

Measuring Circulation Desk Activities Using a Random Alarm Mechanism

Librarians frequently use circulation statistics, collection size, and other data to help justify staffing needs, but they lack statistics on the percentage of time their staff actually spends on various activities. Such data have been almost impossible to obtain for complex service units that have a multiplicity of functions, lack of control over frequency and quantity of patron requests, and extended hours of staffing. Recent technological developments combined with work sampling techniques now make studies of such units feasible. This paper reports a methodology devised to gather meaningful management data relating to circulation desk activity.

INDUSTRY HAS USED "observed work sampling" as an evaluative tool for many years, but Poage, in 1960, first reported using it with library employees.¹ That same year Russell L. Ackoff developed a small, self-powered electronic Random Alarm Mechanism (RAM) that made self-observation at random times a practical technique,² and he and Martin used RAMs to study chemists' and physicists' use of written scientific material.³ Between July 1966 and June 1968, Orr and others worked on a project to develop better methods for objectively collecting data for planning and improving biomedical libraries and the biomedical information complex.⁴ Among the techniques they tested was "random time sampling" using a RAM. Orr recommended it as an "elegant, powerful technique of great flexibility . . . that . . . makes practical time allocation studies of a quality not attainable by the di-

ary method."⁵ In 1971 Spencer used a RAM to study a single activity,⁶ and in 1977 Divilbiss and Self used one to analyze the activities of an individual librarian.⁷ Though it is ideally suited for studying all of the activities of a library unit, no one to date has reported such a study.

In planning postautomation staff utilization, circulation librarians at the University of Illinois at Urbana-Champaign needed information on the percentage of time spent on the manual circulation functions. A search of library literature revealed no studies of a large staff working extended days and weeks for a cyclical period that might be used as a basis for planning, so a longitudinal study was undertaken. It was completed before any aspect of automation was implemented; this was done so that comparisons can be made with a postautomation study.

STUDY DESIGN AND PROCEDURE

The site of the study was the main circulation desk, staffed by twenty-three non-professional employees (one full-time and four part-time supervisors, four full-time and eight part-time civil service clerks, and six hourly student clerks). When school was in session, the circulation desk was staffed ninety-two hours seven days per week; dur-

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ing vacations and between semesters (interims), it was staffed forty-eight hours five and a half days a week. All of the employees except the full-time supervisor worked one night and one weekend shift each week school was in session. Since every member of the staff was trained to perform the basic circulation functions, depending on the time of day, staffing, and patron queues, all employees were asked to participate in the study.

The following categories, basic to the operation of the circulation desk and to most other library circulation units, were selected for analysis:

Charging/Renewing	Processing Overdues
Discharging	Processing Holds
Filing	Processing Snags
Book Sorting	Idle
Patron Interaction	Other

Miscellaneous activities were recorded with a diary entry under "Other"; similar activities recorded in this category were later grouped for analysis.

Sample size was established by estimating the function requiring the most staff time and using a Nomograph Calculation Table⁹ to determine the total sample needed. By estimating that no activity required more than 20 percent of the staff's time, a sample size of 700 was required for a confidence level of 95 percent ± 3 . Because the data were to be further analyzed by employee level, time of day, day of week, and week of semester, a total sample of 4,000 was selected as reasonable and sufficient to produce meaningful results.

Circulation in a university library is cyclical, so the dates selected for the study (January 23 to June 10, 1978) included a semester and an interim. The study was conducted on random days throughout the cycle so the data would be representative. Based on an estimate of 100 tabulations (samples) per day, forty-four days were selected with the aid of a random numbers table. Four days were allotted for a pilot study; the first day's test ran so smoothly, however, that only one day was used. Two additional days, one in the semester and one in the interim, were omitted through supervisory error.

A RAM seemed to be the ideal tool for

selecting the random time of day. A trained observer tested the possibility of simultaneously recording every staff member's activity when the RAM beeped. In addition to being unable to see all of the employees at a given time, the observer could not correctly identify everyone's activity without asking and, thereby, intruding. (Some observed activities could be classified under more than one function; e.g., searching in the card file could be for the purpose of filing, discharging, renewing, processing a hold or snag, or providing patron assistance.) Because only the employee would know under which category an activity belonged, it was evident that self-observation was the only technique that would produce useful data.

