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NOTE

Sustainable construction: principles and a framework for attainment – comment

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Hill, R.C. and Bowen, P. (1997) *Construction Management and Economics*, **15**, 223–39 discuss the evolution of the concepts of 'environmentalism' and 'sustainability', highlighting their importance in today's context. They relate these concepts, especially the latter, to construction, and provide a framework for environmental management in the construction process. This is a comment on the contents of Hill and Bowen, and endorses their stress on the importance of environmental considerations in the construction process. The paper suggests that other areas relating to the subject of sustainability in construction also require attention, and highlights, in particular, the need to take cognisance of the perspective of developing countries.

Keywords: Sustainable construction, management, developing countries, progress

General review of Hill and Bowen's paper

Hill and Bowen (1997) discuss how the application of modern technology together with the increasing population are leading to the rapid depletion of the earth's physical resources, and give a good coverage of the evolution of the concepts of 'environmentalism', 'sustainability' and 'sustainable construction'. They offer a useful framework for environmental management in construction and a list of process-oriented principles of sustainable construction. They highlight the need for trade-offs among the 'principles' of sustainability, and stress the importance of creativity among project participants.

Sadly, the relationship between construction activity and the environment addressed by Hill and Bowen receives insufficient attention from construction researchers. Suggestions of additional work made in this paper are intended to contribute to the effort towards advancing work in the area rather than as specific criticisms of Hill and Bowen in particular.

Hill and Bowen refer frequently to the Republic of South Africa, and cite most of their examples from there. Thus, it would have been useful to include that country in the title of their paper. Despite its reference to some of South Africa's indigenous people, Hill and Bowen's paper is written largely from the viewpoint of developed countries. It is pertinent to highlight the perspective of developing countries.

The environment-related problems of developing countries are acute. Most of them have fragile environments (UNCHS, 1996, p. 228), being faced with high levels of land degradation (erosion, aridity, desertification, drought, flooding, alkalinization and salinization); acute shortage of fresh water; loss of forests; and rapid urbanization with its associated problems of air pollution, and pressure on existing infrastructure such as waste management systems. These countries lack the managerial experience, financial resources, and legal and administrative systems for promotional activities, formulating and enforcing regulations, and giving incentives to encourage appropriate behaviour.

Another important issue is the volume of physical resources which will be required to meet the backlog of infrastructural and building needs in developing countries. Gupta (1993) estimates that India needs some 50 million residential units to provide adequate housing for its people while UNCHS (1996, p. xxi) notes that 'more than 600 million people in [the world's urban areas] are homeless or live in life- and health-threatening situations'. As these countries develop and their populations are able to afford the physical facilities necessary to improve their living standards, this will strain the world's available key construction resources. The Worldwatch Institute (1995) highlights this trend in terms of sharply rising demand for grain and meat in fast-developing China, which is leading to global shortages and price rises. The parallels in construction are also serious, putting into perspective the critical need for the sustainable management of construction resources in these countries.

There are several other reasons why sustainability in resource use is more critical in developing countries (Tisdell, 1985, p. 15). More of their people rely on natural resources at the basic level. For example, Gupta (1993) estimates that 40 million people in rural India rely on the forests for their livelihood. This puts the issue of the use of timber in construction and its relationship with deforestation into perspective. Moreover, low labour and capital mobility makes it difficult for people to move from affected areas. Furthermore, the generally low incomes and undeveloped national social insurance and security systems leave individuals with only little reserve to risk unsustainability.

Under these circumstances, it is not surprising that perceptions of the main elements and principles of sustainability are different in various contexts. Blauert and Guidi (1992, p. 214) note that the indigenous rural population in Qaxaca, Mexico, struggling to regain control over their physical and social resources do not consider their problem to be 'environmental' in the Western terms of soil erosion and deforestation alone. Instead, they view these ecological factors as symptoms of a wider crisis including falling production, lack of credit, a disadvantageous marketing system, repression, insecurity of land tenure and threatened cultural environments.

