudes d’Assurances (CEA) Belgium (under the commercial denomination of CEA Real Estate) and ASCCO International have been appointed to write the draft text for a European Warranty – a standard contract to be used by UEPC members.

INSURANCE CONTRACT EDIFIS: PERENNIAL PROPERTY DAMAGE INSURANCE INTEGRATING THE REQUIREMENTS OF SUSTAINABLE DEVELOPMENT

At the time of writing, the first considerations for the All Building Specific Insurance System (EDIFIS) had been made, and the major orientations of this European insurance product defined. Because of the extreme diversity of construction liability regimes across EU member states, a property damage insurance seems to be the most appropriate solution.

The insurance product will cover the period after completion of the works, will take into consideration the eco-technological developments in the construction sector and will cover the energy performances to be delivered.

CONCLUSION

European developers and house builders want to offer their customers (home and property buyers) effective protection against the consequences of faults or incidents that may occur in the early years after construction. The drafting of a contract whose terms are based on multiple experiences rather than theories, will be the best guarantee of its effectiveness.
ABSTRACT

Since 2010, the French Agence Qualité Construction (Agency for Construction Quality) has conducted a specific survey of risks of defects in low-consumption buildings to prepare the construction industry for the increase in energy-efficiency standards. The first phase of this study was carried out over six months among a sample of 50 players who were involved in about 30 building projects. The analysis was used to list a large number of dysfunctions and to identify the main factors of defects. Following these encouraging results, this study is being continued on a larger scale to contribute to the necessary adjustments of good practice standards and to guide preventive measures.

CONTEXT

Agence Qualité Construction/Agency for Construction Quality (AQC)

Founded in 1982, AQC is a French interdisciplinary organisation. It is a strictly non-profit organisation, whose executive board brings together representatives of almost all disciplines involved in the construction industry, including insurance companies, various French construction standards bodies and the Ministry of Housing and Construction.

AQC’s objectives are to reduce the number and scale of construction defects in order to reduce future building insurance costs. It also strives to improve construction quality both by taking preventive action and by promoting cooperation between the various groups of professionals.

Rapid evolution toward low-consumption buildings

Through the Grenelle national environmental forum, France has set ambitious objectives to reduce the energy consumption of the entire construction industry. In 2012, every new building will be a low-consumption building (BBC). In 2020, the objectives are to build positive-energy buildings and reduce the energy consumption of existing buildings by 100kWh/m2/year (primary energy).

To achieve these energy efficiency objectives, professionals in the sector have to use new products and must change the way they interact with each other on building projects. However, this rapid yet necessary change in construction practices and regulations could lead to new construction defects.

In line with its mission, AQC wants to avoid a possible generalisation of these potential new defects. However, our existing in-house tools that monitor and highlight construction defects have proved to be inefficient in successfully detecting the initial dysfunctions that occurred in the pioneering of low-consumption buildings. Moreover, the current methods for monitoring these pilot buildings focus mainly on technical description and performance follow-up. Thus, a real deficit of feedback on difficulties and dysfunctions in these buildings has been identified. In view of this situation, AQC and France’s Ministry of Housing and Construction have decided to jointly fund a specific study to fill this gap.

METHODOLOGY

Field survey

The chosen working method is based on a classic approach in risk management: the collection and analysis of feedback from pioneers by means of a field survey, as shown in figure 1.
Only buildings that were already being used were chosen for the field study. This was to better facilitate feedback on the three main phases of a building project: the design, the construction and the use of the building. To this end, the main criterion for the selection of these buildings was the period of use.

The targeted players or contributors that were actively involved in each selected project predominantly comprised the client/owner, the architect and the user (or operator). Whenever possible, the objective was to interview several contributors on each project in order to compare their interpretations of identified events.

The first phase of this survey was conducted from March 2010 to October 2010. A total of 50 contributors involved in about 30 building projects were interviewed during the three-month field data collection period.

Sample presentation

The sample of projects covered a wide range of typologies, including offices, educational buildings, individual houses, row-houses (or terraced houses) and apartment blocks, as shown in figure 2. Five of the selected buildings were renovation schemes.

![Figure 2: Distribution by typology (left) and an example of one of the selected buildings (right).](image)

Operations were selected from four regions of France only to ensure a representative sample of the four types of climates in the country, namely maritime, mountain, Mediterranean and continental (see later in the paper).