The close proximity of the employees in the desk area made the use of individual RAMs inadvisable. Employees might respond to a colleague's beep, while the annoyance of many RAMs beeping at various times on a given day posed a potential staff cooperation problem. It was resolved by adapting a single RAM so that its beep was broadcast through a small speaker over the entire circulation area. It was easily heard simultaneously by all of the employees, and though some complained about its pitch, volume, and length of beep, it served its purpose well. It was preset electronically so it would average one beep every forty minutes over the total study; no resetting or manipulation by the staff was required.

A lightweight tag was designed as the device on which the data were recorded. Categories were listed on the left half of the tag, and the right half was used for tabulations. Space was provided for the date, time of issuance and return, and initials of supervisor issuing and receiving tags. Lines were provided on the back of the tag for itemizing activities tabulated under "Other." A screw was placed through a hole at the top of the tag and screwed to a nut that had been welded to a small clip; the tag was clipped to a blouse, shirt, or belt so it was readily accessible when the RAM sounded. Each time the RAM beeped, a tick mark was entered beside the activity; only tick marks by "Other" were explained on the back. This fast, simple procedure insured

prompt employee response and minimum intrusion on public service.

Shift supervisors kept a daily log of the times the RAM sounded. A sheet of lined paper with the day's date was attached to a clipboard on which a digital watch was mounted. When the RAM beeped, the exact time was read from the watch and recorded. This provided a count of the beeps and served as a validity check: the number of beeps recorded for a given time period was checked daily against the tick marks recorded for the same time period on each employee's tag.

The RAM continued to beep while employees were away from the area for breaks, meals, and special assignments, so a method was devised for keeping their tags accurate. When an employee left the desk area, the tag was given to the shift supervisor, who attached it to the daily log clipboard. If the RAM sounded in the employee's absence, the supervisor recorded a tick mark under "Other." When the employee returned, the tag was retrieved and the daily log checked to determine if the RAM had beeped. If it had, the employee completed the diary entry on the back of the tag.

Staff motivation and cooperation were essential if the data were to be valid, and special efforts were made to achieve their support. The purpose and plan were discussed first with the supervisors and then with all of the clerks. These small group meetings, in which everyone discussed, questioned, challenged, and offered suggestions, resulted in a detailed itemization of activities, which was typed and posted in the desk area. These meetings clarified for each employee the categories under which activities should be recorded; they also allowed everyone to help design that part of the study with which they would be most intimately involved. They became quasi-designers of the study—not mere subjects. They saw its value and purpose, were interested in its results, were willing to participate, and were motivated to tolerate the annoying interruptions of the RAM and to conscientiously record the data.

To achieve total cooperation, every concern raised had to be satisfactorily resolved. Two major concerns were repeatedly vocalized: anonymity, and the meaning of "Idle."

The latter concern was easily resolved by narrowly defining the category to mean "on-the-job idleness, personal telephone calls and conversations." Coffee and meal breaks, to which the employees were entitled, were recorded as diary entries under "Other." Preserving anonymity and obtaining valid data at the same time was a larger problem. The staff was asked to initial their tags for identification of employee level and for validity checks. They feared repercussions for persons recording "negative" data (e.g., excessive idleness) and thought some might be tempted to skew their tabulations to "acceptable" activities if initials were required. It was agreed that the staff need not initial tags so long as validity checks showed no discrepancies; if problems developed, everyone would be asked to initial tags until the problems were resolved. (No problems occurred.) Marks were made on the tags to provide data by employee level: yellow stripe for shift supervisor, green stripe for non-shift supervisor, and red X for students. Though it was possible to identify the shift supervisors and some students by comparing dates and schedules, no such comparisons were made.

A high-level employee who was not participating in the study but who arrived early each day for work was given the list of preselected random days. On weekday test days, she notified the shift supervisor as soon as he or she arrived for work. Weekend supervisors, who were students in the Graduate School of Library Science, were notified privately on Friday afternoons when a test day was scheduled for that weekend, and as budding professional librarians they lived up to this confidence entrusted to them. Except for the weekend supervisor, the staff was never aware which days were study days until they arrived for work.

The following list of responsibilities and protocols was typed and posted in the desk area adjacent to the activities:

Employees

1. Pick up your tag from the supervisor when you arrive for work; check that the date, time of issuance, and supervisor's initials are on the tag.
2. Attach the tag to your clothing and keep it visible at all times.

