

# A Survey of Sustainability and Passive Design Curriculum Development in Schools of Architecture

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## INTRODUCTION

A breath of freshness is currently revitalizing Architectural education in Canada and the United States. The focus of the Architectural Curriculum is beginning to look outward and beyond formal issues of "style." Recognition of the impact of Architecture and Urban Development on our dwindling supply of natural resources for both construction as well as embodied and operating energy<sup>2</sup> has necessitated a restructuring of the curriculum to focus on issues of Sustainability and Passive Design, not merely as appended "technical" topics, but as conceptually directive considerations in the formation of environmentally conscious design. Such courses are being offered on both a core and an elective basis, as well as the primary focus of "Design Studios." Research and development in the field is beginning to recognize a new "Sustainable Vernacular."

Although there seems to be much abuzz regarding the teaching of Sustainability to students of Architecture, the current state of this teaching is not clearly defined. In an effort to understand the present condition of Sustainable education, I am conducting a United States - Canada Survey on the influence of "Sustainability and Passive Design" on curricular content and direction in Schools of Architecture. The purpose of this paper is to present a snapshot of the current status of Passive and Sustainable teaching; address issues in approach related to "regionality" — on both a geographic and climatic basis; and review preferred teaching resource packages, texts, videos and software. The current data is based on 68 responses out of 190 mailings, representing 53 schools of Architecture in the United States and Canada.<sup>4</sup> Respondents are typically teachers of Environmental Control Systems and Building Technology. (Figure 5) Delinquent surveys are being pursued in an effort to more thoroughly complete the database to allow for an accurate geographic analysis. This paper reflects the "September 95" status of the analysis.

The survey questions were based on four areas of concern:

A. *General*: The overall status of Sustainable and Passive Design teaching in the School and the perception of impending "change" with regard to this status.

B. *Sustainable Design*: More definitive information regarding actual numbers of courses being taught and the format of that teaching.

C. *Passive Design*: More definitive information regarding actual numbers of courses being taught and the format of that teaching.

D. *Support Material*: A bibliography of recommended texts and references, videos, software and resource packages for teaching, as well as information regarding computer platform preferences.

## ANALYSIS OF RESPONSES

### General Questions

Although Passive Solar Design may be characterized as an aspect of Sustainable Design, the survey specifically requested separate responses to the topics of "Sustainable Design Teaching" and "Passive Design Teaching". Whereas Passive Design teaching has been increasingly incorporated into the curriculum since the energy crisis of the mid 1970's, specific "Sustainability" courses would seem to have been more recently implemented in accord with current environmental concerns — the majority after the meeting of the World Commission of the Environment on Development in 1987.

The results of the survey support the notion that Passive Design teaching has been more firmly established in Schools. Data indicates that Passive Design teaching is solidly established in the majority of schools with 78% of respondents recording the topic addressed either to a "great or moderate extent". The same respondents noted the teaching of Sustainability to a "great or moderate extent" in only 54% of the cases. (Figure 1) When queried as to the School's intention to expand teaching in the area of Sustainable Design, 54% of respondents noted anticipated or planned curriculum expansion. (Figure 3) This direction of action is supported by the incidence of dedicated Committees to either Sustainable or Passive Design Curriculum/Research at schools. As can be seen in Figure 2, a higher proportion of schools report new committee activity in the area of Sustainable Design. When queried as to intentions

to expand teaching in the area of Passive Design, only 29% of respondents answered affirmatively, (some adding notes to the effect that they felt that their current Passive course offerings were significant and not in need of expansion).

### Sustainable Design Versus Passive Design Teaching

For the purpose of the survey analysis, I have compared the statistics gathered for the Sustainable versus Passive responses. Based on the answers to part A of the survey, it would appear that courses on Sustainability are a more recent addition to the curriculum, and are being actively expanded.

