

## **Using Virtual Cities in Teaching Architecture and Urban Planning: Auroville**

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### **Abstract:**

The paper describes the Auroville project, which is in essence, the creation of a virtual and fictional city for use in architectural education. The project is firstly a didactical method for teaching fundamental Computer Aided Architectural Design (CAAD). Furthermore, by encouraging the design of infrastructure projects for the city, the students are initiated in co-operative work practices. Thirdly, as the virtual city has grown, the students have been confronted with urban planning issues such as conservation and renewal. Auroville is a fictive city based on the writings of the Guru Sri Aurobindo. The authors have mapped out the city using CAD software and essentially have created a palette of lots on which students can "build". The lots are assigned or acquired by each student at the beginning of the semester and in a series of exercises stretching over the semester, a built environment is created for these lots. The lot descriptions are connected to a central CAAD server so that a complete three-dimensional city file structure is created. This allows the students to see the city as a whole as well as the urban effects of their designs (as well as those of their neighbour's.) In the past three years, approximately 900 students have taken part in the Auroville project. Indeed, the city, as originally laid out, is well nigh full. This led the organisers to focus work on infrastructure issues such as urban transit. Nonetheless, many students wish to continue work on individual parcels. This has also led to planning proposals by the students to "remove and replace" so called unsightly buildings. This has allowed urban planning issues to be raised. As well, the group has attempted to find ways to democratically resolve conflicting views. These resolutions are also used to plan larger scale infrastructure projects. A seminar dedicated to designing light rail transit lines and their stations focused on the balance between commonality and individuality. Auroville can be seen as a microcosm of current urban planning problems. The accelerated speed of development in the city serves the pedagogical role well. The negligible monetary costs in renewing the lots serve to highlight the other costs involved in real-world urban fragment issues such as cultural heritage, time and the image of the city. Current work is focused in three areas. Firstly, on a social engineering level, the authors are seeking to establish a "city council" in order to allow the students to autonomously direct the development of Auroville. Secondly, the technical conversion of the CAAD files into immersive VR files will allow real time exploration of the city. Lastly, the extension and structuring of the CAAD files could allow a wider range of analysis to take place. Additional functionality through and time-based simulation will allow technical issues such as solar gain, wind movement, traffic analysis, etc to be taught using the virtual city Auroville.

Key Words: Education, Virtual Cities, CAAD

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The Teaching Chair for Computer Supported Planning at the Aachen Technical University was established in 1999. Part of the mandate of the institute is to carry out introductory courses in Computer Aided Architectural Design (CAAD) for lower level students of architecture. As is the case in most every school of architecture, the dilemma in introducing CAAD to architecture students lies in balancing principles of data organisation

with specific functions particular to the computer program being used to teach these principles. In this spirit, AutoCAD is used as the program with which the strategies of using CAAD in design are taught.

Experience has also shown that merely explaining the functions and principles of CAAD are not sufficient for students to retain the course content after the lessons are completed. Goal based assignments that engage the students allow the methods to be used and applied. Attempts had been made to allow the students to use the CAAD system to model the design problems they concurrently were trying to solve in the design studio. This, however, has led to large problems. Work slowed to an insufferable speed owing to either the unfamiliarity of the students with the CAAD system or difficulties with the design problem itself. In pursuing design ideas, it seems that speed with which the author can test the idea, often through repeated sketches, is of extreme importance. In trying to use an unfamiliar CAAD system for this sketching proved detrimental to the design development. This frustration was also mirrored in learning the CAAD system. Learning and using different commands was far easier when done with meaningful content. However, if the design was not well formulated, the students had little with which they could manipulate. In both cases both the CAAD course and the design studio work suffered. Nonetheless, using a design problem sufficed to engage the students. It was decided that rather than assign a building to be modelled with CAAD, the course employed a reduced design problem independent of the larger design studio projects. This also allowed the students the "freedom" to design unencumbered by weighty design studio criticism. In effect, the students were freed from design responsibility.

Concurrently, research in the field of Computer Supported Co-operative Work (CSCW) has demonstrated the potential and need for students to understand the methods being introduced into practice. To this end, the authors have developed a syllabus that employs collective as well as individual assignments. In essence, the students receive a parcel of "land" from a fictive city and in collaboration with their neighbours, the students must design a building for the site and do so using the CAAD system.