The sample was also representative of the principal technical solutions available on the market for structural construction materials (concrete, wood, metal, clay, mixed structure); insulation materials and mode (external, internal, etc.); and the various services plant equipment (for heating, ventilation, water heating, power generation, etc.). Only two specific items of services equipment were installed in most of the selected buildings: double-flow ventilation system units (61% of all cases) and solar water heaters (90% of residential schemes).

Data collection and analysis

Each defect event reported by an interviewee was collected according to a specific format, as displayed in figure 3. This data collection form separated the different characteristics, which described the event (in particular the type of impact and the cause) and clearly identified the product, equipment or technical solution concerned.

![Figure 3: An example of a collected defect event.](image)

Because of this dissociation, a double analysis of the collected data was possible. Firstly, defect events were listed for every specific technical solution and organised according to the frequency of occurrence. Then a second and more condensed, overview analysis was performed for each of the main defect risk factors (causes).

Initial results

A qualitative inventory of defects and dysfunctions by technical solution

To illustrate the wealth and range of data collected in the first phase of the study, this paper looks specifically at one item of equipment used in the buildings surveyed – the double-flow ventilation system unit.

The most frequent dysfunction identified regarding this unit related to the generation of noise pollution. Depending on the projects, the cause(s) of occurrence could be different and/or multiple. These varied from conception/design defects, in particular the location of the unit (figure 4.2), and...
the design of the air duct network to installation (i.e. non-regulated flow) and maintenance defects (i.e. clogged filter). In most cases the players managed to correct or reduce the dysfunction, for example, by installing a muffler (figure 4.1) or by optimising the flow setting.

<table>
<thead>
<tr>
<th>Technical solution</th>
<th>External Insulation with PSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of event</td>
<td>Dysfunction</td>
</tr>
<tr>
<td>Description</td>
<td>Non-joined installation of panels and interstices filled with plaster</td>
</tr>
<tr>
<td>Cause/Origin</td>
<td>Lack of know-how</td>
</tr>
<tr>
<td>Period of appearance</td>
<td>Implementation</td>
</tr>
<tr>
<td>Impact</td>
<td>Building envelope performance</td>
</tr>
<tr>
<td>Corrective solution</td>
<td>Training</td>
</tr>
</tbody>
</table>

**Figure 4:** Examples of corrective measures (i.e. muffler) and defects in a double-flow ventilation system.

Other dysfunctions were directly related to the performance of the system. For example, in figure 4.3, the system was installed in a non-insulated attic of a detached timber house. In summer, the temperature in this attic – which was covered with metal roofing – was very high. As a result, incoming air was being preheated before entering the house, thus creating thermal discomfort for the occupants (overheating). More generally, some players pointed out that the over-sized design of their systems directly affected its output and therefore the general energy performance of the building.

A lack of consideration of maintenance constraints in the design was also found in some cases. For example, in figure 4.4, the system was installed behind several air ducts and low down in the services plant room, making access to the equipment for maintenance purposes very difficult.

While these various examples of dysfunctions mainly related to design defects, other recurrent non-quality risk factors were identified through analysis of the complete collected data.

**An overview interpretation based on main defect risk factors**

A lack of know-how among some building contractors was often identified by the interviewed players as the primary difficulty faced during operation. In particular, this new generation of buildings requires high quality treatment of building envelope airproofing to avoid uncontrolled energy losses. However, few construction workers have already mastered the necessary care and practices this task requires. For example, figure 5.1 shows a defect in the application of the adhesive airproofing between a window and a steam-proof membrane; while figure 5.2 illustrates the overuse of polyurethane foam in a timber framed house to achieve required airproofing quality standards.

**Figure 5:** An illustration of the general lack of know-how in airproofing treatment.

A large number of dysfunctions also related to the incorrect setting of equipment, such as ventilation equipment (particularly for balancing flow), sensors for automatic artificial lighting control, roller shutters etc.

The management of interfaces between the works undertaken by the various contributors throughout the projects was another problem. The role and responsibilities of every contributor should be clearly defined from organisational, technical and contractual points of view.

Some dysfunctions were directly related to the quality of the industrial product delivered on the building site. For example, many airproofing defects were found in glazing beads of new windows (figure 6) or even in roller shutters.