3. Record your activity *immediately* when the RAM beeps; if you are uncertain where the activity belongs, check the activities list; if still uncertain, check "Other" and diary it on the back of your tag.
4. Leave your tag with the supervisor if you must leave the test area; retrieve *your own* tag when you return and check to see if the RAM beeped while you were absent. If it did, make a diary entry regarding the nature of your absence, e.g.:
10:00-10:15 Coffee break
11:15-11:35 Searching Deck 6 for overdues
5. Hand your tag to the supervisor when you complete your work shift.

Shift Supervisors

1. If opening the desk, immediately switch on the RAM.
2. Prepare the daily log sheet and attach it to the clipboard. Keep the clipboard with you at all times.
3. Notify each employee arriving for work that the day is a study day.
4. Issue each employee a tag on which you have recorded the date, time of issuance (read digital watch), and your initials. Make any identifying marks required: yellow stripe, green stripe, or red X.
5. Record the time of each beep (read digital watch) on the log sheet; record your own activity on your tag; record the beep beside "Other" on any tags left by employees with you.
6. On tags returned by employees at the end of their shift, record the following information: time returned (read digital watch), your initials.
7. Remove clips and place returned tags in designated box.
8. Attach clips to clean tags so they will be ready for next employee reporting for work.
9. Switch off RAM at end of closing procedures and immediately before locking door for night.

A research assistant was hired to process the data. After each study day, he collected the tags and daily log, checked the validity of each tag, recorded the number and level of staff on duty, noted absences and vacancies from the posted schedule, tabulated the data on coding sheets, recorded circulation statistics on coding sheets, and prepared tags for the next study day. He keypunched the data from the coding sheets and also noted any special information on the log sheets that would be helpful in later interpretation of the data (e.g., spring break; three-hour day).

Using a data-base system (Data Retrieval System [DRS] by Aeronautical Research Associates, Princeton, New Jersey) the data were processed on a General Automation 1830 computer. On-line editing allowed grouping and analyzing data in the "Other" category. The coding instructions were verified by running the data from the pilot study through the computer; no changes were needed.

RESULTS

A total of 4,304 tabulations was made during the study; the average of 105 per day compared favorably with the projected number of 100. The formula shown as equation 1 was used for computing absolute accuracy. At the 95 percent confidence level, work activities of the total staff had an absolute accuracy between ± 0.4 percent (Snags) and ± 1.1 percent (Patron Interaction). The RAM, which had been preset to average one beep every 40 minutes, actually averaged one every 39.4 minutes. Its average daily frequency varied from 27.9 to 66.9 minutes, while its *real* frequency varied from twice in one minute to once in three hours, twenty-two minutes. Daily validity checks revealed that only rarely was a tick mark missed.

$$a = \pm 1.96 \sqrt{\frac{p(1-p)}{N}} \quad [1]$$

where:

- a = absolute accuracy expressed as a decimal fraction
- p = cumulative percentage expressed as a decimal fraction
- N = total number of tabulations

While a few members of the staff expressed mild annoyance with the RAM as the study progressed, no one thought this affected the reliability of their data. They found the tag easy to use, the categories clear and logical, and the procedure for recording the activity so quick it did not interfere with good public service. When an activity that belonged in a specific category was occasionally entered under "Other," the research assistant coded it in its proper place. Comments and questions were discussed in the regular weekly staff meetings.

After the study was completed, four addi-

tional categories were created, three by grouping activities recorded under "Other" and one by recording absenteeism and staff vacancies from the weekly schedules. The three categories and their definitions were:

Supervisory: Opening and closing procedures, staff training, and evaluations.

Administration: Routine activities essential to unit operations (e.g., reading correspondence, sharpening pencils).

Personal: Coffee breaks, meal breaks, visits to washroom.

The fourth category, "Absent," was created because of its impact upon the performance of clerical functions by supervisors.

Patron Interaction occupied more staff time than any other function (table 1). Twenty-five percent of the staff's total time was spent working with patrons and charging materials, and 40 percent was spent working with the "housekeeping" aspects of circulation (discharging, book sorting, filing, overdues, holds, and snags). Supervisors spent 30 percent of their time on administrative and supervisory functions, compared with 11 percent for the staff as a whole. Supervisors spent less time on most routine clerical functions and more on Patron Interaction and areas where they had verification responsibilities (Overdues, Snags). There is a close correlation between the total staff percentages and the clerks' percentages, but this is to be expected since

clerks recorded 68 percent of the data. Students, who constituted 13 percent of the staff, contributed only 7 percent of the data. No doubt their high rate of absenteeism (26.4 percent) contributed to their low input. When the functions are grouped by type, circulation activities occupied 68.5 percent of the staff's time, administration and supervision, 11 percent, and personal activities (Idle, Personal, Absent), 20.5 percent.

