

Ojai Section: Dilemmas of Daylit Classrooms — Historical Elegance, Modern Conflicts

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INTRODUCTION

Many innovations in school design occurred in the 1950s and 1960s as Architects scrambled to build schools to accommodate the post-war baby boom and keep up with the changing social conditions.

In the late 1940's, the development of the fluorescent light had a profound influence on the design of electrically lit buildings but still naturally daylit classrooms were the preferred mode. It was during this time, that the OJAI SECTION—a scheme implementing an innovative use of natural daylight was developed by Architect Maynard Lyndon and used in an elementary school in Ojai, California, in 1946. Over the next 20 years, Maynard Lyndon implemented variations of what he called the Ojai section in a number of schools around the US.

Lyndon's innovative design idea to achieve a balanced daylighting in the school classrooms was composed of four main features:

- **North walls** of clear glass, full height above work surfaces and full width to maximize the amount of diffuse north sunlight.
- **South walls** with clerestory windows. In some cases these south windows were also protected by exterior overhangs.
- The critical element was an ingenious set of **louvers** in the sloped ceiling under the south clerestory windows, which were carefully designed and positioned to block all direct sunlight entirely, yet permit full reflected diffused light downward into the room. These cover about one-fourth of the sloped ceiling inside the classrooms.
- A **wide roof** below the clerestory windows on the South acting as an exterior light shelf throwing reflected light in the classrooms, at the same time serving as a shade for the circulation corridors.

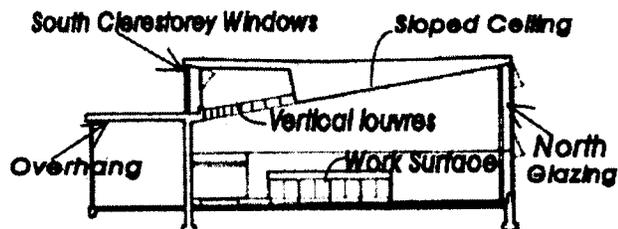


Fig. 1. Typical Classroom with Ojai Section.

As Maynard Lyndon put it himself, "...a nearly uniform light distribution at the desk level resulted from this arrangement over the full width of the classroom..."

Lyndon successfully used variations of the Ojai Section in schools in Ojai, Vista, Duarte, Malibu, Los Angeles, Apple Valley, Yucca Valley and Buena Park. Many of these schools have received International awards from the fifth Pan-American Congress of Architects and national and local awards from American Institute of Architects.

Of over 30 schools built with the Ojai Section by Lyndon with the Ojai Section, only two schools remain which were chosen as case studies:

Mieners Oaks Elementary School 1946, Ojai, California, and Royal Oaks School 1951, Duarte, California

The objectives kept in mind while visiting these schools were to further investigate/ examine Maynard Lyndon's ingenious design; and to analyze the direct consequences of architectural decisions on occupant comfort given changing needs over the years and today.

RESEARCH METHODOLOGY

Meiner's Oaks Elementary School being the first one to be built with the Ojai Section, the Architect himself had developed an ingenious method of measuring the relative uniformity of illumination levels across the classrooms. In his own words:

"The Ojai section begins to evolve with maximum windows on the north and shielded light from clerestory windows on the south. After I had built some classrooms this way, I made rather careful measurement of the light distribution by exposing 6" wide strips of Ozalid printing paper laid on the floor across the room. When they were developed, they showed remarkable uniformity of light density from wall to wall, except, of course, a surplus of light in the eight feet or so near the windows. The average was about 30 foot candles—the unit we used at that time. And in these classrooms, lighting fixtures were almost superfluous, except when there were meetings at night or for night cleaning..."

On a visit to these schools on two occasions, the classrooms in both the schools were brilliantly lit by natural light.

The evaluation project to test the adaptability of Ojai Section in these classrooms consisted of following four phases:

- Building the model in the computer using landscape and running the simulation analysis.
- Building an actual physical small-scale model of the Ojai section and recording the performance by measurement of light levels.
- Recording field measurements and plotting the readings to get the distribution graph.
- User survey.



Fig. 2. Brilliantly lit Mieners Oaks School Classroom

The performance of Ojai Section was then arrived at by comparing the actual field recorded data with the computer-analyzed data.

1. Computer Visualization

When modeled in Lightscape, we got relatively balanced illumination levels across the width of the classroom as apparent from the illustrations.

