Regional Building Culture and the Structural Engineer

L'ingénieur et l'architecture locale

Der Bauingenieur und die regionale architektonische Kultur

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SUMMARY
The impact of western architecture and technology makes a noteable contribution to the distortion of townscapes in third world countries and at the same time deprives architectural science of the contributions that it could obtain from a comprehensive investigation into traditional layouts and techniques. The author introduces a methodology for this research aimed at the transmigration of constructional ideas from ancient technologies to modern techniques. The method suggested permits the insertion of the results of the research directly into the procedures of automatic design.

RESUME
L'impact de l'architecture et de la technologie occidentales contribue considérablement à la dénaturation de l'ambiance urbaine dans les pays du Tiers-Monde et en même temps déprive la science du bâtiment de la contribution qu'elle pourrait obtenir d'une recherche étendue sur les lay-outs et les techniques traditionnelles. L'auteur propose une méthodologie pour cette étude visée à la transmigration des idées constructives des technologies anciennes aux techniques modernes. La méthode suggérée permet l'insertion directe des résultats dans les procédés du dessin automatique.

ZUSAMMENFASSUNG
Der Einfluss der westlichen Architektur und Technologie trägt beträchtlich zur Entstellung der Städte in den Ländern der Dritten Welt bei und zugleich entzieht er der Bauwissenschaft die Beiträge, die ihr durch eine globale Forschung der traditionellen konstruktiven Lösungen der jeweiligen Länder zuteil werden könnten. Der Autor illustriert eine Methodologie für diese Untersuchung, die darauf zielt, die Übertragung der konstruktiven Ideen der antiken Technologie auf die moderne Technik zu entwickeln und das, um ein direktes Einfügen der Untersuchungsergebnisse selbst in den Vorgang der automatischen Bauplanung zu gestatten.

Only recently has it been realized that the products of building industry, perfect and aseptic as they are, can be as polluting as the best products of engineering science, from the television to the atomic bomb: if not from the physical point of view at least from that of the impact on the various anthropological cultures.

This means that building design, born from the meeting of modern science, which is universal and of western technical practice must develop new functional, constructive and gestaltic models attached to the physical and cultural environment of each country, which has had in the past a different evolution related to different feelings, habits, cultures, languages and religions. We here propose to rationalise and systemise the retrieval of informations on the possible contributions to architectural science of different local cultures. The aim is to utilize them throughout the design procedure, at the right point of the different stages.

These stages are in fact:

a) Listing and analysing the design data

b) Analysing the requisites to be obtained

c) Inventing a set of forms, i.e. images of the object to be built. This can be done (Pask, 1962): (c1) by extrapolating from and or interpolating amongst the forms of various objects already realized, in order to carry out identical or analogous functions; (c2) translating into another language or rather adapting an already experimented form to another environment; (c3) optimising a set of parameters related to the object to be designed in order to quantify the requisites.

d) Valuing the preceding points within the structure of Architectural Science, a structure which can be called Vitruvian (see further below); and thence proceed to the ultimate choice of design solutions to be adopted.

Good design, at the stages (a), (b) must be checked an a list of observations of the surrounding townscape. And this because environment, specially in towns, includes man made products, mainly buildings, in which are embodied the records of past ways of life, the indigenous techniques: in other words the cultural traditions crystallized in architectural forms. The living cultural heritage ranges from the ability to use this or that material, to the built forms which optimize the energetic balance (e.g. in Iran) to the intuition of immaterial stresses flow in structures (as in M.E. vaults), to a series of building solutions both in construction (e.g. Japanese extralight antiseismic houses) and in layout (the Tatami modulated plans).

We observe now that at stage (c) of the design the engineer (or architect) is accustomed to follow routine (c2), translation, i.e. adaptation of western constructional forms and techniques to environmental conditions. He generally achieves this aim by trusting only to intuition and it is a known fact that the results are uneven. We propose therefore to follow an alternative (or at least parallel) design routine of the type (c1) to (c3). Namely: (i) to find and draw new forms extrapolating from (and/or interpolating amongst) the built forms traditional in the geographical area in which the new constructions are to be erected; (ii) to proceed to a choice between the constructional forms invented as above, following a routine of optimisation which includes suitable checks of the standards of quality. The confrontation by which the optimisation is obtained could also include the design solutions obtained by translation.

