By JOHN O. KRAEHENBUEHL

Lighting the Library

Dr. Kraehenbuehl is professor of Electrical Engineering, in charge of the Illumination Laboratories, University of Illinois, Urbana. Below he outlines basic principles of lighting libraries. This article will be followed by a report on a series of experiments with fluorescent table lamps. These were conducted by the author.

THE LIGHTING of a library presents the important problem of an installation which is adequate in foot-candles and at the same time satisfies the most exacting requirements of quality in lighting. It is the normal condition in library finance that special attention must be given to the economic aspects of both the initial installation and the maintenance and renovation of an existing system. It does not behoove the administrators of library funds to be influenced by trends stimulated by advertisements or by the recommendations of those strictly motivated by commercial interests. The lighting installation in the library should meet the minimum conditions and exceed these lower limits as much as possible within the budget available, and each dollar expended should produce the maximum effective lumens per watt. In no instance should quality be sacrificed.

In recommendations for library lighting much pressure is being exerted at present for the installation of fluorescent lighting. Where fluorescent light proves economical and where the lighting obtained is equivalent to that from an indirect incandescent system, there is no reason why these newer systems should not be adopted. However, the work must not be exposed to the brightness of the fluorescent tubes, and the maintenance problems involved must be understood. Special consideration must be given to these new systems where the problem of air-conditioning and radiated heat in summer may be a part of the building problem. The element which must be guarded against is encountered where sales influence and novelty are the major factors injected into the recommendations, and as is often the case, too much saving is indicated by a sacrifice in the quality of the lighting. There is a movement being fostered which recommends brightnesses much higher than the ones accepted after years of study, this higher brightness specification for the source permitting the use of exposed fluorescent tubes or direct exposure of the work to bare tubes. Until research indicates a brightness of 1800 foot-lamberts (approximately 4 candles per square inch), instead of 2.5 candles per square inch (1100 foot-lamberts) to be a satisfactory maximum, it cannot be correct to expose the reader to either direct or indirect glare from more brightly lighted sources. For the library it has always been considered that the source should be of the indirect type and that preferably the brightest source should not exceed 0.25 candles per square inch (113 foot-lamberts).

None of the preceding recommendations will exclude the use of fluorescent lighting

in the library, but it will exclude much of the equipment which may be offered by manufacturers attempting to take advantage of the national advertising which has been and is in progress concerning the introduction of a new type of lighting to the public. This new source has many advantages and can be installed to give the same quality of lighting which has been recommended for incandescent lighting. However, it should not be accepted until each individual problem has been studied by competent individuals and the installation proves equal in quality and is as economical as a satisfactory incandescent installation would be.

Amount of Light

It is common practice to specify lighting on the basis of foot-candles of illumination. It has been recommended that the minimum illumination for school libraries should be 15 foot-candles,[1] at the same time it will be found that the recommendation for general office lighting is 25 foot-candles. The task of transcribing notes as well as doing reference work which requires prolonged attention to one's own handwriting is considered as difficult a task as office work.

It can be stated safely that an illumination of double that recommended as a minimum, or 30 foot-candles, should be considered where new installations or remodelling is being undertaken. Adequate wiring may be installed in the new design at no excessive cost and there is now available a thin walled wire which permits the installation of more capacity in the installed conduit without the necessity of changing the basic distribution system. There is the additional benefit of being able to increase by 25 per cent the fill of such conduits.

Quality of Lighting

For the library reference and reading rooms it is essential that the illumination be of the highest quality possible. In general this means that the work surface shall be free from annoying reflected glare and that the individual not be subjected to direct glare from *any* light source. Direct glare is present in that region within the normal field of view from the horizontal to approximately 45 degrees above the horizontal and as suggested before, if the brightness in this region is reduced to from 0.5 to 0.25 candles per square inch the system of lighting will prove comfortable. The reflected glare depends upon the brightness of the source and regardless of the reflection factor under the usual conditions of wall surface and library equipment the above limits of equipment brightness will control reflected brightness. Where the lighting equipment is not in the line of vision the brightness value may be made several times larger without producing an annoying reflected glare unless library equipment of high specular reflection redirects the source into the eyes.

