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Daniel Siret

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Le Corbusier – Plans
DVD N°11

Notice
“1950 - Climate Chart (Chandigarh)”

Daniel Siret

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Among the many challenges faced by Le Corbusier in his Indian projects, adaptation to climate was by no means the least. What was at stake was to demonstrate the virtues of modern architecture in a difficult climate, which grouped in a round a very hot season from March to May (temperatures around 40°C), a very wet season from June to October (arrival of the monsoon), and a cool season from November to February. Apart from the question of sunlight that Le Corbusier had grappled with since the early 1930s (1), problems of interior ventilation, control of air humidity levels and protection against rain came to the fore as elements of vital importance for his projects in India.

To respond to these issues, the atelier developed late in 1951 a new methodological tool: the climate chart. I. Xenakis appears to have been the originator of this idea; at least he introduces himself as *‘in charge of the climate chart’* in a note he sent to the Senior Architects of Chandigarh on 14 January 1952 (2). This note lists the work accomplished since 9 December of the preceding year: definition of both the climate study programme for Chandigarh and the climate chart from 9 to 15 December, study with A. Missenard (3) and application to houses of 110 m² from 16 December 1951 to 1st January 1952, study of sunlight at Chandigarh during the first week of 1952, final solutions for houses of 110 m² by 15 January 1952.

This tight schedule seems to have been completed. On 16 December 1951, Xenakis defined the main lines of a *‘Programme of studies for Optimal Climatic Conditions and the Architectural Means of correction’* (4). The programme is put together in a precise enough manner, even if the wording, tinged apparently by the hygienist theories of A. Missenard, is often obscure. Xenakis defines *‘the climatic ambience’* as depending on four variables: temperature, relative humidity, wind speed and temperature of walls, and he proposes to *‘define the optimal and theoretical variations of the ambience in order to conserve or attain the best LIVING performance’* (5) by considering diurnal and annual variations. The objective consists in *‘finding as of climatic data and pre-established theoretical results the architectural processes of correction. This by means of a chart (see copy)’*.

1. See the article ‘Sunlight’, DVD 7, Coffret 2

2. FLC P2-1-10

3. André Missenard, physicist and teacher in the hygienist vein, author of *L’Homme et le Climat*, published in Paris in 1937. He is described in this note as a *‘French specialist of the climate question’*.

4. FLC P2-1-1.

5. Capitals as in the text.

The copy Xenakis refers to probably corresponds to presentation panel FLC2642, of 21 December 1951, entitled '*General outline of chart for climatic conditioning of the Secretariat*'. This drawing transposes by graphic means the principles presented in the text. However, it differs from the text in that it takes into consideration six physical factors (shown as six horizontal strips) which correspond to sun, light, temperature (of air), ventilation (prevalent winds), rain and relative humidity. The chart is divided into three columns, which correspond to the three stages in the method: recording of climate data for the site, the '*optimal conditions*' to be attained, and, last of all, the '*architectural processes*' liable to secure these optimal conditions in the given climatic context. Each column is cut up into twelve months, which are grouped in seasons, opposite which are illustrations of various data. In this way, the first column (climate data) presents the variation graphs of air temperature and relative humidity, solar diagrams (azimuths and heights) as well as different pictograms that indicate the presence of rain or the direction of prevalent winds. The next column shows the conditions desirable for an individual occupying the space. These conditions remain, at this stage, wholly schematic and are not quantified; the aim being to protect from sunlight, ensure good natural ventilation and avoid humidity in spring, protect the building from summer rain, and bring in sunlight while blocking out wind in autumn. The means by which these ends are reached are described in the last column. Several question marks testify to uncertainties, in particular concerning protection against excessive heat or humidity. Exact positioning of brise-soleil solved problems caused by sunlight, varied openings enabled adjustment to needs of natural ventilation, loggias were proposed against rain...