Persisting disagreement and confusion

Hill and Bowen restate the regrettable fact that the principles of environmentalism and sustainability remain as yet poorly defined, and subject to much confusion and disagreement. Mitlin and Satterthwaite (1996, p. 1) point out that the experts on 'sustainability' are split between those favouring conservation and those advocating the meeting of human needs. They also disagree on what is to be sustained, at what scale (or level) and how this is to be done. Moreover, environmentalists are split into various interest factions. At the global or even national level, the mainstream view in each respect changes over time.

The lack of agreement on the field of the environment extends to the often-quoted definition of the concept of 'sustainability' by the World Conference on Environment and Development (Bruntland, 1987) which Hill and Bowen referred to. This definition is still subject to criticism and further refinement. The framework of 'sustainability' offered by Mitlin and Satterthwaite (1996) is useful: (i) minimizing use or waste of non-renewable resources including fossil-fuel energy sources, minerals, and cultural and historical assets; (ii) sustainable use of finite renewable resources such as freshwater; (iii) biodegradable wastes not overtaxing capacities of renewable sinks; and (iv) non-biodegradable wastes/emissions not overtaxing (finite) capacity of local and global sinks to absorb or dilute them without adverse effects.

For construction, which is acknowledged to have real and potential adverse impacts on the environment and the well-being of the populations of the world (Ofori, 1992; UNCHS, 1993, 1996) the continuing confusion on concepts and lack of agreement on causes, effects and remedies is unfortunate. This is mainly because there is difficulty in providing guidance for good practice in construction based on well accepted and understood concepts and ideas. Moreover, practitioners wishing to persist in their old ways can cite the lack of a convincing case for action.

Historical review

Hill and Bowen (1997) suggest that concern about environmental degradation dates back to 'the middle of this century' (p. 224). They could have referred to much earlier literature on environmental concerns. Miller (1995, p. 4) cites Plato, in the second century BC, and deploring the erosion caused by defrostation in Attica, and Van Pelt (1993, p. 1) points out that, in the third century BC, Erastothenes described how governmental land policy, navigation needs and mining resulted in the deforestation of Cyprus.

The case made by Hill and Bowen for looking at traditional practices for lessons on responsible living and working (p. 223) can be made more strongly. It seems that as time goes on, humans lose their relationship with the environment, and the necessary feeling for its protection and, possibly, enhancement. In construction, the spread of 'modern' ways of

building and the use of materials without reference to context, climate and culture is a legitimate target of the effort to attain sustainability. Hill and Bowen also could have dwelt more on 'Agenda 21', the Action Plan for global sustainable development, agreed upon by world leaders in Rio de Janeiro in 1992, and its Chapter 7 on Promoting sustainable human settlements development (UN, 1993).

Hill and Bowen's historical review of the evolution of 'environmentalism' and 'sustainability' is largely an outline of conferences, and of changing usage of, and arguments over, words. They could have reviewed key initiatives. These include: the organization of several major international conferences to attain the commitment of, and consensus among, nations with regard to key issues relating to the environment; the formulation and enforcement of statutes and regulations, organization of educational programmes, imposition of taxes and offering of incentives in most countries; the establishment of environmental protection agencies in many countries; debt for environmental programme swaps; international protocols and conventions such as those on chlorofluorocarbons; and the Global Environmental Facility for funding environmental projects. While progress has fallen short of expectations in many areas as evinced by the proceedings at the Earth Summit Plus Five in New York in June 1997 (*The Straits Times*, 1997), these are elements of the overall solution. They indicate that construction: (i) is not the only industry being called upon to act; (ii) is not being called upon to act in a vacuum; (iii) can access several techniques, policy support and incentive schemes to achieve its aims in these regards; and (iv) may be compelled to act by statute or market forces.

