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## **Vitruvian Revival Now**

Michael Hebbert on a science-based revival of forgotten principles of urban design

The November 13th symposium to celebrate the 50th anniversary of Harvard's Graduate School of Design was dominated by an accusation that 'landscape urbanism' is stealing the clothes of urban design, claiming superior ecological credentials and fitness for the challenge of climate change. There's a real issue here. Landscapers play up the climatic contribution of vegetation, planted areas and green infrastructure - quite right too. But we should equally appreciate the micro- and meso- climates created by dense environments of buildings and streets. Built form, land use patterns and urban morphology affect weather to a significant extent. Cities are not just passive recipients, they shape their own climates for better or worse. And whatever else it may be, urban design is the oldest medium for anthropogenic climatic modification.

## THE VITRUVIAN LEGACY

We can call this medium 'Vitruvian' because that's how Marcus Vitruvius Pollio approaches the topic of urban design in his classic treatise *De Architectura*. Chapter I.6, 'The Directions of the Streets: with remarks on the winds', calls for a Tower of the Winds - a marble *amussium* - to be set up in the centre of a town-site and streets to be aligned exactly along the lines of division between the quarters of the various winds, so they strike against the angles of the blocks and their risk to health is broken and dispersed. Vitruvius was drawing upon long traditions of classical thinking about the microclimates of towns. Hippocrates' treatise '*Airs Waters and Places*' argues that healthy residents with good skin colour and clear voices live in cities exposed to the winds originating in the East, between the summer and winter risings of the sun. Healthy positioning in relation to wind and sun comes before military security as the first principle of town layout in Aristotle's *Politics*. Classical thinking echoes the sensibility of other ancient civilisations, such as the close appreciation of wind, water and physical setting in Chinese town plans, still echoed in *feng shue* design method.

*De Architectura* was rediscovered in the library of the Convent of St Gall around 1413. Besides his influence on Palladio and the course of Renaissance architecture, Vitruvius revived interest in the climatic effect of street layout. Alberti seized on this in his 1485 updating of Vitruvius and Spiro Kostof suggests that it influenced Leonardo da Vinci's 1503 design for the city of Imola, the earliest town plan to incorporate a wind-rose. King Philip II of Spain showed a Vitruvian concern in the ordinances concerning the laying out of towns in the New World which he issued from the Escorial in 1573: town sites were to allow entrance and departure open to the north wind, and building lots and edifices to

be arranged in such a manner that rooms might enjoy the best airs; in the middle of the every town should be an oblong plaza from which

. . . shall run four main streets, one from the middle of each side of the plaza; and two streets are to meet at each of its corners. The four corners of the plaza are to face the four principal winds, because thus the streets diverging from the plaza will not be exposed to the four principal winds which would cause much inconvenience.

Vitruvian theory of town layout reappeared as a significant consideration in response to the population concentrations and atmospheric pollution of the early industrial city. Public health reformers appealed to the authority of *De Architectura* to justify controls over street layout to ensure clean-sweeping breezes. So did both sides in the late twentieth century planning debates between proponents of straight and curved streets. And come the 1920s Le Corbusier and the Modern Movement claimed the same mantle in their polemic against the corridor street. The whole purpose of the Charter of Athens was to reconcile what it called those *four functions* of housing, work, recreation and traffic with the *'three imperious necessities'* of space, sun and ventilation.

#### THE UNAWARE DECADES

For whatever reason, climatic awareness lost ground in the second half of the twentieth century. Stanford Anderson's massive *On Streets* of 1978 - 416 pages in a wide three column format - looked at streets from every architectural, social, economic and cultural angle but had nothing on climate, weather, wind, sunshine or comfort. 'Air' was discussed only as in 'air right development'. It was typical of the postwar decades that weather came to be taken for granted as something to be fixed by central heating and air conditioning, or avoided by provision of covered walkways. Criticising this blind spot in

her book *The Granite Garden* of 1984 Anne Whiston Spirn drew attention to the one major exception - in Germany, Vitruvian planning was alive and well. The leading example was Stuttgart, a motor manufacturing city in a deep valley with low wind speeds. The city council had - and still has - an inhouse meteorological team whose climate maps have played a significant role in urban design and development control, for example protecting cold air drainage paths down valley slopes in the interests of inner city ventilation. Figure 1 shows a detail from the updated 2008 edition of the *Klimaatlas*, covering the entire metropolitan region of the city and adjacent municipalities.

