

Enla Minnaar

Commentary on “site managers manual on energy and water efficient housing”

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Abstract

An attempt to address the general lack of instruction material on energy efficient housing existing in South Africa needs to be evaluated by the target audience. This becomes even more relevant where valuable financial support of sponsors is used for the compilation of such an effort. The manual is critically evaluated and a survey is included. The survey was conducted by means of a survey questionnaire sent to tertiary education institutions offering courses for construction managers. Most of the respondents found the contents not to be relevant to the study field and to be inadequate as undergraduate study material.

Keywords: Undergraduate study material, energy efficient housing, South Africa

Abstrak

'n Gebrek aan onderrigmateriaal op die gebied van energie effektiewe behuising in Suid Afrika bestaan. Wanneer hierdie leemte dus aangespreek word is dit nodig dat die teiken gehoor die materiaal sal evalueer, des te meer wanneer waardevolle befondsing en finansiële steun gebruik word om sodanige werk tot stand te bring. Die handleiding word geëvalueer, en 'n opname word ingesluit. Hierdie opname is gedoen deur vraelyste aan universiteite en teknikons wat kontrakbestuur aanbied, te stuur. Die meerderheid respondente het bevind dat die inhoud nie op hierdie studierigting van toepassing is nie, en het die handleiding ontoereikend as voorgraadse studiemateriaal bevind.

Sleutelwoorde: Voorgraadse studiemateriaal, energie effektiewe behuising, Suid Afrika

Dr E. Minnaar, Restoration T U Delft, Ph D (Architecture) (Pret), Department of Construction Economics, University of Pretoria, South Africa. Tel: +27 12 460 2523, Mobile phone: +27 82 575 6331, Fax: +27 12 346 1669, Email: <emminnaar@telkomsa.net>

Current contact details: Dr E Minnaar, Deputy Chief Architect, Heritage Advisory Services, Department of Public Works, Pretoria, South Africa. Tel: +27 12 337 2838, Fax: +27 12 337 2745, Email: <enla.minnaar@dpw.gov.za>

1. Introduction

There is a general lack of relevant and sound instruction material relative to energy efficiency in housing in South Africa. The manual concerned constitutes an attempt to address this need and was sponsored by the Sustainable Homes Initiative (SHI).

The International Institute of Energy Conservation (IIEC) aimed to address this shortcoming with a publication entitled "Making energy efficient housing...making housing energy efficient: site managers manual on energy and water efficient housing." The IIEC an affiliate of the US based Civil Engineering Research Foundation (CERF), is a subsidiary of the American Society of Civil Engineers (ASCE).

In an effort to assess the suitability of such publications, to learn from the experience and to share the insights gained with other stakeholders, the Department of Construction Economics at the University of Pretoria interacted with other institutions likely to be recipients or end users of such a publication.

Based upon the hypothesis that the study material should be suitable for the intended target readership, a written survey was conducted through a formal questionnaire sent to all Tertiary Education Institutions offering courses for construction managers.

2. Defining the responsibilities and qualifications of a 'site manager'

In practice, construction managers are highly qualified people who usually have tertiary qualifications in construction management or civil engineering (Hauptfleisch & Siglé, 2004: 56).

According to Jansen (2004), site managers work at the entry level for construction managers, and help manage day-to-day activities on site. These people usually are either working while still studying, or they have recently completed their studies. However, it is also possible for a craftsman to be promoted to the level of foreman or site manager if he/she possesses the appropriate attributes such as (Hauptfleisch & Siglé, 2004: 32):

- Managerial skills;
- Leadership;

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- Knowledge of human nature and tactfulness;
- Ability to accept responsibility;
- Ability to command and show respect;
- Integrity;
- Promptness; and
- Objectivity.

3. Defining the 'designer' as a demarcated position

Designing definitely stays demarcated as the duty and prerogative of the architectural profession. The duties of the architect are clearly stated in the Architectural Professional Act, Act No 44 of 2000 (Republic of South Africa, 2000: 1.3), as

comprising the business and management of the process of investigating, assessing, defining, conceptualising and designing a physical intervention in the environment, and processing the design through technological development and co ordination of the input of professionals from other disciplines, to produce documentation which can be utilized for the tendering and construction of the project and which the architectural professional will use for the administration, cost and quality control of the construction process, with the ultimate purpose of delivering an architectural product which responds to the client's requirements in a manner which exemplifies design excellence, enhance ment of the environment, social responsibility, appropriate technology and quality of construction and the whole executed in an ethical, competent and professional manner.