On the very day this drawing was done, Le Corbusier wrote to Jane Drew to inform her of the invention: '*We've had a second meeting with M. Missenard, and we've evolved an 'hygienic climate chart' that enables us to get a clear view of our problem. Things are moving quickly and we hope to be able to make useful propositions.*' (6)

The definitive chart was drawn up in a document dated 31 January 1952 and signed '*Atelier LE CORBUSIER*' (7). The chart is defined as '*a material tool for visualisation that enables enumeration, coordination and analysis of climate data for a place defined (by its latitude) in order to orient architectural research towards solutions suited to human biology. The aim is to regularize and rectify in a useful way the asperities of extreme climates and to obtain by architectural devices conditions able to guarantee well being and comfort*'. Le Corbusier's written expression seems to have corrected that of A. Missenard, opening a vast programme of study that would be classified today under the heading of bio-climatic architecture. The first three columns are turned into 'titles'. The first (Title A) concerns '*Conditions of ambiances*'; the six factors projected in the drawing of 21 December are replaced by the four factors initially formulated by Xenakis: air temperature, relative humidity, direction and speed of winds, sunlight and thermal radiation of constructions.

The second column is entitled '*Corrections in view of comfort and well-being*', this new title replacing advantageously that of '*optimal conditions*' and the search for the '*best living performance*' of the first version. In the squares of this column, *the physicist-biologist will inscribe corrections or rectifications thought to*

6. Letter from LC to J. Drew, 21 December 1951, FLC P2-1-9.

7. FLC P2-1-3

be indispensable. In this way, the reading of the second panel of the Chart will constitute the programme to inform the intervention of the architect’.

Last of all, the third column carries the title ‘*Architectural solutions*’ and is drawn up according to a precise protocol. It does not aim at representing in graphic terms the schematic solutions on the chart itself, but rather at signalling by the presence of a stamp (the letter ‘D’ for ‘drawing’) the existence of a solution duly studied, referenced in the body of the stamp and accompanied, where possible, by an explanatory diagram. These graphic pieces gathered in a notebook in annexe ‘*constitute the architect’s answer*’. The document refers to the scheme of the chart that was ultimately published, along with the text quoted above, in the *Oeuvre complète* (8).

The first application of this new tool concerned the projects for the 110 m² houses (i.e. Peons’ Houses) at Chandigarh (9). The title B of the chart (under the heading ‘*desirable corrections on premises*’) was drawn up by A. Missenard on 16 January 1952 (10). It was initially reproduced in a schematic version (FLC5612), then in the complete chart signed Le Corbusier, on 21 January 1952 (FLC5623). By its use of the ‘D’ stamp system, the latter chart referred to diverse architectural solutions which are consigned in the group of drawings FLC5627 (16 sheets) and reproduced in presentation panels FLC5600 and following. These drawings bear witness to architectural research stimulated by the climate chart and to the many formal and material solutions imagined in view of ensuring the best interior comfort in the climate of Chandigarh. They include proposals for a cooling system by ‘*creating a fine mist of water drops in the garden and over the roof and walls*’ (FLC5600), the installation of brise-soleil (FLC5601) and awnings to ‘*increase the shaded area*’ (FLC5609), a system of doors and moveable screen walls to enable ‘*establishment or suppression of air circulation depending on sunny weather*’ (FLC5602, FLC5611), a double roof ‘*parasol painted white to reflect hot sun rays*’ (FLC5603), another cooling solution that entailed ‘*the creation of a render-coat of greenery over walls using espaliers*’ (FLC5604), an increase in the level of air humidity by installing ‘*a wet calico at the point where wind enters*’ (FLC5605), the careful orientation of openings according to prevalent winds (FLC5607), and rooms closed ‘*by means of thick cotton drapes that roll up under the ceiling*’ for the cool season (FLC5610), etc.