The Stuttgart case was featured in a colour film *Climate and Development* shown as part of the German Federal Republic's exhibit at UN Habitat in Montreal in 1976. Anne Whiston Spirn describes how the city manager of Dayton Ohio happened to see the documentary and was instantly won over. Dayton has the opposite problem to Stuttgart - too much strong wind hitting the city centre - but its message of harnessing climate analysis to design was just as applicable. The municipality built a 1:600 scale model of the entire downtown in the Parks Department workshop, the City Manager's assistant loaded it into suitcases and drove it to Cambridge Mass for testing in the M.I.T. wind tunnel, maps were drawn and measures taken, and in the early 1980s Dayton briefly led the way in climatic urbanism.

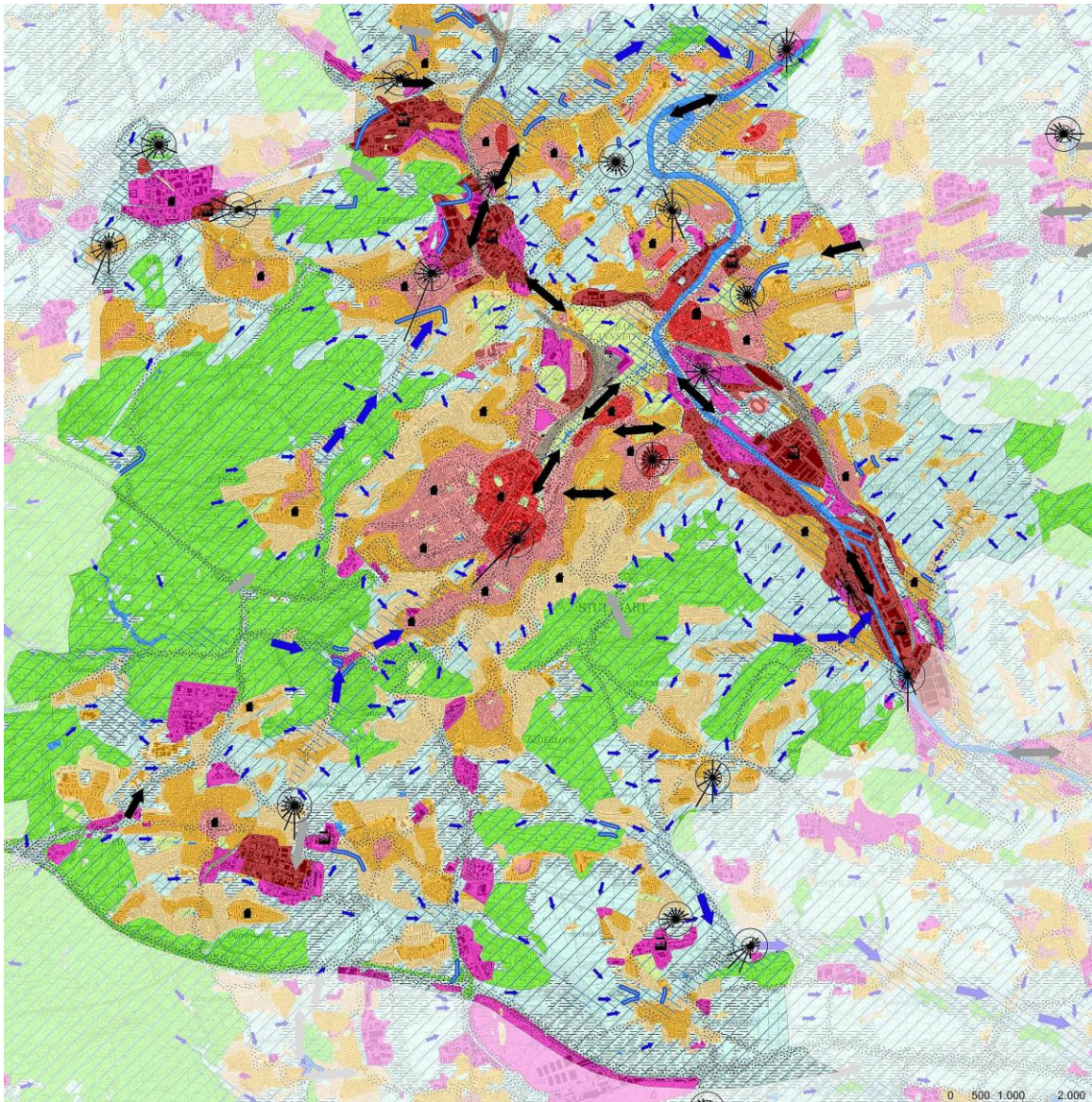


Fig 1 Detail from *Klimaatlas Region Stuttgart* (2008) showing windroses, climatopes and airflows.