**Figure 6:** An airproofing defect in a window, detected with a thermal infrared camera.
The survey also highlighted occupant behaviour as a defect risk. For example, some defect events showed non-compliance with instructions for the maintenance of equipment by the user or the risk of perforating the airproof envelope by installing new equipment, such as decoration on timber houses.

CONCLUSION

By gathering information on a wide range of representative dysfunctions, this method has proven its effectiveness in filling the gap on feedback on the risks of defects of this new generation of buildings, which will be standardised by 2012. While the limited sample does not allow us to make any statistical analysis of the results, the quality of the information collected – which has been compared with feedback from construction experts – seems representative enough to start sharing the results with the building industry. This would help to avoid a repetition of identified defects and, more generally, to improve the know-how of all players involved in construction projects.

These initial results also confirm the relevance of new recommendations for the building process, such as:

- Promoting an integrated design approach that brings together all the players involved at an early stage to maximise building comfort and usability while minimising resource use.
- Ensuring that all systems in a building are installed, tested, operated and maintained as originally intended (commissioning).
- Improving the know-how of construction tradesmen and contractors concerning energy efficiency and construction quality (notably with regard to airproofing performance).

PERSPECTIVES

Since 2011, this study has integrated an ambitious national programme called RAGE 2012 (standard practices for 2012 as defined by the Grenelle environmental forum). This programme aims to, in particular, update and create standards for construction practices in order to meet the objectives of building energy efficiency, as defined by France’s national Grenelle environmental forum.

Therefore, this study is currently continuing on a larger scale with the objective of increasing our sample to a total of between 150 and 200 operations by the end of 2011. With this in mind, partnerships have been signed with various organisations and construction standards bodies, which have direct sources of information and which contribute to this ongoing study by following the same working method.

Figure 7: The change in sample size since the start of the second phase.

REFERENCES

ABSTRACT

The author suggests that the age of consumerism has reached its climax and that the world is experiencing a consumer, sovereign economic and social crisis that has effectively demoted the commodity status of residential property.

The author further proposes that the structural changes that have taken place since 2007 are not unlike those experienced during The Great Depression, and that fundamental shifts within consumer and sovereignty behaviour are required to overcome impending economic and climate changes. It is suggested that this will require a fresh economic approach, perhaps in the form of the so-called ‘green revolution’.

Residential property as a preferred asset class and store of wealth creation faces a number of challenges. If homeownership is to reinvent itself, key stakeholders (including entities that provide defective workmanship warranties) will have to do the same, and position themselves to take advantage of the opportunities offered up by the new global economy.

THE US SUB-PRIME MORTGAGE LOAN CRISIS AND ITS GLOBAL AFTERMATH

Global context

The wealth of the world was calculated at approximately US$44 trillion in 2008, of which approximately US$13.2 trillion was held in residential property. Since then, the collective wealth of the world has decreased to approximately US$35 trillion (World Bank). Prior to the economic downturn, homeownership was considered the cornerstone for wealth creation.

Property is, by its very nature, a ‘boom-bust’ commodity. Historically, these cycles repeat themselves every seven years, with property currently being in a ‘bust’ cycle. Against this backdrop it would appear that the economic aftermath of the sub-prime market crisis marked the end of the age of consumerism as we knew it. It also appears that the outlook for residential property as an attractive asset class remains, for the balance of the decade at least, murky.

The recent global recession exposed the over-indebtedness of both sovereign states and their citizens, where both parties were living beyond their means for at least two decades. There is a shift now towards a more frugal approach. Such austerity measures and changing values will result in both economies and individuals reducing their overall indebtedness, which is likely to result in lower economic growth, compared to the past decade.

Capitalism relies on increasing levels of consumption. As a result of the aforementioned scenario, this now too is in the process of being replaced by more responsible, lower consumption levels, which in turn reflect themselves in lower business profitability and formal employment opportunities. Some economists have coined the phrase ‘the new global economy’. Despite attempts by most developed countries to artificially stimulate their economies either through negative real interest rates and/or sector-based stimulatory packages/financial bailouts, economic growth within these countries remains lower than during the previous decade.