Attempts to use this didactical approach at the University of Karlsruhe used the City of Karlsruhe itself as the "site". This met with varied responses. On the whole, the use of a real city brought more issues into the project than any clarification owing to its reality was worth. As was the case with the design studio assignments, the real cities encumbered the CAAD didactics with other non-trivial issues. Urban planning problems tended to dominate the student projects when the real goal was simply to learn to effectively use the CAAD to design. Again the engagement of the design topic was positive, but its scope was too far reaching for the purpose intended.

The CAAD Teaching Department in at the Technical University in Aachen sought to alleviate these problems by using a new city, fictive city. This city is called Auroville. In fact, Auroville is a real city located in India. Auroville was a fictive city based on the writings of the Guru Sri Aurobindo and in the late 1960s and early 1970s, an attempt was made to create a city using these writings. The state of the city today is rather disappointing, but for the students, the Auroville exists as an imaginary and fictive place. In creating the course context, the master plan for Auroville was used as a city map. At the beginning of each semester, each student then receives a parcel on which they are to place their building. The CAAD Department teaches approximately 250 students each year. Over the past 2 and 1/2 years, it has been possible to fill up this city with buildings. As of this writing, (in the winter of 2001), the city of Auroville is almost full. This naturally begs the same questions facing all cities with rapid growth concerning expansion, renewal and capacity. This allows the Department to pursue two strategies simultaneously.

In addition to the introductory CAAD courses, the Department teaches courses involving CSCW as well as general computer aided design training using net based design

studios. A third aspect of the pedagogy is the introduction of interdisciplinary teamwork. Auroville, with its rapid growth and complexity, serves as a platform for these secondary and tertiary issues. That is to say, the introductory CAAD courses serve to populate the city. Advanced CAAD courses use the city structure to commonly create the city's infrastructure. Lastly, the city serves as a common platform for related disciplines. In this way, Auroville is a microcosm simulating the real issues affecting the real cities we as Architects, Planners and citizens deal with.



Figure 1: Initial seeding of Auroville

## CAAD I

The initial CAAD courses are taught with design in mind. This means that the CAAD system is seen as a support for design as opposed to a replacement for drawing. The course is divided into five assignments. These are three-dimensional modelling (massing models), model refinement (manipulations in X, Y, Z), special forms (rotations and surfaces), plans and sections design development), and presentation (Basic Photomontage). By starting with three-dimensional modelling, the students are thrown full on into the CAD system. While this entails a relatively steep learning curve, it reflects the way the students are trained to attack design problems.

The students are instructed to pick a parcel on which they can "build". Initially, all parcels were empty. As each semester's work is added to the city, the empty parcels have become scarcer. Students now have the option of redesigning for parcels with existing buildings.

Each student must then communicate with his or her neighbour in order to divine the design directions on neighbouring properties. As the designs become more detailed, the level of co-operation and communication also shifts to smaller scales.

The parcels are defined using an Auroville-wide co-ordinate system. This allows the city to be readily constructed from the constituent parts using either BLOCK or XREF AutoCAD commands. One of the more difficult aspects of the city at the moment is its size. An in-house database system allows the students to easily submit their 5 assignments. The database then arranges the student's work in a common web site. This facilitates easier tutor access to the student's work and enables quicker and a common communication path between neighbouring parcels.

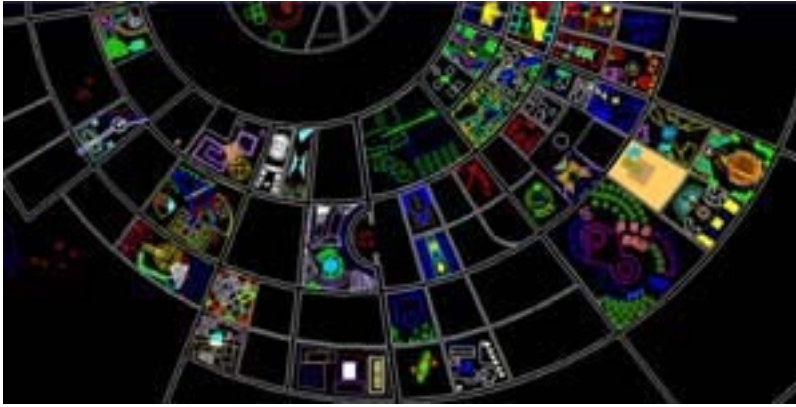


Figure 2: Auroville City Plan in AutoCAD

## CAAD II

The focus of the second CAAD course is twofold. On the one hand, the students are shown how CAAD models can serve as a core data model of the building. From this core model, the students learn about general rendering techniques, detailed lighting simulation, connection to CAM techniques used in the manufacturing and construction processes, rapid prototyping techniques used in building physical models as well as immersive virtual reality systems such as the CAVE system in Aachen.