If we consider together stage (c), invention of forms, and stage (d), evaluation of the design solutions, we realize that it is not sufficient for every structural en-

gineer or architect coming from western countries to be ready to learn his lesson from the buildings he sees, but that it is necessary to organize on a wide collaboration basis the information retrieval of all the structured messages which can be detected in a scientific study of the building traditions: a study aimed at developing the transmigration of planning/constructional ideas from ancient native technologies to modern techniques.

In this research the notion of reversibility between design procedures and building analysis can be of use. It has been stated (Guerra, 1974) that the system of less and less abstract models which constitutes Design Methodology, if developed in the opposite order, i.e. more and more abstract models, constitutes the set of the operations necessary to carry out the analysis of any building. On the other hand the theory of architecture can establish an order in very large sets of observations, which not only makes possible their analysis but facilitates the use, for design purposes, of the data extracted from the analysis itself.

The so-called Vitruvian structure (Guerra, 1958) consists in distinguishing three categories under which the data of the project or the results of the analysis can be classified: (i) aspect: i.e. physical environment, built form, mechanical behaviour, etc.; (ii) degree of abstraction of the model: physical, geometrical, topological; (iii) scale: environment, building as a whole, single floors (or main structural parts), rooms (or elementary bearing structures), constructional details. The Vitruvian scheme takes also into account all the interactions between informations belonging to each of the above categories.

We refer to the bibliography for a complete description of the Vitruvian system and we limit ourselves here to noting that the category scale has a different definition in each of the two classes of design methods: the morphological (Zwicky, 1948) and the atomistic (Alexander, 1962).

In the morphological methods we decompose the physical models of the building to be analysed according to scale, dividing them into main structures, sub-structures, and so on down to the most minute elements; returning (if these last are related to the whole building without any reference to the intermediate structures, as in the finite elements method) to the atomistic methods.

The classification of the physical models of a building arranged according to scale starts by identifying in each of them the proper topological structure. In other words at the topological level the model (i.e. the graph) of a layout or of a structural skeleton can be oversimplified (considering as vertices only the main parts of the building) or complicated (taking in account all the elementary functional units).

This means that the analysis of existing buildings performed by rational and progressive elimination of less essential details leads to less and less complex abstract models. Furthermore analysis by successive abstractions leads to the enumeration of all possible topological structures of the physical models of buildings under each of the aspects. (Guerra, 1961; Spillers, 1974; March, 1977). In this framework buildings of all typologies, of all times and all countries can be analysed and classified.

Vice - versa by enriching the complete set of abstract models with all the useful details it should theoretically be possible to design all imaginable constructive forms. In practice, however, it is neither possible nor advisible to consider and evaluate all imaginable forms and for this reason, it is necessary in stage (c), in-

vention of architectural and/or structural forms, to proceed as stated above by extrapolation or interpolation of existing forms. A widening of the spectrum of the built forms to be examined will increase the probability of a satisfactory design. This means increasing the number of buildings, different by type and/or geographical collocation (i.e. different cultural environment), to be analysed.

At the CIB congress, held this September (1977) in Edinburgh, we dealt (section K, rehabilitation and re-use of ancient buildings) with the retrieval methodologies: The IABSE Munich October congress could be the occasion to propose a systematic research on the traditional building techniques of the various countries with the aim of understanding their static-formal principles. This investigation should be carried out on a few classes of buildings which are characteristic of varying cultural areas and along the lines of the Vitruvian analysis; this would facilitate the classification of the data acquired in a way suitable for use in Design Methodology. A study of this kind would enrich the design abilities of our engineers with experiences not yet embodied in western Architectural Science.

I should like therefore to suggest that the Congress propose the inclusion of such a study in the UNIDP (United Nations Intercountries Development Programme) which deals with urban development projects. Recruitment of experts is open by ESCAP (Economic and Social Commission for Asia and Pacific) for this programme; the structural engineer, who ultimately defines the constructional form and consequently the built environment, must be encouraged and helped to take an active part in the U.N.O. programme.

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