The steady increase in the oil price over the past year has yet to fully reflect itself in most economies, with some economists warning that the energy crisis could result in a fresh recession, or a ‘double dip’, within many economies. Further, economists warn that the world is sliding towards economic ‘stagflation’, a situation characterised by high inflation and unemployment levels and low economic growth. In some quarters there is the suggestion that this cycle could last for at least a decade, with residential property price growth being commensurately affected.

International bank regulators – prompted by the discovery of inappropriate lending standards primarily within the United States and a number of European Union countries – have forced local regulators to demand a review of bank lending, capital adequacy and liquidity standards in the form of amendments to the international regulatory framework that governs commercial lenders (Basel III). Since its inception, this framework has shifted from an initial capital limitation framework to include the granularity of asset classes and now to also focus on liquidity management. Going forward, lenders can expect to have to manage their liquidity ratios (net cash outflows/matching long-term loans with deposits with a term of at least 12 months); risk weighted capital; and minimum surplus capital to be held in prescribed assets.

This presents another challenge for the residential mortgage market, where the expected lender ‘liquidity squeeze’ will force lenders to either reduce their mortgage portfolios and/or review the pricing of their mortgage loan portfolios.

South African context

While South Africa escaped a financial crisis similar to that of the United States, it did not escape the resultant global economic fallout. In 2009 the country experienced its first recession in 17 years. Over the past two years it has shed approximately 1.2 million jobs (19% of its formal employment workforce) and now faces a position where 5.3 million taxpayers support a population of almost 50 million people. Of that figure, 40% of the people are under the age of 16 and nearly 15 million rely on the state for welfare hand-outs.
This is an unsustainable position both for the state and the private sector. On the one hand, the state is forced to try and recover lost revenues from a recessed economic environment and on the other, local and global economic uncertainty promote lower local investment and consumption spend. Added to this, the National Credit Act that was introduced in 2007 has acted as a hand-brake for unsustainable credit and consumption levels. As a result of a decade of overspending, 46.7% of South African credit users have impaired credit track records and disposable income to household debt is 77.6% (off a high of 82% in 2008).

While interest rates are at a 30-year low relative to inflation levels, weak consumption and credit demand continue to prompt the central bank to keep interest rates level despite a rise in inflation (due to high food, energy and fuel prices). Mortgage loan impairments are currently 9.4% or R7.6 billion – an un-tenuous position wherein three of the four major mortgagees publically announced that their residential property divisions had suffered a net loss position during 2010.

In addition, the state has been increasing its administered prices – prices regulated by the state that account for about 20% of the average family’s expenditure – by three and a half times the official inflation rate. Similar administered price increases can be expected for the next few years, including for electricity (50% over the next two years); road toll fees; the introduction of a state health care system; and municipal services (20% per annum).

Many economists therefore believe that the weighting within the Consumer Price Inflation (CPI) basket is skewed and that the increased cost of living for the average middle-class family is approximately 10.3%, with wage increases being aligned to the official CPI rate.

Overall property values are 38% off their 2007 peak. Estate agents report that 53% of sellers looking to sell their homes are doing so due to financial difficulties. They also estimate that new build properties are 30% more expensive than comparable resale market homes, and that the overall asking price for a residential property is about 25% higher than average household affordability levels.

Against this background – and a 40% decrease in demand levels for housing within the middle and upper income market segments, coupled with excess supply – residential property prices have struggled to achieve any real price growth for the past three years. Some property economists believe this could well be the case for at least the next four years, and that homeowners may need to temper their sale price expectations if they wish to sell their homes. This could suggest that a further decrease in overall residential property prices may be on the cards.

Where to from here for residential property?

It would appear that the structural changes that are occurring are so fundamental that both the property sector and commercial lenders would need to fundamentally review their operating models. Residential property, as the cornerstone for wealth creation for the average middle-class family, is at a crossroads. While it will remain a reasonably stable and sought after asset class, growth and activity levels will not match those of the previous decade.

The South African economy remains vulnerable to global economic instability. In the absence of high local economic growth and ongoing employment certainty, households will continue to temper their expenditure patterns for the foreseeable future. This situation, as in the rest of the world, is not unlike that faced in the latter years of the Great Depression, which featured a disaffected and angry labour force coupled with a business and sovereign world inhibited by uncertainty. Given its illiquid and long-term asset class nature, robust property prices are dependent upon long-term investor confidence. But when this confidence disappears, the tide goes out. It appears this sentiment will dominate for at least this decade.