On the other hand, the communication and co-operation process involved in large construction projects is simulated. This is carried out through a collective assignment to create a light rail transit loop for Auroville. The students are split into 8 groups of three students each. Collectively, the students are responsible for co-ordinating and planning the rail lines and the stations. Each group must then design and model their part of the complete line (with naturally perfect alignment of the rail lines at the area borders). These train stations are then modelled using Rapid prototyping, Rendered and converted to VR files for immersive walkthroughs. In this way, the city of Auroville has not only become populated, but also served with an initial infrastructure.

The student discussions as to where to route the light-rail-transit line through city brought up the question of which the Mayor of Auroville is. Furthermore, this question begged the question as to who would elect this virtual mayor. For some students, it was assumed that the tutor holding the course held this position. Despite the power available to a course tutor, the goal of the exercise cannot be to exercise Machiavellian authority over a fictive dominion. The citizens of Auroville must make these decisions. To be fair, the city of Auroville has a population of zero and so creating elected representatives must either lie with the planners themselves or await the introduction of spatial agents.

## Planning and Theory

The discussions that arose from the student's negotiations have led to the need for a city council. To date, the "building permits" for unused or occupied parcels are decided by an expert panel, namely the tutors. While this "god-like" position of authority is not without certain advantages, it is the intention of the Auroville project to create a simulation of real world urban problems using the virtual city. Additionally, owing to the high rate of change (with approximately 125 new buildings each semester, Auroville replicates the renewal process of real cities, but at a much higher speed. The goal then, is to create a political structure so that the city is self-regulating.

The first attempts to instigate self-regulation have met with mixed results. The CAAD I course is placed relatively early in the curriculum and so the theoretical or practical experience with urban planning issues is mostly absent. The following semesters will attempt to remedy this situation by providing introductory lessons in city government. This method,

combined with the experience gained from other concurrent engineering training sessions using interdisciplinary teams, should serve to engage the students in steering the direction of Auroville development.



Figure 3: Auroville Detail

### Further Development

Auroville is at turning point. The city according to the original Auroville plans is effectively full. The core concept in the CAAD I course is quite successful and so the authors are loath to abandon Auroville or restart the populating process. Instead, the potential is there to create a sustainable process of city development. This process of development and redevelopment is the basic framework for Auroville. The authors contend that the larger potential lies in using this virtual city as a framework for other city oriented planning exercises. Work is underway to extend Auroville in the following areas:

a) Planning Theory - courses in urban planning will use role-playing techniques to create and revise zoning laws for Auroville

b) Spatial Agents - By populating the City with inhabitants, use and behaviour can be used to evaluate the effects of certain urban interventions (within the limits of the simulation algorithms)

c) Immersive VR - The current size of the city is beyond the visualisation capacity of most workstations. Some experiments in the CAAD II course point towards streamlining methods, which would allow the students or visitors to actively explore the city. This, in conjunction with a spatial agent system and multi-user access could allow heretofore-unforeseen virtual urban experiences.

d) Interdisciplinary Development - The development of Auroville must not be restricted to architectural issues. The city data structure is undergoing a revision to allow other fields to work on the city. These include civil engineering projects such as water, gas and electrical grids as well as GIS information about traffic flow and regional development.

The City of Auroville has, over the past two and one-half years grown from a simple CAAD grid for placing artefacts to become a pedagogical platform for teaching a broad range of planning and design issues. While it is not suitable for every didactical approach, the city and its acceptance in the school has well exceeded the author's expectations. Its further success will depend on the high level aspects of its self-determination and the low-level aspects of data structuring.

## References

### Links

Auroville  
CAAD

<http://auroville.arch.rwth-aachen.de>

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