Several issues are clear today. First, the variety and intensity of the threats of environmental pollution have increased; these can have an exceedingly long term impact on conditions on earth (UNCHS, 1996). Second, there is greater awareness and understanding of environmental problems and their wide-ranging and far-reaching effects, as well as the need for action (MoE, 1991; Ofori, 1992; Hawken, 1993). However, there are still arguments on some basic issues, including concepts as well as causes and effects (Miller, 1995). Third, analytical techniques of both the quantitative and qualitative kinds, as well as the necessary information (including national and global databases), are available for addressing the problems (Van Pelt, 1993). Fourth, to achieve sustainable development, there should be changes in thinking, behaving, producing and consuming (Hawken, 1993; UNCHS, 1996). Finally, action is required at several levels: the individual, group, company, project, village, town or city, district, region, national and international (Habitat II, 1996).

Sustainable construction

Kibert's (1994) definition of sustainable construction as: '. . . creating a healthy built environment using resource-efficient, ecologically-based principles', which is cited by Hill and Bowen, does not consider several of the perspectives which Hill and Bowen propose in their four pillars of 'sustainable construction' and their environmental management system (EMS) framework. Thus, Hill and Bowen could have offered an alternative definition which embraces all their pillars of sustainable construction and their principles, and adopts the 'cradle to grave' perspective they refer to, which is also favoured by Ofori (1992). A holistic definition was adopted at Habitat II (1996, p. 13) as participants committed their countries to the goal of sustainable human settlements by developing societies which: '. . . will make efficient use of resources within the carrying capacity of ecosystems and take into consideration the precautionary principle approach, and by providing the people . . . with equal opportunities for a healthy, safe and productive life in harmony with nature and their cultural heritage and spiritual and cultural values and which ensures economic and social development and environmental protection. . . '.

In discussing their EMS framework, Hill and Bowen focus on suggestions made in the literature. Greater coverage of good practice examples other than the practices and procedures of Shimizu Corporation, would have been useful. For example, they could have outlined some of the actions taken in the construction industry in many countries: (i) by clients who emphasize that their buildings should satisfy certain environmental requirements; (ii) by designers, such as those who have established a name for themselves for the environmental-consciousness of their designs (Vale and Vale, 1991); (iii) by contractors which have adopted environmentally conscious techniques (Ofori, 1992); (iv) by professional bodies which have prepared 'policy papers' to guide their members on good practice in relation to the environment (for example, CIB, 1989) and are organizing activities to increase the level of awareness and education of their members; (v) by international agencies which have published manuals offering guidelines for environmentally conscious construction (UNCHS, 1993); and (vi) by international discussion groups such as Task Group 8 (TG08) of the CIB on Environmental Assessment of Buildings. Many of these actions preceded by several years the First International Conference on Sustainable Construction and Kibert's definition of sustainable construction which Hill and Bowen consider to have marked the emergence of 'sustainable construction' or 'green construction' (p. 225) – the latter name had been coined much earlier (see, for example, Vale and Vale, 1991).

Major themes of sustainability

Hill and Bowen 'single out' four 'attributes of sustainability': social, economic, biophysical and technical (p. 226). However, they give no reasons for choosing these four, neither do they indicate the whole list from which they selected these four. Indeed, there is a wide range of themes of sustainability, which is being amended and added to over time. Mitlin and Satterthwaite (1996 p. 1) observe that whereas ecological sustainability used to be stressed, since the Rio Summit, 'economic sustainability', 'community sustainability' and 'cultural sustainability' have emerged as integral parts of sustainable development. Again, there are disagreements. For example Hill and Bowen discuss social sustainability at length (p. 226), and UNCHS (1996: p. xxxi) suggests that strategies for achieving ' . . . social equity, social integration and social stability' are essential underpinnings of sustainable development. However, does social sustainability mean the maintenance of existing social systems or creation of the social conditions necessary to support sustainability (Mitlin and Satterthwaite, 1996)?

For a developing country, several other aspects of sustainability than those 'singled out' by Hill and Bowen are relevant. For example, 'managerial sustainability' is important to ensure that construction products, especially large and complex ones undertaken by foreign companies, remain in effective and efficient use throughout their (reasonably long) lives. Also important is 'community sustainability' in contexts where major development projects are planned and constructed without consulting, or attending to the needs of, the peoples in their locations or their environs, leading to loss of livelihood and disruption of social links owing to resettlement, among others (Ofori, 1993).