History reflects that today’s economic downturn is not the first crisis of this nature that the world has faced and for all intents and purposes, it will not be the last. But history also reflects that previous periods of global prosperity were underpinned by disparate economic revolutions such as the industrial revolution and the technological revolution. This begs the question, what is the next revolution?

Global climate change is forcing countries to relook their consumption and living patterns, with a definitive shift towards a more sustainable approach. This has brought with it what could be termed the new revolution – the green revolution – which offers up a number of opportunities in various areas. From a property perspective, these opportunities include:

- Retrofitting existing residential and commercial properties with energy efficient and environmentally friendly technologies.
- Promoting improved water saving and water harvesting technologies.
- Investing in new public transport infrastructure to reduce traffic congestion and promoting the use of public transport.
- Increasing the use of renewable energy for electrification and transportation purposes.
- Adopting new consumption patterns where preference is given to smaller, denser rental units that are more affordable and that allow families easy access to economic and social opportunities.
- A heightened public awareness of environmental and climate change issues, which will increase the focus on purchasing products that minimise carbon emissions.
- Increased ‘greening’ of suburbs, including the conversion of gardens and public areas into areas of localised food production.
- Changes in land usage and minimum housing standards.
- New development corridors that will facilitate the emergence of mega cities due to favourable regional climates.
- Increased collaboration between countries and in particular, developing countries, to optimise the production of goods that increase their competitive advantage (i.e. increasing production beneficiation).
- The prominence of environmental consultants using science to determine land use, spatial planning, etc. within municipal areas, with a particular focus on carbon emission minimisation. It follows that municipal integrated development plans will dictate development minimum standards (although these could vary geographically).
• The establishment of lifestyle estates within secure environments i.e. eco/agricultural estates as opposed to golf estates.
• An increase in alternative forms of homeownership and tenure (rental stock, multiple families sharing the cost of home ownership, etc.) and efficient, alternative building materials.
• The introduction, by the building industry, of innovative bulk services into new housing development areas (to relieve the burden on existing basic service infrastructure).
• The introduction of innovative products and financing models by financial institutions.

CONCLUSION

What started out as a sub-prime mortgage loan crisis in the United States in 2007 translated into a global economic downturn that now appears to be evolving into an energy crisis. This has the potential to bring about further economic recessions and global stagflation. This, coupled with global climate change, has triggered a series of global events that will continue to play themselves out for the foreseeable future. It is likely these events will collectively dictate that residential property market stakeholders review their areas of focus and operating models. Stakeholders, including entities providing defective workmanship warranties, will need to anticipate and capitalise on the opportunities of the new global economy if their product offerings are to retain their relevance.
EMBRACING ALTERNATIVE BUILDING TECHNOLOGIES

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ABSTRACT

With the slow delivery of housing in South Africa, pressure is mounting on available resources and there’s a frantic search to find ways to solve this problem. One possible solution being considered is the use of alternative technology.

There are several reasons why we would want to use alternative technology:

• To produce better quality units.
• To do business in a more cost-effective way.
• To deliver houses that are more cost efficient.
• To deliver houses that are more environmental friendly.
• To explore different methods and materials.
• To deliver houses faster.

The debate must include the above factors. But if new technology does not satisfy these factors, then what is the reason for even considering alternative technology? If we look at alternative technology, it presents a better way of building, not necessarily a new way of building.

This paper looks at some of the ways in which the Western Cape provincial government has sought to use alternative building technologies to deliver housing in a different and better way.

A CASE FOR ALTERNATIVE TECHNOLOGY IN THE WESTERN CAPE

In the debate we find two other strong arguments: one that points to vernacular and the other that points to the traditional way of building with brick and mortar. The reason for this is that there is still a lot of support for building in the traditional way, as people understand it, they feel more comfortable with it and it’s easy to add to structures built in this way.

Due to increasing urbanisation, there’s a need – including in the Western Cape – for higher housing densities in cities, which sometimes rules out the traditional way of doing things. In the Western Cape we have a strategy to provide greater access to the public in assisting them to acquire basic services. This means that with the same budget, more people can be helped by creating a serviced site and then enabling them to better their own living conditions in an incremental way.