The nature of the questions in the Survey was based on the assumption that *Passive Design is viewed as an aspect of Sustainable Design*. Of the survey respondents, 81% categorized themselves as teachers of Sustainable Design and 74% teachers of Passive Design.(Figure 4) Of those, 66% claimed to teach both Sustainable and Passive Design, 15% Sustainable Design *but not Passive Design*, 7% Passive Design *but not Sustainable Design*, and 12% neither. It was surprising to find that a total of 22% of professors separated the teaching of Passive and Sustainable Design. This attitude seemingly contradicts popular thought in research, publications and conferences that positions Passive Design as a significant aspect of the larger realm of Sustainable Design. This contradiction is being addressed on the Addendum Survey. This type of attitude will have ramifications on the nature and direction of courses being taught at these institutions, and the attitude being passed on to students.

The status of development of both courses in Sustainability and Passive Design, as related to the number of offerings on each topic does not agree with the assessment of the General situation in part A — that is that Passive is more established than Sustainable.(see Figure 1) Of those completing this section (24% of respondents noted either no course offerings or left this section blank) there were 135 Sustainability offerings and 95 Passive offerings.(Figure 6) Of the 135 Sustainability related courses noted, 32% are offered at an introductory level, 42% are offered at an intermediate level and 26% are offered at an advanced level. Of the 95 Passive related courses offered, 37% were introductory, 38% were intermediate and 25% were advanced. These answers are very "grey" as not all respondents noted course numbers, and many noted that the same courses addressed both topics. This would support the notion that 66% of the respondents characterized their teaching as addressing both issues.

Course offerings in both Sustainable and Passive Design seem to be significant, but inconsistent from school to school. The University of Oregon and the University of Manitoba noted as many as 8 courses with Sustainability Content; twelve noted no course offerings. The average number offered by schools teaching Sustainable Design was 2.6 courses. The University of Manitoba noted 6

Passive Design courses; eighteen noted zero. The average number offered by schools teaching Passive Design was 2 courses. In many cases professors specifically noted that the same courses were responsible for addressing both Passive and Sustainable Design issues.

With respect to Sustainable Design, 41% of schools surveyed indicate that the topic is addressed in a core course, although 54% indicate that the coverage may be a "lecture" or "series of lectures" on the topic, within or external to a core course.(Figure 7) In spite of the existence of courses and lectures, 32% of respondents felt that the coverage was "marginal" and 44% that the topic was only addressed "indirectly." Interestingly, 44% of respondents noted the offering of a "Sustainable Design" Studio, although attached remarks noted that these were not "guaranteed" on an annual basis, but often by the availability of an instructor or expressed interest. Most professors noted that offerings in Sustainable design were "well subscribed." Elective course offerings were noted in 35% of schools.

With respect to Passive Design, 44% of schools surveyed indicate that the topic is addressed in a core course, although again, 54% indicate that the coverage may be a "lecture" or "series of lectures" on the topic, within or external to a core course. In the case of Passive Design only 16% of respondents felt that the coverage was "marginal", and 26% that it was addressed "indirectly" — which represents a positive contrast from Sustainable findings. Interestingly, 42% of respondents noted the offering of a "Passive Design" Studio, although attached remarks again noted that these were not "guaranteed" on an annual basis, and were often in conjunction with a Sustainable Design Studio Option. Passive courses were again, "well subscribed" and showed elective course offerings in 26% of schools.

A comparison of the statistics related to "marginal" and "indirect," with Sustainability faring worse, combined with the large numbers of course offerings in Sustainability, would support the respondents' initial impression that Sustainability is not being addressed as thoroughly as Passive Design in their curriculum.

### Curriculum Materials

Relevant, current, comprehensible curriculum materials are essential to teaching. The survey queried recommendations based on self compiled course notes, text, video and software references and teaching resources.

An excellent source of "self compiled" curriculum materials is found to be the Society of Building Science Educators reference library. Members contribute copies of their course materials, course outlines, project handouts and slides. These are available for free use to members who need only pay for copying and shipping charges. A superb list of references, authored and edited by very knowledgeable educators, is available through the secretary treasurer of the SBSE.<sup>5</sup> A large number of survey respondents are members of the

SBSE — whose specific teaching and research interest focuses on Passive and Sustainable Design Teaching.