But this shortlived local experiment only confirmed the lack of Vitruvian awareness in most cities. It was a problem that preoccupied scientists and was repeatedly discussed at their international gatherings. The World Meteorological Organisation gave priority to the issue, joining forces with the Confédération Internationale du Bâtiment, the International Federation for Housing and Planning and the World Health Organisation in various efforts

to publicise the few extant examples of climate-aware urban design from the German-speaking world, Israel, and the Soviet Union. In 1976 the WMO published the report *Urban Climatology and its Relevance to Urban Design* by the British geographer Tony Chandler. Four years later IFHP distributed a booklet *Fundamental Knowledge in Urban and Building Climatology* to all the major European universities and technical schools of architecture and design. It included 30 pages of topics that every urbanist should understand, including the structure of the terrestrial atmosphere, the nature of solar radiation, precipitation, wind, humidity, atmospheric electricity, air pollution, techniques of weather analysis and the various types of climate. The author, Bob Frommes, predicted 'catastrophic damages and dangers' arising from ignorance of such basic climatological factors. You could say history proved him right.

#### CLIMATE SCIENCE AND URBAN DESIGN

The story of climate awareness in urban design is currently being researched at the University of Manchester in a 20-month project funded by the Economic and Social Research Council ([www.sed.manchester.ac.uk/architecture/research/csud/](http://www.sed.manchester.ac.uk/architecture/research/csud/)). We're looking at the way urban climatology has evolved since 1950 and its mostly unrequited efforts at knowledge transfer to design practice. The science has developed at three levels: through observational measurement campaigns of urban heat islands and the local patterns of heat, air movement and humidity at street level; through a growing theoretical understanding of the meteorological dynamics of the Urban Boundary Layer (i.e. the heat island) and Urban Canopy Layer (i.e. the street canyon) ; and through modelling, whether in wind tunnels or via numerical simulation of the exchanges between the three-dimensional surfaces of cities and their atmospheres, using computational fluid dynamics. The website of the International Association for Urban Climate - [6](http://www.urban-</a></p></div><div data-bbox=)



*climate.org* - shows the range of the modern discipline and the extent to which traditional Vitruvian intuitions have been overtaken by robust scientific method, including sophisticated modelling of human comfort and health within a virtual urban environment, now or in the future. And all this is a science of factors directly relevant to urban design - street orientation, building alignment, height-to-width ratios, shadow patterns, the heat-reflectiveness (albedo) of building form and materials, hard and soft landscape, morphology.

#### THE NEW CLIMATIC URBANISM

The ESRC project comes up to date with four modern case studies of climate science and urban design in Manchester, New York City, Stuttgart and Tokyo. The point here is that Stuttgart is no longer alone: now at last, there's a worldwide interest in applying lessons of urban climatology through the feedback loop of urban design. Global climate change has brought home the need for city governments to understand their local climatic environments. Municipal leadership in response to global warming is the defining aim of networks such as ICLEI and C40. Under the UK Climate Impacts Programme, cities are catching up with their own pasts, analysing patterns of historic weather events as a basis for future risk assessments. As city mayors begin to develop their climate strategies various voices are clamouring for attention. Environmental architects frame the remedy in terms of building design and technology, landscape architects emphasize green infrastructure and the evapo-transpirational factor.

As the GSD controversy shows, urban design is still finding its voice. That's what makes those long-established precedents of Vitruvian urbanism so significant. For example the City of Munich's *kompakt-urban-grün* strategy is partly based on climatological mapping

undertaken by the Bavarian urban climate unit Stadtklima Bayern in 1986, which revealed the city's dependence for summer ventilation on cold night-time air draining off the Alps to the south, and daytime flows of fresh air from the Danube plain to the east. This knowledge played a crucial role in the redevelopment of the former airport site as a city extension, the Messestadt Reim: its design (figure 2) incorporates a 'fresh air glade' 400 metres wide from east to west of the site to guarantee the ventilation of the city centre, while the layout of the housing blocks allows for night-time ventilation from the Alps to the south. The concept was devised by one of the climatologists behind the 1986 study of Munich, Prof Helmut Mayer, who has gone on to apply similar strategies for wind management in Freiburg.