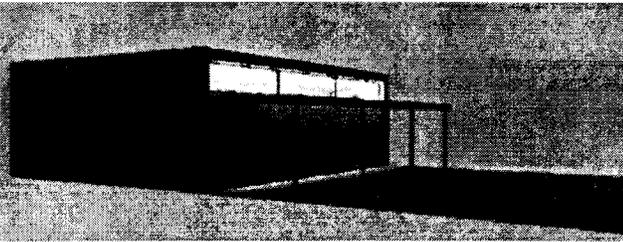


Fig. 3. The South-West view

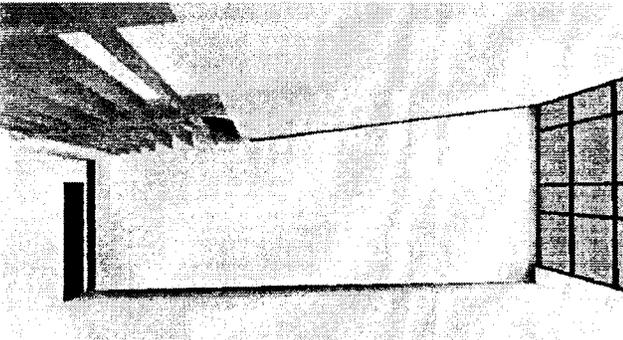


Fig. 3A. Inside View of a Classroom

2. Physical Model Tests

A physical model was built at the scale of 1/2" to a foot and data was recorded outdoors by tilting the model to achieve solar altitude and bearing angles for various months. Two sets of readings were taken—one at 9 a.m. and second set of readings at 12:00 noon. The light distribution graphs as shown were then plotted for different months.

The results as apparent in the graphs, showed an unusually uniform distribution of glare free natural light in these classrooms. One must remember that the key element to glare free comfort is the elimination of all direct beam radiation.

I wish to thank Daniel Bertone for contributing the first two of these phases also commended in the Vital Signs Student Case Study Competition 1998.

3. Field Measurements

In the field test a Minolta illuminance meter with one-degree meter visual field was used to measure illuminance levels across the classroom as Lyndon had done with blueprint paper. A light meter was used to measure illumination levels in these classrooms. Illumination readings were recorded every 27" across the width of the room. The distance of 27" was about the spacing of desks for uniformity across the span of room. The readings were taken with and without the artificial light in the classrooms in the month of April around noontime. These recorded figures were then plotted to get a light distribution graphs across the classroom width.

The plotted graphs displayed relatively uniform and balanced illuminance levels in all the classrooms. Slight variations were found (as shown in figure 8) in classrooms in Duarte, possibly because these classrooms were getting shade from the big tall trees in the courtyards between two blocks originally intended by Lyndon as shady places for students to hang around during lunch time etc.

4. User Survey

A first-hand informal survey of the teachers was conducted who taught in these classrooms in both the schools. The objective of the survey was to discover what the staff and the students thought about the Ojai section and whether they were aware of it at all. Mixed responses from the teachers and the principal of both the schools were obtained; they particularly pointed out the problems they were facing in these classrooms.

Mixed responses:

"...yeah, I remember that this school was once supposed to be an ideal school..."

"...I like north windows because they give good light and also lets me communicate directly with the students while taking rounds. Also, they provide easy access to the classrooms in case of an emergency ... but the negative aspect that we have to deal with because of these big glass panes is the chances of thefts and vandalism because of easy visibility and less wall space..."

"...the clerestory windows are so hard to maintain...I don't know what difference in lighting do they make because we have also installed light bulbs in between the louvers in some places for brightness..."

"...No, only when we pull the blinds or curtains for watching TV, we need to put the lights on or on a cloudy day. Otherwise there is plenty of light inside..."

"...I didn't have any other choice than to put the computer desk on that corner and to cut off the glare. I had to put up that paper on the window..."

"...I like the windows but I wish they were not so big..."

"...I always wondered what the function of these big windows was because it's so dark inside..."

(This remark came from a teacher in Royal Oaks School where her classroom was totally shaded by tall trees in the courtyard, obstructing light rays to even get to the south clerestory or hit the light shelf.)

"...I like the north windows because the big doors give access to the courtyard outside..."

This survey led to a conclusion that being unaware of the ingenious design of Maynard Lyndon, a school to common people was like a chore. And like these occupants, the negative aspects of a routine were felt more than the positive features of the same.