The top used texts to teach Passive, and the Passive aspects of Sustainable Design are, in order:

- 1 Sun, Wind and Light by G.Z. Brown and Virginia Cartwright
- 1 Climatic Building Design by Don Watson and Kenneth Labs
- 2 Design with Climate by Victor Olgay
- 2 Mechanical and Electrical Equipment for Buildings by Guinness, Stein and Reynolds
- 3 InsideOut by G.Z. Brown and Bruce Haglund
- 3 Environmental Control Systems by Fuller Moore
- 3 Heating, Cooling and Lighting by Norbert Lechner

There was no consensus or direction evident in the choice of readings to teach Sustainable Design. The majority of texts were mentioned once only. The most significant list of readings on Sustainable Design was submitted by Robert Pena and John Reynolds at the University of Oregon.

Energy and Passive Design software has seen some exciting additions in the last several years. The most popular program, by far is Energy Scheming 2.0 (Macintosh) by G.Z. Brown of the University of Oregon. The second two most popular programs come from UCLA for DOS platform, Climate Consultant and SOLAR 5.3. These were developed by Professor Murray Milne. Several new programs were released this year and show great promise. "Spreadsheets for Architects", a book and disk combination from Van Nostrand Reinhold by Leonard Bachman and David Thaddeus allows for easy add on of Lotus 1,2,3 for sun angle calculations (amongst other functions). Energy-10 (Windows), authored by Douglas Balcomb was issued for Beta-testing at the Passive Solar Energy Conference in July 1995. The program allows for complete energy analysis and design modifications for major building types based on TMY data. Ener-Win (Windows), by Larry O. Degelman of Texas A&M University was issued for Beta testing at the SBSE Training Session in August 1995. This program looks at whole building energy performance with simulation and prediction for retrofits.

The use of videos in courses appears to be quite limited. Very few titles were submitted in the surveys. The University of Florida has published a series of six videos on "Sustainable Construction" as part of the conference proceedings of the Sustainability Conference held there in 1994. San Luis Video has released 3 videos on Sustainable Architecture, Landscape and Environments which are well done and provide students with a well rounded introductory look at the topic of Sustainability. The AIA release, "Case Studies in Sustainable Design" appears to be well received.

Perhaps the most innovative teaching resource initiative comes from the University of California at Berkeley, Cris Benton, Project Investigator, in association with the Pacific Gas and Electric, The Energy Foundation and the U.S. Department of Energy, and the Society of Building

Science Educators. Under the title "Vital Signs", a series of 12 energy and passive design teaching resource packages are being developed for wide distribution to Schools of Architecture in the United States and Canada. Seven resource packages were launched in August 1995: HVAC Systems and Components by Walter Grondzik (Florida A&M University); Health in the Built Environment by Tang Lee (University of Calgary); Whole Building Energy Use by Larry Degelman (Texas A&M University); Glazing Performance by Michael Utzinger (University of Wisconsin at Milwaukee); Interior Illuminance, Daylight Control and Occupant Response by Marc Schiler (University of Southern California); Dynamics of Solar Heat Gain Through Windows by Scott Johnston (Miami University); and, Measurement and Display of Thermal Performance of Buildings by Murray Milne (UCLA). All of the packages address theory, field protocols for various levels of student experience, assignments and additional references. Most also include software programs. The resource packages offer instructors in Passive and Sustainable Design an opportunity to add depth and hands on exercises to their current curriculum. For more information, Vital Signs has a home page on the Web.<sup>6</sup>

A series of questions was posed which queried instructors as to their preferences for types of computer programs (Figure 8), preferred computer platform (Figure 9) and preferred mathematical units (Figure 10). These figures will be of value to faculty in the process of developing software and texts to teach Sustainable and Passive Design. Preliminary results support this hypothesis, indicating an increased activity level in Arizona, California and Oregon — with the exception of the large number offerings at the University of Manitoba.