Table 2 shows that activity by week tends to follow the semester cycle. Patron Interaction, Charging/Renewing, and Filing were higher in the middle of the semester, when research papers were being written and circulation was high. Book Sorting, Discharging, and Overdues Processing were higher at the end of the semester, when materials were being returned.

Analysis by day of week (table 3) also revealed a cyclic pattern created by both academic patterns and desk work flow policies. Patron Interaction was higher on Thursdays, when students often worked on assignments due the next day or began assignments before the weekend, and on Saturdays, when the general public and visiting scholars came to the library. Discharging increased on Wednesdays and Fridays. Filing, accumulated over the weekend, was heaviest on Mondays, and Charging increased on Mondays and Thursdays, reflecting patron activity before or af-

TABLE 1
PERCENTAGE TIME STUDY OF CIRCULATION FUNCTIONS BY EMPLOYEE LEVEL

Function	Supervisors		Clerks		Students		Total Staff	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Patron interaction	183	16.9	426	14.6	52	16.5	661	15.4
Discharging	100	9.2	493	16.9	43	13.6	636	14.8
Filing	55	5.0	394	13.5	57	18.1	506	11.8
Charging/renewing	69	6.3	309	10.6	26	8.2	404	9.4
Administration	268	24.7	127	4.3	1	0.3	396	9.2
Personal	51	4.7	255	8.7	8	2.5	314	7.3
Idle	87	8.0	188	6.4	23	7.3	298	6.9
Absent	0*	0.0	190	6.5	83	26.4	273	6.3
Book sorting	73	6.7	173	5.9	14	4.4	260	6.0
Overdues processing	53†	4.8	116†	3.9	1†	0.3	170†	3.9
Holds processing	19	1.7	115	3.9	1	0.3	135	3.1
Other	15	1.3	82	2.8	0	0.0	97	2.3
Supervisory	56	5.1	20	0.6	2	0.6	78	1.8
Snags	53	4.8	20	0.6	3	0.9	76	1.8
Total	1,082		2,908		314		4,304	

*A supervisor was always on duty to perform the supervisory functions because supervisors cover each other's absences.

†Overdues processing is divided between the desk and the circulation office.

TABLE 2
CIRCULATION FUNCTIONS ANALYZED BY WEEK OF STUDY

Week No.	Study Days/Week	Tabulations	Patron Interact.	Dischg.	File	Chg./Renew	Adm.	Circulation Functions in Percentage								
								Pers.	Idle	Abs.	Book Sort.	Overdues	Holds	Other	Supvr.	Snags
1	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1	122	14.8	6.6	22.1	9.6	11.5	7.4	8.2	3.3	7.4	0.0	4.9	0.8	3.3	0.8
3	2	174	15.5	10.3	15.5	14.9	10.9	5.7	7.5	8.0	1.1	2.3	1.1	2.3	1.7	2.9
4	1	107	13.1	4.6	3.7	10.3	7.5	5.6	20.6	4.6	0.9	12.1	9.3	2.8	3.7	0.9
5	1	130	16.9	21.5	14.6	10.0	5.4	13.8	9.2	0.0	0.8	0.8	2.3	0.8	3.1	0.8
6	1	128	24.2	5.5	11.7	11.7	10.1	0.8	7.0	12.5	5.5	1.6	0.8	3.1	3.9	1.6
7	2	142	18.3	10.6	8.5	14.1	8.5	6.3	9.9	3.5	2.8	4.2	6.3	4.9	1.4	0.7
8	1	9	22.2	0.0	0.0	0.0	22.2	0.0	0.0	0.0	11.1	11.1	0.0	11.1	11.1	11.1
9	5	557	16.7	14.5	14.0	11.0	8.1	8.8	9.9	2.5	4.1	1.3	2.3	3.1	1.6	2.2
10	4	439	19.4	12.5	10.0	12.3	8.9	5.7	5.9	6.4	5.5	3.0	3.6	2.8	1.8	2.3
11	1	97	24.8	17.5	5.2	5.2	2.1	13.4	5.2	4.1	4.1	8.2	4.1	0.0	2.1	4.1
12	5	530	17.5	9.1	14.3	10.4	14.7	9.1	3.2	6.2	5.3	3.4	3.6	0.6	1.7	0.9
13	3	383	14.9	13.3	14.9	12.0	9.7	5.7	6.5	5.7	7.0	3.4	5.0	0.5	1.0	0.3
14	2	199	12.6	16.6	11.0	11.6	9.0	6.5	5.0	11.6	7.5	2.0	3.0	0.5	1.0	2.0
15	4	405	12.3	17.5	13.1	8.6	4.7	6.4	6.2	9.9	10.9	3.7	1.7	0.7	0.7	3.4
16	2	227	10.6	24.7	5.3	4.0	8.4	3.5	7.0	18.5	9.7	1.8	1.3	2.6	1.3	1.3
17	2	141	8.5	24.1	8.5	2.8	7.1	6.4	9.2	0.0	6.4	12.8	1.4	7.8	0.7	4.3
18	3	367	11.2	21.5	7.6	3.5	12.3	9.0	4.1	3.5	8.4	9.3	1.4	6.5	0.3	1.4
19	1	147	8.2	19.0	8.2	2.0	13.6	8.8	6.8	8.2	6.8	7.5	8.2	1.4	0.0	1.4
		4,304														
Total percentage			15.4	14.8	11.8	9.4	9.2	7.3	6.9	6.3	6.0	3.9	3.1	2.3	1.8	1.8