For the reading rooms there is no better system of lighting than the indirect, which is correspondingly the most expensive type of system when operating cost is considered. Care must be taken that the ceiling illumination from the indirect equipment does not produce a glare surface which, now acting as the light source, may produce all the effects of an excessive light source brightness. Excessive brightness contrast must also be avoided, therefore, the indirect equipment will look better and be more comfortable if a component of light is used to brighten the fixture to

[1] American Recommended Practice of School Lighting, approved February 17, 1938.

at least 10 per cent of the surrounding background brightness. This should hold true for the fluorescent as well as incandescent equipment. Some ceiling mounting fluorescent units produce such harsh shadows around the equipment as to cause discomfort which is due to brightness contrast. The brightness of no equipment should exceed the previous limits given which will classify reference and reading rooms under either the indirect or the semi-indirect systems. The modern library, which is definitely a functional center, should not tolerate a sacrifice of either amount or quality of lighting to the reproduction of some definite period scheme in the design.

Surroundings

Besides the lighting equipment itself there are other room conditions which will enter into the establishing of a comfortable reading or work surface. The ceilings should have a reflection factor of 75 per cent or more and be either matte white or have a very light tint. The side walls should range from 50 to 60 per cent and be tinted so as to reduce the appearance of being annoyingly bright because they represent a low brightness glare surface.

Where equipment such as table lamps or metal files are present on the table or desk it would be well to avoid the dark finishes used in the past. The bronze finishes approaching black in appearance have no place where brightness contrast is of such importance. Both from a psychological and lighting point of view there is enough information available to indicate that the future library room will be cheerful in appearance because of plenty of light and the removal of dark accessories which were often present in our earlier designs.

There seem to be many indications that the tables in the libraries must be altered. Instead of dark table tops where the white book on a dark surface exceeds all reasonable brightness contrasts, the tables will be made to have reflection factors of from 20 to 30 per cent. Students seem to favor a table with a slanting top and a pitch ratio of one to seven seems a reasonable slope.

Natural Lighting

The natural lighting in the usual reference and reading room can usually be discounted except at the windows. After an individual moves away from the windows the benefits from the windows fall off rapidly. These windows, however, will become very annoying glare sources, in particular where the brightness is relatively low but the exposure is for long periods of time. The only solution is some form of shade. The venetian blind is the most satisfactory light control for it will redirect the light to the ceiling thereby producing a more diffused and uniform general lighting. The library patron should not be required to face an exposed window and if it is impossible to obtain correct light control at some particular window the blinds may be left in a fixed position without causing undue effect upon the room appearance. A drawn window covering of the correct type and properly selected to harmonize with the room is acceptable as part of the furnishing.

Local lighting is another offender in large reading rooms. It sometimes becomes necessary to light reference stacks and desk work surfaces to a higher illumination level than the general lighting will supply. The light sources used may in themselves produce such an uncomfortable glare, usually direct, that the whole light-

ing system is considered defective by those affected. No auxiliary lighting equipment should be so placed as to be in the direct line of vision of any of the seating positions in the room.

The library table lamp should not be considered in new installations. There is only one solution for adequate and comfortable library illumination and that is correct general lighting. However, there are at present many installations which fall so far short of what is considered even a minimum requirement, which cannot be corrected by rewiring, that table lighting is the only solution which presents itself. Frequently outlets may be provided or are already installed which, using the new light sources, will permit of adequate local lighting without rewiring the library. The danger of table lamp installations lies in brightness contrast and deficient equipment. Where table lamps are being used, the brightness of the surroundings to the table top brightness should always be one to ten or less, roughly the wall, with lighting equipment on the table, should have at least one tenth of the foot-candles on the work surface. A manuscript is in preparation setting forth the merits of various types of lamps and will be presented as a continuation of this paper.

Lighting Service Areas

Though by far the most important areas in the library are the reading and reference areas there are lighting problems in other areas. Except in the floor space devoted to office work the task is intermittent and though the lighting may be faulty there will not be the severe distress experienced that occurs after working for hours under defective work surface illumination.

The offices and work surfaces used in library detail work should be treated as are the reference rooms. A good indirect system or semi-indirect system of lighting with proper brightness contrast, using care in eliminating machines or surfaces with high specular reflection, is necessary.

Stacks should be so lighted as to properly illuminate the vertical surfaces. The illumination on the vertical surface should be from 10 to 15 foot-candles for quick and easy seeing. It has been found that to obtain these levels of illumination the horizontal illumination will be about twice as much, therefore, a good stack illumination will supply sufficient illumination for the aisles.