### Geographic and Climatic Analysis

Based on the mapping of data from Questions 1 and 2, "Does your existing curriculum address issues of Sustainable / Passive Design?", a geographic tendency can be visualized. Passive Design receives more attention in hot-arid and hot-humid climates. Indeed a response from the University of Arizona stated, "living in the desert as we do, there is no choice but to teach Passive Design!" For Passive Design, the incidence of "great" is significantly higher in the west, filling in with "moderate" in the remainder of the west and south and extending northward, but with notably little attention to the topic in the northeast. For Sustainable Design, the incidence of "great" and "moderate" responses is also significantly higher in the west and south than elsewhere in the country.

There is significant agreement between the University of origin of authors of texts, software and Vital Signs Resource packages with geographic/climatic location and impression of achievement in the teaching of Sustainable and Passive Design. The University of Oregon, University of California at Berkeley, UCLA and the University of Houston have all been responsible for the production of important texts,

software and teaching resources — and all rate their teaching of Passive and Sustainable Design highly.

**CONCLUSION: THE ULTIMATE QUESTION...**

It is critically important that Schools of Architecture increase the amount and depth of teaching of Passive and Sustainable Design. It is intended that the research content and analysis of this paper provide a better understanding of the current status of what is or is *not* being taught in Schools of Architecture as well as serving as a source for faculty who desire to expand Passive and Sustainable Teaching, or who are searching for resources, means and contacts to revitalize existing courses. Much hesitation in curriculum development is due to a lack of knowledge of what "others are teaching." It is hoped that the dissemination of the findings of this survey will assist in filling that void.

**NOTES**

- <sup>1</sup> Young and Wright Architects, Toronto. The Environmental Impact of Building Materials. "The embodied energy of buildings can represent up to 30 years of operating energy..."
- <sup>2</sup> Vital Signs Curriculum Materials Project. "...(buildings) account for more than one third of national energy use and over sixty percent of national energy consumption."
- <sup>3</sup> In this instance Active Design Strategies are included under the umbrella of Passive Solar teaching. The survey does not at this point attempt to single out the teaching of Active Systems. I am in the process of issuing an addendum question to separate Active versus Passive Teaching.
- <sup>4</sup> These schools are: Arizona State University, Auburn University, Cal Poly, California College of Arts and Crafts, Carlton University, College of DuPage, Florida A&M University, Kansas State University, Kent State University, Laval University, Louisiana State University, Miami Dade Community College, MIT, Montana State University, New Jersey Institute of Technology, North Carolina State University, Oklahoma State University, Rensselaer Polytechnic University, Roger Williams University, Savannah College of Art and Design, Sonoma State University, Stevens State School of Technology, Technical University of Nova Scotia, Texas A&M University, University of Arizona, University of Calgary, University of California, University of California at Berkeley, University of Cincinnati, University of Florida, University of Hawaii at Manoa, University of Houston, University of Idaho, University of Manitoba, University of Minnesota, University of Nevada at Las Vegas, University of Northern Iowa, University of Oregon, University of Southern California, University of Tennessee, University of Texas at Arlington, University of Toronto, University of Waterloo, USC, Virginia Tech, Washington State University, Washington University, Wentworth Institute of Technology, Widya Kartika University (Indonesia), Yale University
- <sup>5</sup> Society of Building Science Educators. For more information, contact Professor Leonard Bachman, College of Architecture, University of Houston, Houston, Texas 77204-4431, <lbachman@uh.edu>
- <sup>6</sup> The Vital Signs Project. Contact Cris Benton at <cris@ced.berkeley.edu>