From the above remarks, it seemed that these schools were experiencing problems especially with the presence of Ojai section

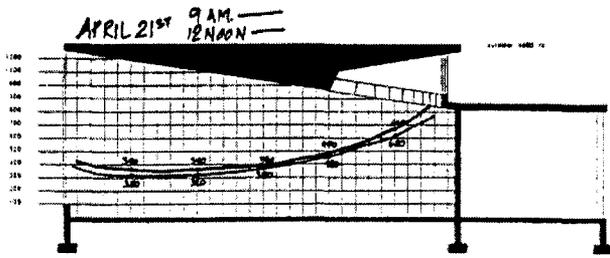


Fig. 4. Light distribution graphs - plotted graph for the month of April

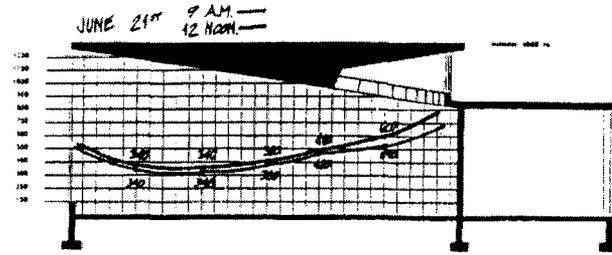


Fig. 4A. Light distribution graphs - plotted graph for the month of June

in their classrooms and that the users had less or no appreciation of the abundant natural light resulting from it. This led to a questionable thought if the Ojai section works at all with the requirements of classrooms today.

PRESENT STATE OF THESE SCHOOLS—DOES THE OJAI SECTION WORK?

These field experiences led to the conclusion that these classrooms produce extremely comfortable abundant glare-free natural light and met all the issues related to occupant comfort when first built. But like many other schools in America, these schools also became a victim of the following primary forces.

Dilemmas and Observations

Advancement in Technology (Program requirements): When built, the needs of the educational program were relatively simple and limited. At the time, architect Maynard Lyndon could not anticipate the demand of technological development. For example, one of the biggest problems that these schools face today is the installation of televisions and computers. Although the full north glazing gives a sumptuous light, the reflected light from the TV screen has caused the teachers to cover half of the window panels with paper. This ultimately cuts the incoming natural light forcing occupants to turn to fluorescent lighting

Second, students face a problem in not finding enough mountable/display space for their creativity. This also is the outcome of change in program requirements. Whereas the first schoolhouses and schools were supposed to be places for learning scientific principles, the modern day parents want their children to develop their creativity, individuality and intellect in all aspects of life including crafts, music and the arts. In the classrooms we visited, these students had just welcomed spring with colorful displays but they didn't have enough space to pin up their affectionately made mother's day posters, so they again turn to those glass panes. This further reduces the incoming natural daylight

Third is the issue of security, another big issue that school authorities face due to the glazed north wall. The easily visible television sets, VCR's and computers have resulted in break-ins, which in turn has increased the maintenance costs. All these issues have become critical today long after Maynard Lyndon designed these schools.

Fourth is an unforeseen issue of landscaping. Especially in case of Royal Oaks School, Duarte, the trees planted long ago in the courtyards in between the two rows of classes now overhang the windows virtually blocking all the light especially of the south facing clerestory windows. So, instead of benefiting from the vegetation, these beautiful, tall and widespread trees actually are impairing the functioning of the Ojai Section.

Fifth is the issue of the maintenance of the louvers under the south clerestory windows, which poses another problem for the school authorities. The louvers prevent easy access to clean or repair the damaged clerestory windows, not only because of their angle, but also since there are light bulbs installed between the louvers and the south wall which further prevent the easy access.

Sixth is the change in enrollment patterns. After accommodating baby-boomers, when they came of age, society stopped focusing on schools anymore. And by late 1980's, they began to realize how neglect and changing demographics had created enormous problems with the educational system. In fact, of over 30 schools built by Maynard Lyndon around the United States, only a few remain in somewhat good condition. In some cases the louvers had been removed and the south clerestories blocked or painted over. This has been the case, for example, with the school that Maynard built in Malibu.

Apart from the above mentioned issues, the following other miscellaneous issues reflect the condition of these schools:

- Broken clerestory windows with loose frames,
- Cracks in the roof slab and repaired patches in it,
- Badly maintained restrooms and drinking fountains,
- Poor condition of the HVAC piping and ducts.