This opens the field to alternative technology in providing services, but for this paper we will focus on the top structures only. Some of the constraints the Western Cape has to deal with include:

• A scarcity of land in well-located areas.
• High purchase prices of such land.
• The perception of the beneficiaries.
• Party politics.

Even though the Western Cape is the second largest province in South Africa, there is very little well-located land available. For example, there are large pieces of land available in the Karoo but for good reasons, these are not suitable for human settlements. The land that is available is either sandwiched between the ocean and the mountains or only available at very high prices and therefore not suitable for development. It is within this that we must see the context of the provincial government’s efforts to try and do things differently and better.

The Department of Human Settlements has been using new technologies for the past 15 years. This is due to the fact that the subsidy was never enough to deliver a full housing settlement because the site and services were too expensive, or the houses too costly to build (due to the Southern Cape Coastal Condensation Area [SCCCA] conditions) or a combination of both.

A standard provincial specification was produced approximately six years ago to which all subsidy housing must conform. Agrément SA and the National Home Builders Registration Council (NHBRC) were recognised in these standards and as such all new technologies must be tested by these organisations. The policy of the department was that we would not conduct our own research but that this would be left to the specialists.

ALTERNATIVE TECHNOLOGY HOUSES CONSTRUCTED

Housing delivery efforts in the Western Cape can be classified according to two categories:

• Ongoing systems.
• International Innovation Housing Competition.

Contractors have been delivering houses in the province, constructed using alternative technologies, on a continuous basis for many years. The most common is the Asla house, which comprises a concrete frame with 125mm infill concrete blocks. More than 25 000 such units have been constructed in the Western Cape alone over the past 10 years.
In 2009, the International Innovation Housing Competition was launched with various role players, including ABSA, the Drakenstein Municipality, the Western Cape Department of Human Settlements, Agrément SA, the NHBRC and others. The aim of the initiative was to test the industry by requesting the construction of alternative house types, to be built in Mbekweni, Paarl, in the Western Cape. The houses had to fall into one of two categories:

- Subsidised housing.
- GAP housing (for which additional funding would be made up by means of a bond for qualifying beneficiaries).

In the subsidy sector, eight houses were constructed, while a total of 17 houses were built for the GAP market after an evaluation process.

THE SUBSIDISED HOUSES

The subsidised houses were constructed using:

- Q-panels: Lightweight, interlocking sandwich panels with two 4mm facings of fibrecement sheet with a low density concrete core of cement and siliceous and micaceous aggregate.
- Imison: Readymade panels of light gauge steel columns, clad with EPS and plastered with super strength industrial plaster (Fibrecote).
- Genesis: A foam panel wall building system.
- APC: A modular building system of factory-produced, precast concrete panes. External walls were clad with 20mm EPS and rendered with 25mm plaster.
- Aruba: Interlocking hollow polystyrene blocks acting as shuttering to the cast in situ concrete, and reinforced with vertical steel rods. Plastered internally and externally with special plaster.
- Kavango: Interlocking block brick system.
- Concretex: Factory-produced precast and prestressed reinforced lightweight paneled concrete system.
- Innoblock: Insulated hollow concrete blocks (thermal properties).

THE GAP HOUSES

The GAP market houses were constructed using:

- Great Force: Factory-produced 120mm thick walls – horizontally cast, prefabricated reinforced concrete panels.
- Keith Rudd: Timber frame structure, insulated and clad with fibre cement boards (Sans 10082).
- Titan Wall: Structural insulated EPS panels clad with Mag Board.
- Locrete: Precast, prestressed horizontal concrete beam system.
- APC: A modular building system of factory-produced, precast concrete panes. External walls were clad with 20mm EPS and rendered with 25mm plaster.
- Concretex: Factory-produced precast and prestressed reinforced lightweight paneled concrete system.
- Innoblock: Insulated hollow concrete blocks (thermal properties).
- Kavango: Interlocking block brick system.
- Imison: Readymade panels of light gauge steel columns, clad with EPS and plastered with super strength industrial plaster (Fibrecote).
- EBS: Factory-produced insulated timber frame wall and roof cover sections, erected in-situ by crane.
- Genesis: A foam panel wall building system.
- Ready-kit: Prefabricated timber wall panels nailed to a timber foundation plate plus ring beam. Acrylic resin impregnated fiberglass woven sheeting (Duramesh) stapled to walls.
- Robust: Panels manufactured from mild steel sheet, formed into a zigzag profile and stiffened transversely by wires. Mortar applied by packing or mechanically.
- Intervolve: LWSF, EPS panels plastered on both sides.
- Q-Panel: Lightweight, interlocking sandwich panel with two 4mm facings of fibrecement sheet with a low density concrete core of cement and siliceous and micaceous aggregate.
- Wintersand: Styroframe building system; a hybrid permanent insulating formwork system with a cavity width of 100mm, fixed to galvanised steel columns at 300mm centres.
- Izoblock: Walls constructed of hollow ribbed wood/cement blocks that are filled with concrete.