According to Schedule 1 of the Act, a person designing 'simple projects' would at least have to be a Professional Architectural Draughts-person. Engineering design work is reserved for persons registered according to the Engineering Profession Act, Act 46 of 2000 (Republic of South Africa, 2000: 18).

4. Description and evaluation of the content of the manual

The manual consists of a 44 page ring-bound file in A5 format with copious free hand illustrations throughout.

Cross ventilation

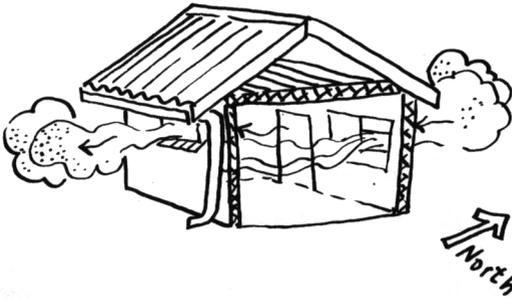


Figure 1: Typical drawing from the manual

4.1 Commentary on part 1

In Part 1, the introduction to energy efficient housing, all the subdivisions comes down to the planning of energy efficient design (Beyers *et al.*, n.d.: 7). Although construction managers are required to understand the principles of design, design definitely is not one of the functions of the construction manager, contractor or building foreman (Hauptfleisch & Siglé, 2004: 27-36).

4.1.1 Attributes of energy efficient homes listed (Beyers *et al.*, n.d.: 10):

- "Houses are well insulated either by 'an installed ceiling'¹, 'double skin brick walls'² or 'cavity walls'³ and 'roofing materials may be made from a material that keep heat inside during winter, and outside in summer'.⁴
- The 'roof on the northern side of the house is extended beyond the wall's edge by 600mm'⁵ to form a roof overhang to shade the windows and doors. Alternatively, a 'deciduous tree'⁶ may replace the roof overhang to provide shade on the northern side of the house.

(Emphasis added by author)

Comments:

1. 'An installed ceiling' on its own does not ensure a 'well insulated house.' Lightweight insulated roofs are feasible, provided that the structure including walls, partitions and floors have enough mass. Useable isolation materials are for instance blown cellulose fibre insulation, which is made of 70% recycled newsprint and harmless household chemicals, and which is fire retardant and rodent resistant. It is cheap and very effective. Furthermore, dust does not reduce its insulating properties (Minnaar & Cloete, 2004: 7).
2. 'Double skin brick walls' provide sufficient thermal insulation in some SA climates, but are inadequate in others (Holm, 1996: 85).
3. 'Cavity walls' consisting of two brick skins separated by a 50mm air gap or cavity that helps against moisture penetration also contributes greatly towards thermal insulation.
4. See (1)
5. According to Holm (1996: 67-72) general guidelines for 'Roof overhang, window height and positioning' differs greatly according to region and charts should be consulted by the designers. Page numbers 67-72 are applicable to the Gauteng region. A 600mm roof overhang will be too wide in Musina, and too narrow in Cape Town to be effective.
6. Planting a single 'deciduous tree' would require specialised knowledge to be effective. This is not the domain of construction managers.

Headers on the following pages such as "What are the benefits of any energy efficient house?" "What is the environment?" and "The home environment" seems to be aimed at the education of homeowners, which according to the manual seems to be one of the duties of the site manager (Beyers *et al.*, n.d.: 8).

The impact of South Africa's 'weather' on the home environment (Beyers *et al.*, n.d.: 13) should have referred to South African 'climate', as the complete concept of climate is what forms the environment.