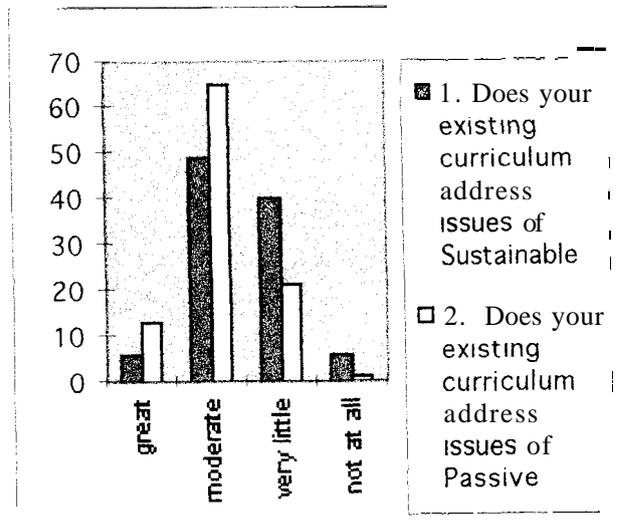


Fig. 1. Passive vs. Sustainable Teaching by Percentage of Respondents

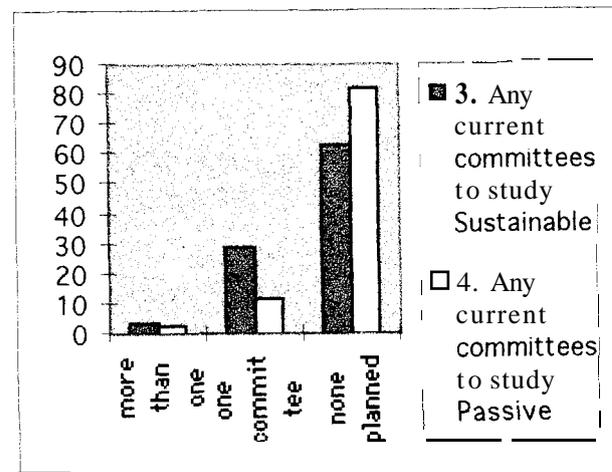


Fig. 2. Committee Development by Percentage of Respondents

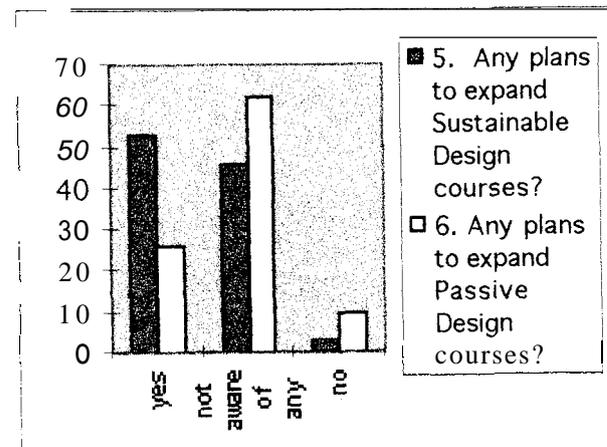


Fig. 3. Course Development by Percentage of Respondents