Hill and Bowen suggest that emphasis on 'technical sustainability' should be reduced in order to achieve 'economic sustainability'. However, technical sustainability should be an aim in trying to achieve economic sustainability, and vice versa: this is a legitimate aim for research and development (R&D) on topics relating to sustainable construction. Effort should be made to achieve cradle-to-grave economic sustainability if the target users of newly developed products are to be encouraged to adopt them.

It is appropriate that the first two issues listed by Hill and Bowen under 'economic sustainability' are on affordability and promotion of employment generation (p. 229), which are of particular relevance to developing countries. On the former issue, the ability of governments to afford essential public infrastructure should also be stressed. The example given by Hill and Bowen of the economic unsustainability of Roman aqueducts and Greek temples (p. 226) raises some questions: (i) long term responsibility for constructed items; and (ii) enforcing regulations beyond the initial approval, to include use, management and demolition in a sustainable manner. This issue is related to the suggestion by Hill and Bowen that resources (and buildings) should be re-used and recycled (p. 230). Whereas this is a desirable aim, it should be designed for, regulated, and enforced. Under 'economic sustainability', the possibility of deriving savings and other forms of commercial advantage through environmentally responsible behaviour (by individuals and companies) (Hawken, 1993) should be stressed. Also worth highlighting is the potential for business opportunities in the area of the environment (IFC, 1992) as well as the sound commercial merits of environmentally sensitive and responsible business.

In Hill and Bowen's 'framework for sustainable construction', a useful aim would be to institute an EMS in each organization involved in construction projects, ranging from developers through designers and constructors, to the organizations involved in managing and, eventually, decommissioning the structure. This would obviate the need for an EIA during the planning and design stages, as the EMS of the organizations involved in the project would ensure that environmental issues are considered at the pre-design stage as well. The ISO 14000 series of standards offer a framework for such EMS (ISO, 1996).

Towards progress

Hill and Bowen make two main suggestions with regard to the implementation of the environmental management framework they offered. These are: the education of the participants and the giving of incentives by governments. The latter is unlikely to be effectively adopted in the developing countries, given their current financial constraints.

It is important to consider how construction can really make progress with respect to sustainability. To this end, it would be most appropriate if works on sustainable construction would: (i) build on, and seek to add to, existing knowledge; (ii) attempt to discuss the operationalization of any principles and checklists for sustainable construction such as those of Hill and Bowen, and assess their implications and likely problems; (iii) identify possible champions and/or catalysts for particular tasks; and (iv) assign specific roles, seeking to strike a balance between what governments will do and what actions the industry (such as professional institutions) should take. In developing countries, the role of the government as a construction client would be paramount. Some detailed case studies of good practice would also be useful. The possibility of

preparing good-practice manuals suitable for use in various contexts could be explored. The developing countries would particularly benefit from such manuals, which could be produced on a regional basis.

An issue requiring attention in developing countries is the effective transfer of knowledge from researchers and administrators to practitioners. A key role will be played by international agencies such as the UNCHS, and discussion groups such as TG08 (which seeks to provide a forum for the coordination of research and exchange of information, and to promote awareness of environmental issues among those involved in building).

Conclusions

The relationship between construction activities and the environment is well recognized. Unfortunately, the industry lags behind other sectors in its response to the problems of the environment. Papers such as Hill and Bowen's contribute towards raising awareness in the industry. Further effort is necessary to establish common concepts, principles and techniques relating to sustainable construction. Enterprises and individual practitioners should be encouraged to constantly seek to make their activities sustainable. These efforts will have different dimensions (Hawken, 1993). In these regards, the 'pillars' and principles offered by Hill and Bowen are useful. Progress can be made only through a concerted effort by participants, following good-practice guidelines. Key roles will be played by different people and organizations in various contexts. Developing countries deserve special attention in the effort to make sustainability an operative criterion in all construction activities.

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