4.1.2 'Practical solutions' proffered for dealing with hot and cold climates (Beyers *et al.*, n.d.: 14):

- 'Thermal mass' – thick walls and solid floors help to regulate the temperature in the home.¹
- Try to 'minimise the amount of sunlight' that shines through windows by providing adequate roof overhangs (600+) and shading.²

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- 'Window placement': In cool areas put large windows on the northern side of the home, so that enough sunlight can shine into the window and onto the northern side of the home, so that enough sunlight can shine into the window and onto the floor, heating the house....³
- Provide roof and wall 'insulation'.⁴
- Provide adequate 'ventilation' in the house, by placing windows that can open on both sides of the house to allow a breeze through the house.⁵
- In hot areas, 'paint houses and even roofs with light colours'.⁶
(Emphasis added by author)

Comments:

1. Thermal mass is a property of some building materials that is necessary to achieve thermal comfort in some climates (Holm & Viljoen, 1996: 11). While this argument is partly correct in hot, dry regions, it definitely is incorrect in hot, humid areas (Holm, 1996: 85).
2. See 4.1.1 (5)
3. Larger windows will allow greater heat gain but will also allow a lot of heat to escape during winter nights unless the windows are temporarily insulated. This is known as the greenhouse effect (Holm & Viljoen, 1996: 12).
4. According to Holm (1996: 85), the addition of insulation without both attention to thermal mass and the infiltration of air will be to the detriment of indoor conditions.
5. Cross ventilation has to be designed in compliance with the ruling wind direction, as no air will flow into the building through openings situated parallel to the direction of the wind (Holm & Viljoen, 1996: 16).
6. Light colours including pastels have a fair reflectance to sunlight e.g. 50% for light green, but they are not as reflective as white paint which has a reflectance of 80% at the same cost (Olgay, 1992: 114).

While the explanation of air pollution and the environmental responsibility of the individual (Beyers *et al.*, n.d.: 14-16) can be of use in a high school or general adult environmental education programme, the current presentation is done in such vague and inexact terms, that it neither applies to teaching on tertiary level, nor is it directly applicable to the designated duties of a site manager.

4.2 Commentary on part 2

Part two deals with the building of energy efficient housing. While the application of the principles of passive solar design is in order, it is the way in which the manual wishes to achieve it that is tainted. Beyers *et al.* (n.d.: 17,18) lament the fact that site managers do not have opportunity to participate in the pre-planning stages such as interacting with the municipalities, town planners, the community and developers. Site design and house plans, with house siting and orientation, house construction including design and detailing, and the interaction with the beneficiaries are all included as tools and obligations of the site manager according to the manual. The duties and knowledge of professionals such as town planners and architects are thus disregarded and are then transferred to the 'unsuspecting' site manager.

4.2.1 Stages 1-3

In Stage one: Pre-planning, the authors declares the site manager to be involved in the planning process of the project from the outset, whereby "a project's eco-efficiency may be increased by up to 80%" (Beyers *et al.*, n.d.: 19). Here the theme of brown-fields development is introduced unannounced, and without a definition. The term, spelt differently, is used again later on in the manual.

According to the manual, time and money should also be made available to the site-manager to interact 'properly' with the beneficiary community and to explain the energy and water efficiency issues in the project.

Site managers are also supposed to suggest "green finance options to cover the cost of energy efficiency interventions such as fluorescent (misspelt in the manual) lighting or ceilings" (Beyers *et al.*, n.d.: 20) in Stage 2: the project site layout.

The spelling-mistakes apart, the function of the site manager is again misinterpreted and misrepresented here.

4.2.2 Stage 4

In stage four: 'House construction', a text box minds the site manager to make 'customers' aware that windows should be opened for at least part of the day. This is a statement that needs to be qualified, as loss of heat during the winter needs to be mitigated,

Minnaar • "Site managers manual on energy and water efficient housing" by closing the windows, shutters, thick curtains, or rolling down mats during the night. During summer, the same should be done during the day, to block out too much heat (Sowman & Urquhart, 1998: 140).