The effervescent activity around the climate chart in the period from December 1951 to January 1952 gradually subsided. The chart, followed by the descriptive text quoted above, were sent to J. Drew at Chandigarh, on 22 January and then 8 February (11). A meeting between M. Fry, J. Drew and PL. Varma took place on 8 March. The report records (12) diverse criticisms levelled not so much at the principle of the chart as at the pertinence of the climate data taken into account (Title A) and the proposed solutions (Title C). The data given did not correspond to actual climate conditions experienced on the spot. Certain solutions for ventilation and the principle of humidifying air were judged inefficient. The principle of planting greenery (on roofs and over walls) was accepted. The decision was taken to build three experimental houses, which would use in turn the ideas of Le Corbusier (greenery on walls), of

8. Vol. 6, p. 108.

9. Observation notes on the layout of the houses of working class Indian people and domestic life season by season (‘*Resumé : 3/4 of the time they use the veranda*’) are given in panel FLC5485, but we do not know whether these notes are related or not to the making of the climate chart for this project.

10. FLC P2-1-27

11. Letter from LC to J. Drew, 8 February 1952, FLC P2-1-13

12. FLC P2-8-25

the engineer-in-chief Varma (planted rooftops) and of J. Drew (unspecified). It was also decided to correct the chart's climate data according to local knowledge of the climate in Chandigarh.

On 14 May, J. Drew informed Le Corbusier of a project for an exhibition on Chandigarh in New York and asked him if it would be possible to include in it, along with the CIAM town planning charter, the climate chart (13). Le Corbusier approved in his reply of 4 June 1952. On 20 June, in answer to a request made by Doshi on 20 May, the Meteorological Bureau of India sent to rue de Sèvres the weather data recorded month by month for the cities of Ahmedabad and Ambala, the latter being the meteorological station closest to Chandigarh. On 22 July, Le Corbusier wrote to J. Drew and referred briefly to the climate chart. Over a year later, G. Samper sent to J.L. Malhotra at Chandigarh '*a copy of the climate chart drawn up at the atelier in January 1952*' (14), pointing out that it was established going on weather reports from Ambala '*which are somewhat different from those of Chandigarh (...). Because of this, the chart should be considered as an example that merely demonstrates method*'.

After this the chart disappeared from correspondence and plans, even if many drawings testify to thought generated by it. Presentation panel FLC2827 for example shows clearly the effects of sun, light, rain and movements of air in section for the Secretariat project. Panel FLC4639 shows a detailed study of natural and artificial ventilation for the High Court. Questions of climate comfort were also studied for the villa Sarabhai project (FLC6676). Similarly, the brise-soleil used in India were designed with a close attention that owes a great deal, once again, to the work of I. Xenakis (15). Other indications that point to awareness of the importance of climate include the wind roses that show the direction in which the building faces, the highest solar azimuths winter and summer, and the direction of prevalent winds for each season, which figure in many plans of this period (see for example panels FLC29150 and FLC4891).

The climate chart made its last appearance in January 1959 when, for reasons unknown, Le Corbusier asked Maisonnier and Xenakis '*to send without delay to Pierre Jeanneret a blueprint for standard brise-soleil and a Climate chart*' (16). They were sent on 12 February 1959, accompanied by a letter in which Le Corbusier himself puts an end to the history of the climate chart: '*My dear Pierre, I'm sending you the (...) climate chart that served to develop the architectural solutions used in the study for the peons' houses. None of this was built, but the work method that the climate chart enables was interesting.*' (17).

13. FLC P2-1-29

14. FLC P2-11-21

15. See article 'Studies in sunlight - Tower of shadows' in the present volume.

16. PLC P2-1-32. The tone of this note, by no means cordial, reflects the strained relations between Le Corbusier and his collaborators at the time, before the break of autumn 1959. On this subject, see S. Sterken, « Travailler chez Le Corbusier : le cas de Iannis Xenakis. Le conflit comme stratégie créative », in J. Quetglas : *Massilia*, 2003. *Anuario de estudios lecorbusierianos* (28), Barcelona, Fundación Caja de Arquitectos.

17. FLC P1-13-34