THE DEPARTMENT OF HUMAN SETTLEMENTS’ EXPERIENCES

Houses constructed from alternative technologies and delivered over a significant period of time, such as the ‘Asla house’, have proved to be financially viable and successful from a mass delivery perspective. Because they were delivered over an extended period, teething problems have been sorted out and contractors have had the time to correct unresolved details. Regular on site meetings and inspections with the contractors have resulted in ‘well resolved’ technical structures.

The Mbekweni initiative in Paarl was delivered through a competition where available, serviced sites were used. The housing units were delivered with a wide range of issues that still had to be resolved. Some units were shipped to site as complete units, whereas others still had technical issues.
to resolve first. Where traditional housing units usually take approximately one week to complete, these units took approximately one month to complete (since for many of them, it was a once-off experience).

Although everything was scrutinised by the panel (the NHBRC, Agrément SA, the provincial department, local municipality etc.) beforehand to ensure the units were compliant, there were still some details that were left to be designed on site.

Most systems only made use of alternative technologies in the wall structures of the units; traditional windows, doors and services were used. With lighter walling systems, alternative foundering ways were used i.e. ground beams or lintels.

**CHALLENGES**

The nearer alternative housing technologies are to traditional building methods, the easier it is to monitor construction and ensure the quality and standard of the end product.

One of the major challenges in using new technologies is that technical inspectors do not understand, or are not experts in, the engineering and specifications of particular systems. With factory-produced systems, often developed for a particular project or site, the ability to deal with on-site changes poses a huge challenge to the construction team.

But probably the biggest challenge lies with the acceptance by the beneficiary community, and their perception of what a house should be constructed from. Experience has shown that if the alternative structure is not remarkably larger (+15%), it will be hard to sell to the beneficiaries. Aspects such as saving on the energy/insulation value of the structure are hard to determine at the beginning or at the time that beneficiaries exercise their choice.

**THE PROVINCIAL DEPARTMENT’S POLICY ON ALTERNATIVE TECHNOLOGIES**

The Department of Human Settlements has a policy that all alternative housing technology systems must have NHBRC clearance and must be delivered by a contractor that is registered with the NHBRC. The housing unit must also be enrolled with the NHBRC. All this provides the department with insurance (the unit was tested by Agrément SA and therefore has undergone a process of scrutiny).

**INFLUENCING THE INDUSTRY**

The biggest value add through such initiatives is that they influence the traditional construction industry to use new ways and materials to conduct business. We find the alternative market is developing at a pace, and is bringing new materials and methods to the table all the time. This rubs off on the traditional market, which can then use some of these newer components to better their products or to help them curb ever-increasing costs. One of the real benefits of most of the alternative technologies is their awareness of energy efficiency. The developers of these systems are usually very aware of the insulation values of their products, and usually add some form of new energy intervention that is marketed with their products (i.e. solar heating, solar lighting, wind generators, etc.).

**ALTERNATIVE SETTLEMENTS**

The Western Cape was fortunate to have the opportunity to establish a show village consisting of houses constructed solely of different alternative technology materials. A major benefit of this process was that it was easy to compare the different technologies, as the playing fields were level. A study was also conducted in the form of a questionnaire, posed to about 400 beneficiaries, of how they and their community experienced the houses.

Unfortunately the outcome of this initiative was still conventional plots with different types of houses on it, and the concept of an integrated designed settlement that addresses sustainable development was not met.

**CONCLUSION**

We need to think differently in planning and urban design. To merely look at alternative ways to build housing structures will do little for sustainable development. It might reduce the energy consumption of the houses built, but won’t help much in creating energy and softening those buildings’ carbon footprints.