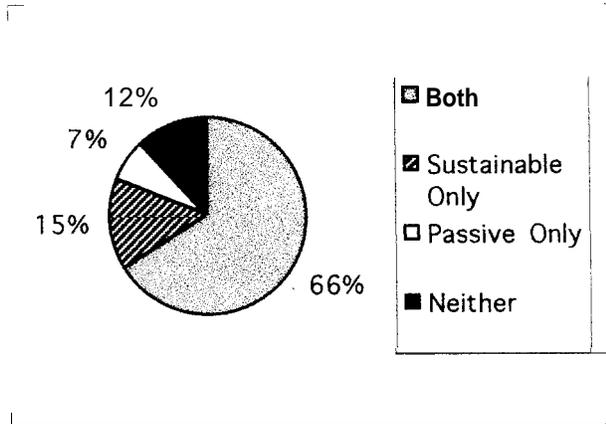


Fig. 4. Respondents Curriculum Area

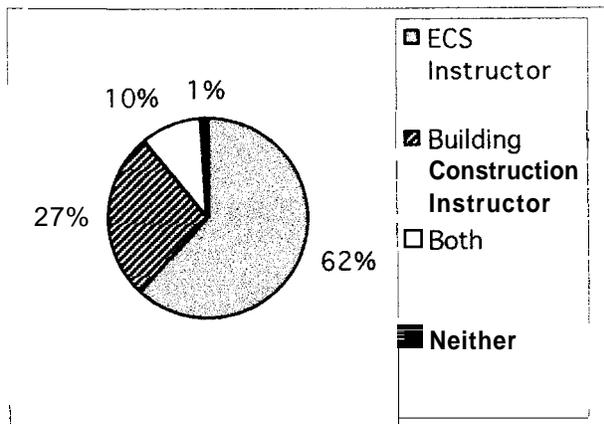


Fig. 5. Respondents Teaching Expertise

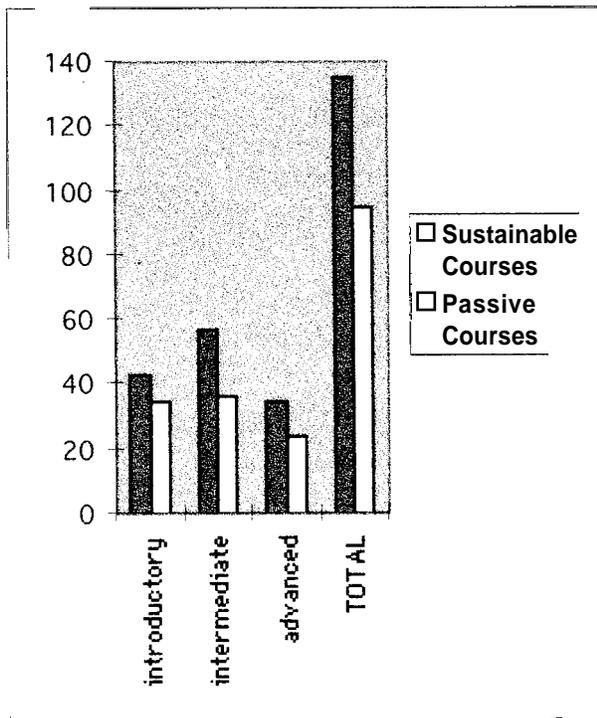


Fig. 6. Quantity and Level of Difficulty

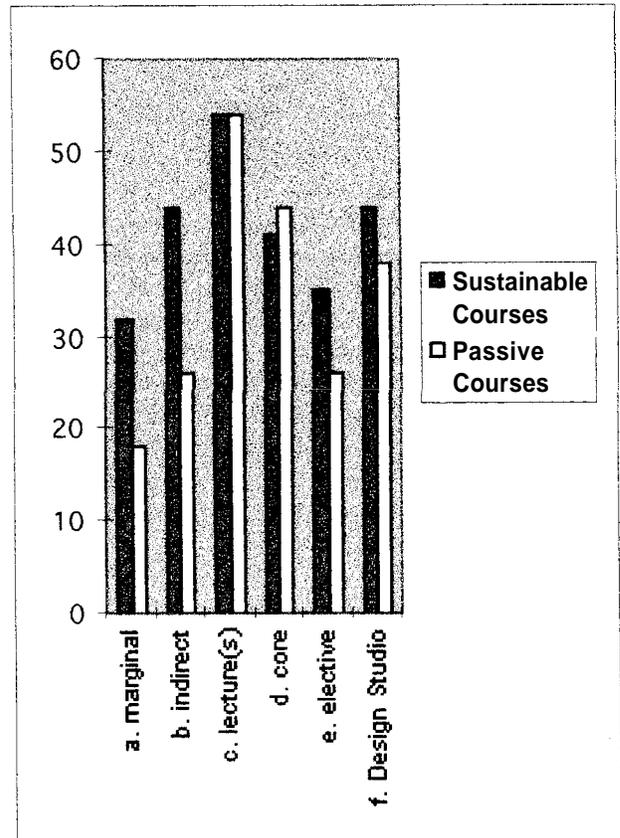


