

HOSPITALS continued

of \$1,770,000 for power, light and heat. Fuel alone cost \$690,000. This represents an average of \$256 a bed for the mechanical services. If we were to build these hospitals today, fully insulate all buildings and design economical boiler plants, we could hold these costs down to around \$75 a bed—a saving of over one million dollars. What's more, as a firm, we personally feel panel heating could further reduce fuel costs as much as 25%! But more about this later.

Insulation vs Radiation. In the course of business we've met many architects and engineers who claim hospitals can't afford the expense of insulation. Let's analyze it from first-hand experience at Yonkers, N. Y. and Hagerstown, Md. Here the typical room has an outside wall area of 130 sq ft—36 in windows and 94 in wall. For insulating the walls we used fireproofed fiber furring blocks, 20x80x3 in. thick. Together with a 12-in. brick curtain wall, a 2-in. air space, and 1/2 in. of plaster applied directly on the blocks, we got a heat-loss coefficient of 0.1065 Btu per sq ft per hr.

At the time of purchase, this furring block ran 35¢ a foot, but we could lay it up in a third less time than the usual 15¢ split-tile furring it replaces.

The hermetically-sealed double glazing cost \$2.50 a foot as against 35¢ for the double-thick glass. Allowing for extra labor on installation the selected windows run \$2.25 a foot more.

Thus to insulate the typical room described above we paid 20¢ extra for 94 sq ft of wall or \$18.80, and \$2.25 extra for 36 sq ft of window, or \$81, a total of \$99.80. So much for insulation extras.

For radiation in the insulated room at Hagerstown we selected 28 sq ft, and at Yonkers, 48 sq ft.

Three contractors indicated they based their unit-estimating costs for installation of a complete heating plant at \$5.75-\$8.00 a sq ft of radiation (1950 levels). In the interests of extreme conservatism let's say \$5.00 per sq ft. The 20 sq ft less radiation at Hagerstown saved \$100 a room, the full cost of the insulation. Fuel consumption is substantially cut in half for the life of the building. What's more, the insulated building in three controlled tests has proved 3 deg cooler in summer than an adjoining uninsulated structure.

This subject of radiation suffers from what our firm feels are outmoded ideas. For too long, architects and engineers have revered the 18th-Century tradition calling for a radiator under every window. It costs roughly \$30 to hook up and valve each radiator and doubling up is rank extravagance.

Heat requirements may be roughly estimated at a ratio of 1 sq ft of radiation to 80 cu ft of space, and double that, or 160 cu ft of space, if the building is properly insulated. Table III indicates the wide spread in engineering design and the varied allowance made for insulation. This variation is further emphasized by the following examples of the amount of radiation in rooms of identical size and construction heated with hot-water radiators.

I: Hospital With All or a Portion Insulated

Location	No. beds	Days care	Total cost	Power, light per bed per yr	Heat cost per bed per yr
Toronto, Ont.	547	175,488	\$40,622	\$ 74	\$0.23
Prince Edward Island, Canada	200	54,037	19,373	97	.36
Hagerstown, Md.	170	57,783	27,718	163	.48
Glens Falls, N. Y.	162	59,208	19,048	117	.32
Bethlehem, Pa.	307	89,001	58,153	198	.65

II: Hospitals That Are Uninsulated

Location	No. beds	Days care	Total cost	Power, light per bed per yr	Heat cost per bed per yr
New York, N. Y.	520	152,686	\$163,199	\$314	\$1.07
Brooklyn, N. Y.	341	96,966	117,897	346	1.21
New Jersey	284	71,856	71,367	251	.90
Long Island, N. Y.	336	69,040	77,023	286	1.10
Central New York State	218	66,323	43,509	200	.66
New Jersey	307	56,588	65,317	316	1.16
No. New York State	150	41,959	27,828	186	.66
New York, N. Y.	131	39,741	58,541	447	1.07
Connecticut	134	36,157	43,130	322	1.10
Long Island, N. Y.	110	32,843	36,775	334	1.18
Westchester City, N. Y.	100	28,261	33,975	340	1.20
Brooklyn, N. Y.	143	30,288	43,875	307	1.43

The local figures are from a group of hospitals with uniform accounting.

III: Comparison of Radiation With and Without Insulation

Hospital completed	Cu ft of building	Sq ft of radiation	No. of cu ft to sq ft of radiation	Insulation	Walls	Windows
Prince Edward Island, Can.	550,000	5,100	107	Yes	Yes	Yes
Bethlehem, Pa.	750,000	3,750	200	Yes	Yes	Yes
Hagerstown, Md.	560,000	3,900	156	Yes	Yes	Yes
New Haven, Conn.	1,605,000	13,248	121	Yes	Yes	Yes
Toronto, Ont.	1,880,000	16,600	113	Yes	Yes	Yes
Hospital being planned						
Scranton, Pa.	333,000	3,343	99	Yes	No	No
Long Island, N. Y.	514,000	7,320	70	Yes	No	No
New Jersey	425,000	6,600	65	No	No	No
Glens Falls, N. Y.	605,000	7,400	85	Yes	No	No
Virginia	1,137,521	23,813	47	Yes	No	No

Heating contractors roughly estimate heating-plant installations @ \$6.50 per sq ft of radiation, including boilers and equipment.

In first group all except Prince Edward Island are wings added to existing structures.

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1. Yonkers, N. Y.—on a hill above the Hudson River, with extreme exposure

—has 48 sq ft of radiation and 160 cu ft of space in the typical room. 2. Port Chester, N. Y.—20 miles away in a sheltered valley—has 62 sq ft of radiation with 1 1/4-in. connections.

3. Hagerstown, Md.—fully insulated walls, double-glazed windows—needs only 28 sq ft of radiation with seamless copper-tubing connections.