More statements from 'stage 4' of the construction of a house in the manual have to be clarified (Beyers *et al.*, n.d.: 28-34):

- 'Each room in a house should have airbricks leading to the outside'.¹
- Dark colours provide better 'warming' capacities than light colours.²
- 'A 50x50 roof timber is used to support the (roof) overhang sheet'.³
- 'Use V5 strength sheeting and long nails (9cm) to secure the roof to the walls'.⁴
- 'Insulation material stops air of different temperatures from moving from one place to another. For example, insulation materials will prevent heat from escaping from a warm room in winter, when the outside temperature is low, and likewise keep hot air outside the house, when it is very hot outside in summer'.⁵
- All gaps in the house that can potentially let drafts of air in should be sealed off. This 'weather-proofing' will prevent warm air from escaping from the house in winter, and cold air from blowing in.⁶
- 'Vaulted ceilings give excellent insulation in small houses'.⁷
- 'Because heat rises, the type of roofing and ceiling material in a house makes a big difference to its energy efficiency'.⁸
- 'Corrugated iron roofs ... offer very little insulation. Asbestos cement roofs provide a greater level of insulation ...'
'Roof tiles provide excellent thermal insulation ...'.⁹
- A number toilets, however, use small amounts of water, these toilets are regarded as 'water efficient' toilets and use less water than the average toilet.¹⁰
- 'Dark floor colours retain heat well'.¹¹

(Emphasis added by author)

Comments:

1. The practice of providing air bricks have proven futile in the past and is not recommended any longer, as the airflow through the insect screen portion of the mesh quickly collects dust. This leads to the serious impaired function of the brick through collection of grime.
2. Dark colours may have a better ability to absorb heat, as opposed to the ability of light colours to reflect heat (see 4.1.2 [6]) but no colour will ever have the ability to warm or cool a structure.
3. Apart from proposing a detail of very poor quality that will not have the necessary bearing capacity, construction details are not precededented in the applying of energy efficiency.
4. See (3)
5. See 4.1.2 (4)
6. According to Holm and Viljoen (1996: 15) the main function of ventilation in airtight buildings is to supply fresh air to the occupants. The proposition to make the house airtight is however also contradicting the counsel of the authors to include an airbrick in each room (see 1).
7. 'Vaulted structures' of any size will benefit if the mass of the vault (heat storing capacity) is enough to achieve thermal comfort. It will, in other words, benefit from its mass, using the flywheel principle (Napier, 2000: 9.19.2).
8. Heat cannot, and will not rise, but hot air does.
9. The use of asbestos in any product nowadays is prohibited in our country. The product that replaced asbestos cement is called fibre cement sheeting and tiles. The insulation of the three types of roofing materials: corrugated, galvanised steel sheet, fibre cement sheeting and concrete roof tiles used on their own without isolation material and a ceiling does not differ that much.
10. The different types of sanitation available today, and their advantages and disadvantages could definitely have been expounded in the manual (White paper on basic household sanitation).
11. The absorption of darker colours may be better than that of light colours, but heat storing or thermal capacity is decided by mass (Holm, 1996: 85).

Throughout the manual, reference is made to the preferred general orientation as being north, presumably as a rule for the whole of South Africa (Beyers *et al.*, n.d.: 9, 17, 18, 21, 23, 36). According to Holm and Viljoen (1996: 10) buildings should be orientated to maximize on solar gain during winter, whilst avoiding it in summer.

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Optimum orientation is dependent on the local topography where buildings on a south-facing slope will receive less solar radiation than buildings on a northerly slope, and three-dimensional structures like adjacent buildings and trees will also have an effect on it. Recommended orientation of sites according to these authors is a deviation of no more than $\pm 15^\circ$ from true NS or EW.

4.3 Commentary on part 3

Part three deals with the handover instructions for new home-owners and the use of an energy efficient house. Beyers *et al.* (n.d.: 23-24) urge site managers to gather as much information on the community and their specific needs, as possible. The site managers are even instructed to try to talk both men and women and to become the advisors to the homeowner once he or she has managed to get invitations to energy efficient houses when the homeowners have moved in. According to Beyers *et al.*, the site managers also have the duty to explain the concept of ventilation to the homeowners. According to these authors, further obligations also extend to the managing of the whole project, from the calling of a public meeting at the start of the project, to all the explaining of phases and possible impacts, electing of a project committee from the community, compelling members of the community to work as volunteers and the arranging of a launch for the opening of show-houses.

Hauptfleisch and Siglé (2004: 23) defines construction management, or site management as "a procurement process for which the employer appoints a manager at a professional fee (or a salary) to manage the construction work on site from beginning to end by using specialist contractors." The client, be it the government or a private institution, called the employer in the definition above, have to appoint people to manage the community, if needed.