Lighting of Card Files

The lighting of card files compares with the lighting of similar files in the business office. The stock used for the cards should be light, thereby aiding in reflecting the light to the bottom of the cards. Since the cards are small the general lighting system will suffice if the files are placed toward the center of the room. If the general lighting system does not illuminate the files there is a variety of counter type lamps which may be placed on the top of the catalog file in such a position as to illuminate the cards. An illumination of 25 foot-candles on the horizontal surface of the file will illuminate the cards sufficiently for reading purposes. Where the file boxes are moved to desks or tables for notations and inspection these tables should be equipped with auxiliary lamps if the general illumination is not sufficient to provide 25 foot-candles.

Washrooms, reception rooms, and other service areas will be sufficiently illuminated with 10 foot-candles. In these areas direct lighting systems with higher equipment brightness will prove satisfactory. In the reception rooms atmosphere may be

more important than actual illumination and the use of floor lamps for lighting local areas, where reading can be done while waiting, proves very desirable.

Hallways, aisles, and passageways which are used for walking, and in particular stairways, should be free from deceptive shadows and an illumination of 5 foot-candles will prove adequate. In these areas the designer can usually execute the spirit of the design in conjunction with the lighting without penalizing the conditions of seeing.

It is becoming the practice of the libraries to include a browsing room as a part of the library service. These areas are for recreational reading and should be so arranged. The room should be equipped with lighted centers, usually groups of easy chairs and a floor lamp which meets the specifications of the Illuminating Engineering Society. The general lighting of the room should meet the 1 to 10 brightness requirement and the book shelves should be sufficiently illuminated to attract attention and not require excessive effort in browsing among the books that are made available for choice.

Summary

Those in charge of the choice of the lighting system for the library should equip themselves with the fundamental knowledge necessary to distinguish between factual information and that which is sales promotion. The selection of the lighting equipment should not be confined to the inspection of catalogs. Because the library usually faces the consideration of economical operation as well as low first cost it is doubly important that careful study be given to the choice of system and equipment so that the lumens per dollar invested is a maximum. After the system is installed there is the problem of maintenance. It is essential that the lamps be burned at their proper voltage and that burned-out lamps be quickly replaced. The equipment must be kept clean and the ceiling and side wall periodically cleaned. The reflection factor for well painted surfaces can be kept high by washing the surfaces every two years and repainting every six years. The washing removes the outer surface of the paint and after two washings the paint surface has been reduced so that a third washing would wear through the surface. This maintenance is required if the average illumination in the room is to be maintained.

In selecting a lighting system, the wiring should be made adequate for an increase of illumination in the future, the appearance of the lighting equipment should be suitable for the room and should look well both when lighted and when not lighted. The material in the equipment and its construction should produce a sturdiness which will withstand the necessary cleaning and maintenance without losing its shape or breaking. The equipment should be efficient for it is possible to obtain luminaires for the same service which have wide ranges in lighting efficiency. The system chosen, whether incandescent or fluorescent, should justify the choice by supplying the greatest number of lumens per dollar considering the costs of investment and operation. Lastly and most important the lighting system must supply sufficient illumination of the correct quality. The equipment must supply the adequate foot-candles, suppress direct and reflected glare, give a uniform and nearly shadowless illumination for offices, reading rooms, and reference

rooms. For other areas the selection of the lighting system must meet the specific needs as outlined.

The selection of lighting systems and equipment for other than illumination purposes should always be secondary to the functional use of such equipment.

The attached bibliography has been selected to enable interested individuals to obtain a broader knowledge of the requirements of lighting for seeing.

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Evaluating Library Service to Higher Education

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Exhibit C. *Library Classification*

Libraries of Class	*Have a Rating of*	*And Are*
A	Over 1800 points	High for sections high in resources
B	1500 to 1800 points	High for country as a whole
C	1000 to 1500 points	Minimum for advanced sections; high for sections low in resources
D	1000 points	Minimum for country as a whole
E	800 to 1000 points	Minimum for sections low in resources
F	600 to 800 points	Substandard for advanced sections
G	400 to 600 points	Below standard for whole country
H	Below 400 points	Below standard for sections low in resources

ments. Standards considered too low among New England college libraries frequently proved too high for college libraries in the South. Accordingly, a classification which would recognize a regional differential has been proposed which resembles very much the thermometer used by the Eells Committee in the Cooperative Secondary School Standards. Roughly, this plan might provide for eight classes of libraries as shown in the table to the left.

Perhaps some idea of the committee's work and problems has been presented. We are hopeful that the second draft of the committee's plan will be available in detail for criticism by the membership before Boston. In the meantime, we repeat our invitation to every member of the A.C.R.L. to contribute such ideas and suggestions as will advance the quest for an adequate measure of library service to institutions of higher education.