Fig. 7. Manner in Which Material Addressed—by Percentage of Respondents

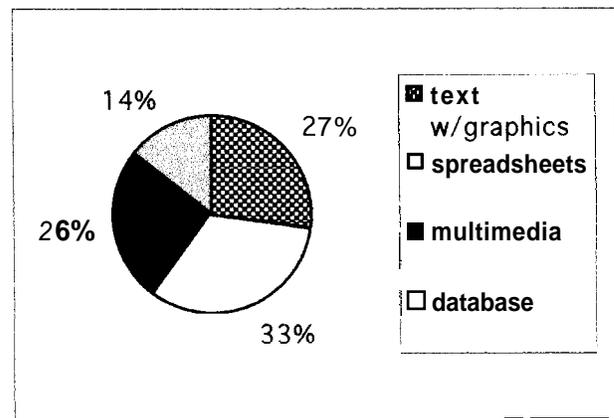


Fig. 8. Software Type Preferences

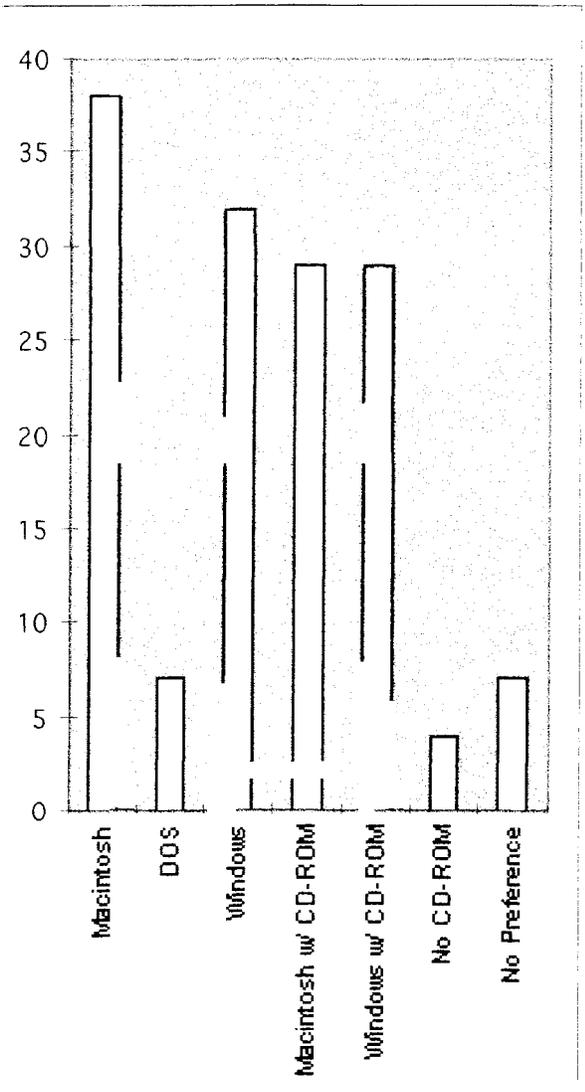


Fig. 9. Platform Preference by Percentage of Respondents

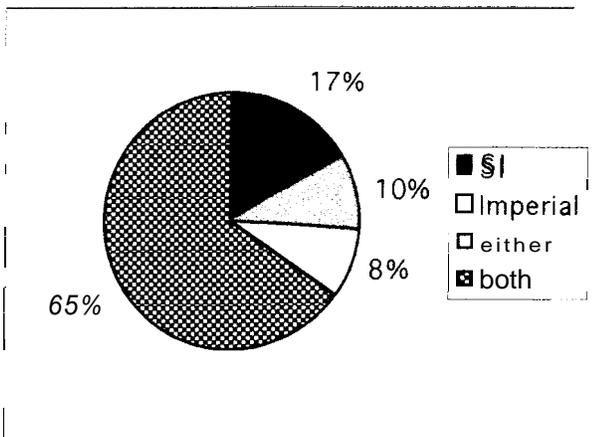


Fig. 10. Unit Preference