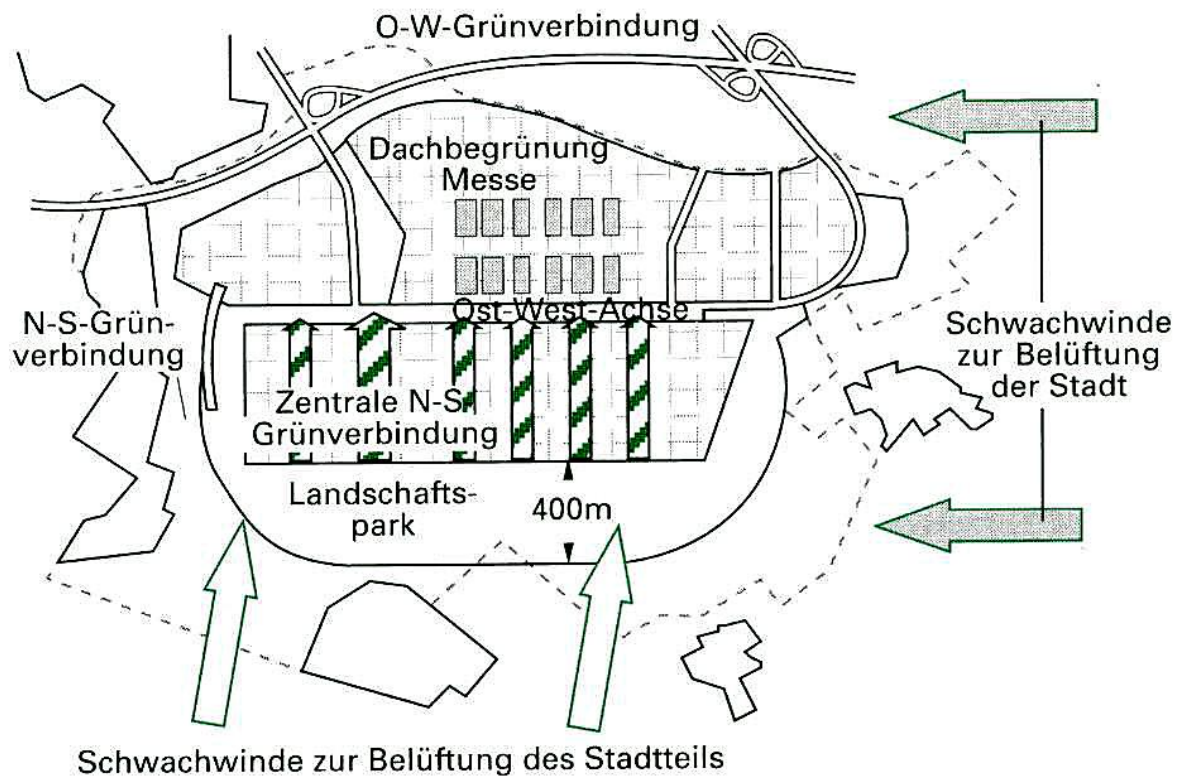


Fig 2 Wind analysis for the Messestadt Reim, Munich (from 1995 fig.14)



Stuttgart continues to play a leading role. Its technique of synthesizing climate data into maps that can be used by planners has been adopted as a national standard by the German Institute of Engineers [footnote: *Umweltmeteorologie - Klima- und Lufthygienekarten für Städte und Regionen* Verein Deutscher Ingenieure VDI 3787, 2003], and is now beginning to be applied internationally - a new study finds examples in Brazil, Chile, China, the Czech Republic, Hong Kong, Sweden, and Thailand [footnote: Chao Ren, Edward Ng and Lutz Katschner 'Urban Climatic Map Studies: a review' *International Journal of Climatology* forthcoming]. In November 2010 the city published a report on *Climate Change as a Challenge for Urban Climatology*. The report, in German and English, shows how Stuttgart's long-standing application of Vitruvian principles for ventilation and air quality is being extended to the global challenge of climate change - fascinating reading, and freely downloadable from the website [www.stadtklima-stuttgart.de](http://www.stadtklima-stuttgart.de).

The new Vitruvianism applies sophisticated scientific understanding to the oldest question of how the solids and voids of the city should be shaped for health and thermal comfort. 'Landscape urbanism' be damned, this is a great opportunity for urban design.

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