Generalities regarding the cooking done inside the houses and heating of houses contribute nothing to the value of the manual. Recommendations on the drawing and opening of curtains and covering of floors are only partly correct and therefore insufficient (Beyers, n.d.: 37). Certainly, curtains should be drawn during daytime in summer, and opened at night, when the windows are opened to let a fresh breeze in. The opposite is true during wintertime. During the winter, the flywheel-effect should also be utilised by enabling the sun to shine on massive floors, where this is required according to the climate.

Factors such as pollution caused by coal-burning power stations, coal-burning stoves and traditional braziers are however ignored in this manual, and should form part of the issues considered when designing new housing schemes. Certainly the renewable energy systems such as solar power using photovoltaic panels have to be considered in a sustainable village, although they have higher initial costs, it is generally known to also have very low running costs. This has to be compared to the monthly electricity bills and running costs of electricity plants (Minnaar & Cloete, 2004: 10). By using photovoltaic panels, electric geysers, their thermostats and the extra insulation of pipes and geysers proposed by Beyers *et al.* (n.d.: 37), all become obsolete.

Beyers *et al.* (n.d.: 38) only devoted two sentences to the very important issue of rainwater harvesting, without cautioning possible tenants to refrain from using water from thatched roofs and roofs painted with poisonous paint for drinking purposes. Neither do they advise that although corrugated galvanised steel sheet tanks are relatively cheap, they rust easily. According to Mollison (1991: 81) moulds are available for making concrete tanks. Mollison also advocates that rainwater tanks should be placed on the shaded side of the houses, i.e. south preferably under a trellis, to cool water down for drinking.

5. Survey

A written survey was conducted through a formal questionnaire sent to eight tertiary education institutions offering courses for site managers. Each questionnaire was accompanied by a manual.

After several follow-up phone calls, four questionnaires were received back. A fifty percent response is considered to be excellent and representative.

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Table 1: Evaluation of response to the survey

Questions	Response %		
	Yes	Partially	No
Are the contents conveyed clearly?	100.0	0.0	0.0
Is the content relevant to the study field?	50.0	0.0	50.0
Do you find the manual adequate as undergraduate study material?	50.0	25.0	25.0
Do you find the drawings to be clear and to the point?	100.0	0.0	0.0
Would you describe the manual as effective and successful in conveying information?	100%		
Would you like to prescribe this manual to construction manager students?	25%	25%*	50%

6. Comments by the respondents

Respondents volunteered the following comments:

- "A suggestion that the manual should be targeted at planners and designers, or at the very least, at project managers who are involved at the onset of projects";
- "The finding that the contents are much too elementary for the undergraduate curriculum";
- The lecturer that found that the manual would be partially acceptable as prescribed reading matter qualified his statement by saying that: "It would only be as recommended extra reading matter", and
- "It was recommended that in publications such as this, sources used should be acknowledged since students are penalised for plagiarism."

7. Conclusion

Although it appears that the respondents generally understood the questions, an inconsistency is apparent in the answers:

While the answers of the respondents were mostly positive regarding the manual, the determining questions have to be seen as the second question, regarding the relevancy of the content to the study

field, and the last question. In the case of the latter, lecturers had to indicate their inclination to prescribe the manual as study material. Most (75%) of the lecturers answered this question in the negative, 50% of them already having found the contents inadequate as undergraduate study material, and/or not relevant to the study field.

In South Africa, the obligation of the site manager is to do precisely that – to manage the site. An 'environmentally aware site manager' can also contribute by not wasting water and energy and by putting into practice construction waste management on site, but not by being planner/designer/social surveyors, as he/she is not trained to do so.

Important lessons learnt are that prospective authors of manuals should identify their readership very carefully, consult with the relevant lecturers and ensure that the information offered as learning material is factually correct. Repetition of information, faulty information and generalisations, together with spelling mistakes, lead to a feeling of unease when reading through this manual. The general naivety of the predominant presentation, bestowing on the site manager the power of being omnipotent designer/planner/construction manager/community advisor, is one of the main problems of the manual, which really should not have any audience in the present format.

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