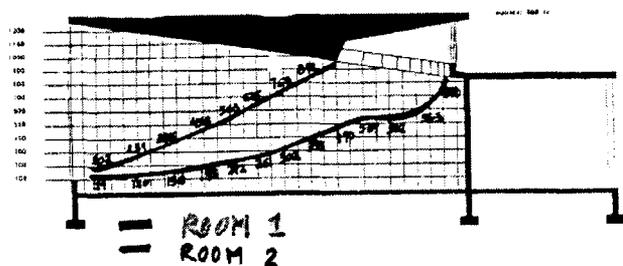


Fig. 5 Light Distribution Graph for Miener's Oaks Classroom

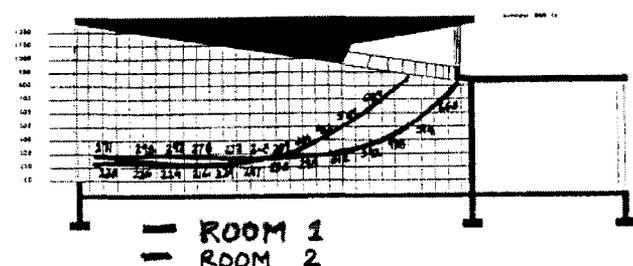


Fig. 5A. Light Distribution Graph for Royal Oaks Classroom

SUGGESTIONS

There are many ways to take care of these problems. The major problem of mounting TVs and other equipment in the classrooms could be efficiently handled if instead of mounting them from ceilings near the north glass, they could be encased in a cabinet. This has actually been followed by one of the teachers in her classroom. She had a cabinet built on the west wall of the classroom and it not only houses TV and VCR but also has a built-in computer desk in it. The cabinet door not only cuts off the glare but also helps solve the security issue related to the easy visibility of all this equipment.

The other solution to handle this problem could be to place computer cabinet/desk on the southeast or southwest corner perpendicular to the south wall with careful placement and shielding that can virtually eliminate the issue of reflected glare, hence solving the problem.

On the other hand, operable louvers and blinds also offer a solution to this problem which is good for any room either in an office or school, and they are especially helpful if working with slide and other projectors. Except the problem of their huge size and cost especially for the large north windows and operating and maintenance problem of the blinds on the south clerestories above the ceiling louvers.

The issue of more display area for class projects could be handled in many different ways:

- by hanging small posters around the classroom walls, which also makes the classroom look colorful;
- installing more mountable board on the walls;
- using movable rolling panels, which could be shifted around in the room corners (which could also serve the dual function by cutting the unwanted glare on the TV and computer screens);
- by more frequently updating the old displayed projects.

The solution to the dilemma faced by the school at Duarte due to the big trees in the courtyard could, in part be solved by trimming or topping them so that they do not hamper the working of the south clerestory windows. In addition, reflected north light up onto the ceiling of the classroom could be increased by removing some of the ivy covering the entire courtyard. This will also allow children to make use of the courtyard seating area during lunch time and for other outdoor classroom activities. In addition, it will also reduce the damp and cold look given by the courtyards making them much more accessible as originally perceived by Maynard Lyndon.

CONCLUSIONS

All the four evaluation studies described in the previous section of the study—the computer model, physical model, user survey, and the field measurements agree with each other to an extent. In all the cases, illumination levels were relatively balanced. This validates Maynard Lyndon's concept of achieving balanced illumination in the classrooms and is a reminder that design phase tools are available to architects for some issues like the illumination level distribution. At the same time, it also demonstrates that in the face of changing programmatic usage, issues like glare and comfort evaluation are a little hard to achieve.

Although these are just a few suggestions to counter in part the problems faced by these Ojai Section classrooms, many other more efficient ways could also be thought of to tackle these issues only if it is widely believed that the naturally well-lighted environment is the best for schools.

Daylighting not only provides a better quality of light, it also generates a comfortable environment for its occupants. There is some evidence that good daylighting can improve the productivity of workers and school children.

Additionally, daylighting is a proven and affordable technology for reducing annual operating costs of running a school especially since it is available during all operating hours of a normal public school. All this makes us to think why we should not benefit from this great natural resource. But at the same time it becomes our responsibility to recognize and preserve the ideas of people who made it possible for our classrooms to enjoy this wealth.

SOME PERSONAL OBSERVATIONS

It is sad to realize that although highly efficient in terms of space planning and internally well-lit environments, these schools have also been a victim of neglect especially since no-one made an effort to recognize and realize the purpose and uniqueness of Maynard Lyndon's design.

It's a shame that as a society, we demonstrate such limited attention spans. We set our minds on the task of building schools and did it well then. But after proving that we can do something well, we stopped doing it. And eventually here we find ourselves in the middle of a crisis. Disappointment with the performance of American students, and concern for the amount of energy we consume and its impact on the attending environmental consequences, now we discover the importance of what we have stopped doing. Realistically speaking, although highly efficient in terms of space planning and internally well-lit environments, these schools have also become victim of our neglect. Nobody made an effort to recognize and work towards preserving the benefits of Maynard Lyndon's brilliant original design.

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