TABLE 3
CIRCULATION FUNCTIONS ANALYZED BY DAY OF WEEK

Day of Week	Study Days/Week	Tabulations	Patron Interact.	Dischg.	File	Chg./Renew	Adm.	Circulation Functions in Percentage								
								Pers.	Idle	Abs.	Book Sort.	Overdues	Holds	Other	Supvr.	Snags
S	4	298	15.4	13.0	9.3	7.7	1.3	8.7	15.4	11.4	4.6	1.6	0.6	3.6	1.6	5.0
M	5	609	13.7	10.6	17.2	14.1	11.0	8.7	6.2	2.6	5.0	3.6	2.9	1.6	1.6	0.6
T	10	1,256	15.4	15.1	12.3	8.6	10.2	7.6	6.7	5.8	6.2	2.8	4.2	2.3	0.9	1.1
W	5	516	14.5	21.1	8.1	7.7	7.5	6.3	4.6	5.0	8.7	6.3	2.1	5.6	0.7	1.1
T	6	657	16.4	12.4	12.0	11.7	10.9	4.8	4.4	8.2	8.0	3.5	2.1	1.2	1.8	2.1
F	5	622	14.7	16.8	12.2	6.9	10.7	8.0	6.2	7.8	4.5	3.5	3.0	1.4	1.9	1.7
S	6	346	17.9	13.2	6.0	7.5	5.2	6.9	10.6	5.7	3.1	8.3	5.2	3.7	2.8	3.1
		4,304														
Total percentage			15.4	14.8	11.8	9.4	9.2	7.3	6.9	6.3	6.0	3.9	3.1	2.3	1.8	1.8

ter the weekend. Idleness was highest on weekends, when fewer patrons were in the library. Absenteeism, primarily a student problem, was greatest on Sundays and Thursdays, the days before many assignments were due. Faculty Overdues were processed only on weekends, and that was reflected in the data. Special assignments were usually a part of weekend activity when routine functions required less time for both clerks (Holds, Other) and supervisors (Snags).

Early in the study it became obvious that it was not possible to identify the time of day an activity was being performed by persons who worked full time or during a meal hour. Beginning with the eighth day of the study, the staff drew vertical lines on their tags representing 12 noon and 5 p.m. and placed tick marks in the appropriate sections. Table 4 reflects activity by time of day for the last thirty-three days of the study. Analysis by employee level was applied only to supervisors and clerks because there were only 257 student tabulations during that period; total percentages, however, include student data. Almost 50 percent of the days' total activity occurred in the afternoons; mornings were slightly busier than evenings, but the type of work done in the mornings differed from that in the evenings. Patron Interaction was negligible in the mornings and quite heavy in the after-

noons—60 percent more than in the evenings. Discharging was the primary morning activity and second most frequent activity in the afternoons. Though all of the previous day's circulation was filed each morning, Monday through Friday, Filing was *not* the primary morning function. This was a surprise discovery.