4. Bethlehem, Pa.—with the double corridor plan—requires only 1 sq ft of radiation to each 200 cu ft of space.

Steam Requirements for 100-Bed Hospital

	Max. steam hp	Steam pressure	Hours a day of varying loads
Heating system	68	2	24
Boiler delivery	2	2	6
Hot water	10	2	10
Hot water	15	2	7
Hot water	11	100	7
Steam	6	2-20	6
Hot water washing	10	40	5
Total	129		

Estimated appraisal of steam needs, and knowledge of today's boiler technology, can result in savings that limit the need for one boiler hp or less a bed, even in winter. What's more, this rule has been proved over and over.

V: Hospital Plants With One Boiler Horsepower or Less per Bed

Location	Erected ¹	Bldgs	No. beds	No. boilers	Boiler Hp		Approx. space allocated
					Winter	Standby	
Brooklyn, N. Y.	1918	3	100	2	100	100	0
Hagerstown, Md.	1936	5	158	2	130	130	1/2
Bethlehem, Pa.	1943	11	293	3	300	150	1/2
Stamford, Conn.	1940	2	70	2	60	60	0
Bangor, Me.	1940	8	213	3	130	2 @ 60	1/2
Rome, N. Y.	1939	1	135	3	100	2 @ 63	0
New Haven, Conn.	1941	8	383	3	300	150	1/2
Westchester, City, N. Y.	1945	4	145	3	150	2 @ 100	0
Glens Falls, N. Y.	1936	2	162	3	150	150-60	1/2
Prince Edward Is., Can.	1937	2	200	2	60	60	All
Toronto, Ont.	1938	4	547	2	250	250	1/2
White Plains, N. Y.	1939	4	196	3	160	2 @ 106	1/2
Yonkers, N. Y.	1929	6	195	2	125	125	None
Total			2,801		3,923		
Average hp per bed			1.4				

*Data erected is for most recent building when usually a new, large boiler was installed to carry the winter load. Only at Bangor and Rome were boilers designed economically to supply the reduced steam demand in summer. Rome has a 100-hp low-pressure and two 63-hp high-pressure.

radiators at all in center service with no outside wall exposure.

Table IV gives a very good summary of actual steam requirements for a hospital. These demands, as the table lists them, for hospital needs in winter heating, represent only a fraction of the estimated total boiler load.

Under Plant, U.S. Public Health Service, referred to before, suggest that more than one boiler horsepower per bed when the heat load is figured at zero F. We have records of 100 hospitals, Table V, with a total of 2,801 beds where boilers of one hp per bed usually less, have carried the winter load. Total boiler capacity in these hospitals, including standby, average 3.92 hp per bed. Six general hospitals in New York City, on the other hand, with 2,000 beds have boiler plants averaging 2.6 hp per bed.

The problem of standby boiler capacity is no small one. We have found that engineers specify two high-pressure boilers, each sufficient to carry the winter load. But this premise entirely disregards the summertime drop in load to about a third of this load. So for the six months a year one large boiler operates at a load level way below rated and at its most inefficient performance range.

The most economical boiler installation for our money, for a 100-bed hospital, Table IV, combines a 70-hp steel hot-water heating boiler with two 40-hp radiators.

POWER has stated its position on the "one boiler" question. "But where it has been a long time, as in hospital work, it is not an unusual case."

125-pai designs, a saving of 50 hp over the conventional two 100-hp 125-pai units. The hot-water heating boiler costs less than the high-pressure units. You can repair or recondition it in the summer months. In event of a winter breakdown you can get by comfortably with the two 40-hp high-pressure units. A check back on Table IV indicates that with the variable demands you have to meet, the two high-pressure boilers need work at 125% rated capacity for only relatively limited periods.

Heating Methods. As long ago as 1937, a study, put out by the Central Bureau of Hospital Information, London, England, presented panel-heating advantages so strongly that, as a firm, we felt its inclusion in American hospitals was a certainty. Greatest objection seems to be first cost. The impression exists with many architects, engineers and contractors that panel heating runs 20 to 30% more than a radiator job. However, from a business standpoint, we're convinced that given insulated buildings, proper structural and heating design, it should cost less to install than radiators. Prefabricated coils in flat-slab construction eliminate hung ceilings and plaster, save weight and cubage; cushioned floors would control sound transmission.

Two recent projects in our office confirm this belief. One small hospital in Rhode Island drew up alternate plans for a circulating hot-water system, and panel heating with prefabricated ceiling coils cast in a thin, concrete floor slab. An experienced heating contractor bid and saved 10% on a highly successful

panel installation for this hospital.

An article in *Schweizerische Bauzeitung*, April 19, 1947, bears out this belief. It reports on the operating experience of 170 panel-heating installations in Switzerland from 1937 to 1947. There were 34 in hospitals, 85 in office buildings, schools, etc., and 51 in residences. Total tube length was 450 miles. Results were excellent and, significantly, no tube leaks were reported.

Mechanical Ventilation. One of the big hidden leaks in hospital construction and operation budgets has been too much ventilation. Given plenty of windows, a forced fresh-air system is rarely if ever justified, particularly so, when you consider the extra boiler capacity you need to heat the induced air. Small local, fractional-horsepower fans will do the job well enough. There is no point in going to the large central fans popular in the past.

Operation, Maintenance. In the last analysis, though, much of a hospital's experience with its mechanical services is wrapped up solidly with its operating engineer. In the average hospital he maintains buildings and grounds as well as running mechanical plant. Since the public notices broken shades and peeling paint more than a leaking steam valve or a dirty boiler, first consideration usually goes to this housekeeping phase.

For our money it would be smart and economical to retain the consulting engineer who designed a hospital's plant to inspect it at least twice a year and supervise an efficient operating and maintenance program.