CONCLUSIONS

The technique of random time sampling, using a RAM, is practical for evaluating all of the activities of a large staff working extended days and weeks. The RAM is an ideal instrument for selecting random times; one that is electronically preset, so it need not be touched by the study participants once it has been activated, has the added advantages of high reliability and minimum intrusion.

A self-observation study will fail unless the staff *willingly* participates. Total honesty in explaining the purpose and plan, scrupulous care in following agreed-upon procedures, prompt resolution of participants' concerns, and complete trust between administrator and participants are required. When information is being sought that might be interpreted negatively, few people will honestly record "negative" data unless they can be guaranteed anonymity. Study procedures may need to be modified in order to provide this guarantee, but it is

TABLE 4
CIRCULATION FUNCTIONS ANALYZED BY TIME OF DAY

Function	Supervisors* Percentages			Clerks† Percentages			Total Staff‡ Percentages		
	Morn.	Aft.	Eve.	Morn.	Aft.	Eve.	Morn.	Aft.	Eve.
Patron interaction	2.8	7.2	6.2	3.4	7.2	3.6	3.1	7.3	4.5
Discharging	2.8	4.7	2.6	6.2	7.6	3.8	5.1	6.8	3.6
Filing	0.4	0.4	4.2	5.1	3.6	4.3	3.8	3.1	4.3
Charging/renewing	1.6	1.8	2.6	2.0	5.5	2.6	1.8	4.5	2.6
Administration	9.5	13.9	2.3	2.0	1.5	0.6	3.7	4.5	1.0
Personal	1.3	1.9	0.2	2.6	4.2	2.4	2.1	3.4	1.8
Idle	2.5	2.8	1.8	1.4	2.6	2.1	1.6	2.6	2.0
Absent	0.0	0.0	0.0	2.3	3.1	2.1	1.8	3.2	2.4
Book sorting	2.1	3.6	1.6	2.5	2.7	1.2	2.4	2.8	1.3
Overdues processing	2.0	2.7	0.7	2.5	1.4	0.2	2.2	1.6	0.3
Holds processing	0.3	1.4	0.2	1.0	2.2	0.6	0.8	1.8	0.5
Other	1.2	1.6	0.0	0.6	2.0	0.2	0.7	1.8	0.2
Supervisory	1.2	1.5	0.7	0.2	0.2	0.1	0.5	0.5	0.2
Snags	1.5	2.0	1.8	0.2	0.4	0.0	0.5	0.8	0.5
Total	29.2	45.5	24.9	32.0	44.2	23.8	30.1	44.7	25.2

*Based on 913 tabulations.

†Based on 2,508 tabulations.

‡Based on 3,678 tabulations (includes 257 student tabulations).

worth the effort when highly reliable data result. Self-observation is the best technique for complex staffing studies where an activity can be classified in more than one category.

Library administrators now have available the tools and technique to obtain valuable information that was almost impossible to collect a few years ago. Staffing studies of

this type isolate problems, confirm or refute staffing theories, and provide conclusive evidence to support staffing needs. Administrators need not be restricted to staffing studies, for with the aid of computers, RAMs, and work sampling techniques, they can evaluate a variety of library operations to make them more cost effective.

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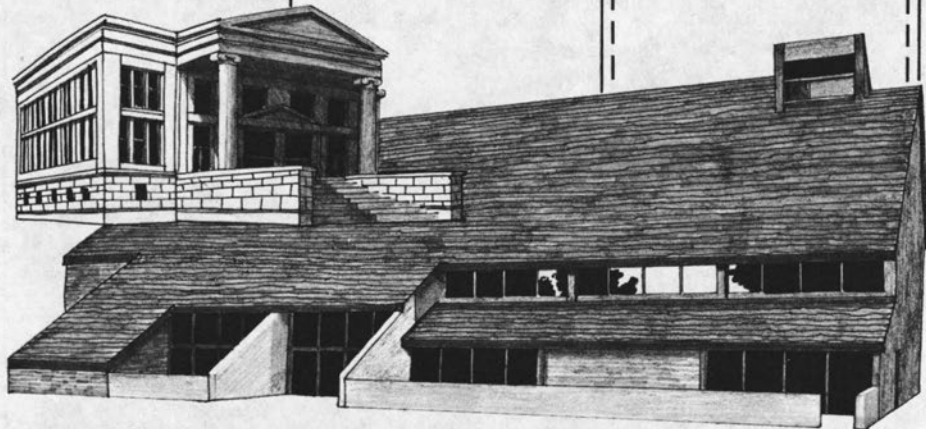
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