Supermarkets

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August 18, 1952
LETTER OF TRANSMITTAL
Office of the Dean  
School of Architecture 
Mass. Institute of Technology  
Cambridge 39, Mass.

Dear Dean Belluschi,

This thesis on a supermarket is duly submitted in partial fulfillment of the requirements for the degree, Bachelor of Architecture.

Respectfully,

Salem K. Shaheen
THESIS
Adequate justification is found.
in the design
and the location
for a supermarket
as a profitable venture
on a limited site.
BACKGROUND
This thesis deals with supermarkets, and in order better to understand the discussion which develops, it was considered highly appropriate to present first a brief sketch of the story of the supermarket.

**Origin**

The supermarket was born in the early stages of the depression and nurtured in the sentiment of those troubled years. Prior to 1932, there had been large markets of the same pattern, combination food markets, public markets, farmers markets; all having the same theme of providing under one roof a maximum of food merchandise. These go back as far as memory serves, and even today they are still to be found, little changed by the impact of supermarket methods. However, they lacked several important characteristics of supermarket operation and consequently their methods and volume of business have remained more or less static throughout the years.

Now during the years preceding the depression, the food market business had come to view with alarm the increasing dominance of the chain store markets. As a result of centralized mass purchasing, grouping their advertising, and stressing price advantages,
the chains had reached a point by the early thirties where 35% of the country's food buyers were their own customers.

Then in 1930 on Long Island, a food merchant named King Kullen, proclaiming himself "The World's Greatest Price Wrecker", established the King Kullen Market, opened the way for supermarkets, and gave the first pause to encroaching chains. By 1932, King Kullen was operating eight stores reported to be doing a volume of $6,000,000 and was planning ten additional stores in the coming year. He had set the stage for the debut of the supermarket.

Early in 1932, two men, R.M. Otis and R.O. Dawson, well versed in the methods of merchandising through years of experience with numerous chains, launched the Big Bear market in New Jersey. After persuading a large Hoboken wholesaler to join their enterprise, they leased the vacant Durant automobile plant, with over 50,000 square feet of floor space, and converted it into a huge food department, surrounded by eleven other specialty departments. Nearby a large parking lot was provided. A circus-like atmosphere was created throughout the building; merchandise was stacked on makeshift pine tables, inexpensive fixtures, large signs, huge dump displays, and hundreds of market baskets near the doors all contributed to the bargain
atmosphere. Full page advertisements launched the enterprise into one of the most revolutionary eras in the age-old history of the trade.

The response was equally fantastic. Succumbing to the lure of coffee at 22¢, Lifebuoy at 4¢, and Quaker Oats at 3¢, customers drove in from as far as 50 miles away and packed their market baskets full. During the first three days, sales skyrocketed to over $10,000 daily. In the first year, total sales mounted to over $4,000,000 with a net profit of $166,507.47; all on an initial investment of $10,000 only $1,000 of which allegedly was cash. Needless to say, the supermarket was born.

Reaction

After the initial impact of Big Bear, the reaction began to set in. New Jersey grocers, through their State Retail Association passed resolutions condemning supermarkets for their price cutting practices. A bill was introduced in the New Jersey Assembly to outlaw selling below cost. The Associated Grocery Manufacturers of America condemned Big Bear as uneconomic and unfair, and each member was urged to act independently to protect his
product. Pressure was brought to bear on the press, so that papers were obliged to refuse Big Bear ads. One publication deplored this innovation as follows: "Four walls - crude floors - bare ceilings - flimsy fixtures - glaring lights and gaudy signs - merchandise piled anywhere and apparently any old way - that's the inside of a typical 'cheapy' in the food field.... The destructive consequences of this type of merchandising will be evidenced by failures, bankruptcies, credit losses and a weakened distribution structure of the food industry, and the public will pay dearly as they always have."

Newspaper headlines and editorials took up the cry with charges of "Municipal Suicide", "Big Bear Raids", "Another Challenge to Nationally Advertised Brands". But the managers fought back with handbills, more loss leaders, and underdog propaganda. And the public came back; Big Bear stayed in business.

Reorientation

The years that followed were to see a major revolution in food distribution. Roy O. Dawson, one of the founders of Big Bear, predicted this in 1933 when he said: "Some day supermarkets will do nearly all of

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the business all over the country. It's inevitable because it's cheaper, because people have automobiles, and because they like to shop. It's the new method of retailing." He might also have mentioned two other factors which aided the development: the mechanical refrigerator, allowing for longer storage of perishables and less frequent buying; and the sociological changes resulting from the levelling off of incomes, which meant that more people had more money - an enlarged middle class which went to the supermarket in droves.

The early estimate of Professor McNair of the Harvard Business School that "self-service would be alright for poor people but that the middle class would never go for it", thus had to be discarded in the light of events. Also discarded were the early prevailing opinions "that supermarkets would thrive only in empty and abandoned factories, ramshackled buildings, deserted garages and barny structures in run-down neighborhoods".

"The new way of life - with its cars, refrigerators, greater leisure, bigger average income - and the supermarket - with its piles of goods, convenience, attractiveness - suited each other to a tee.

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b The Supermarket: Revolution in Retailing, Business Week, June 28, 1952, p.42

c Zimmerman, M.M., op.cit., p.21
The result: the luxurious, expensive, sleek supermarket of today."

**Nature of the Development**

The earliest acceptance of the supermarket was by the independent grocers. Those with foresight mobilized their resources behind this new medium for combating the dominance of the great national chains. The limited scope of their operation afforded them the mobility necessary to follow population changes and out-maneuver the slower moving chains. The increased volume of their new supermarkets tended to place them on an equal basis with chains in their buying power.

For similar reasons, the local and regional chains followed suit. The national chains were the last to accept the supermarket being tied down by leases. However, once they started, two forceful advantages spurred their conversion. First, the concentration enabled them to side-step the increasing dangers of chain store taxation. Second, the reduction in number of operating units by 75% eliminated much of the administrative complexity and inherent inertia of their previous establishment.

The net effect of the supermarket idea was to
strengthen the position of the independent and small chain operators. The spectre of the national chains, ominous in the early thirties had now vanished. This is not to say that the big chains went into decline, the over-all effect was to stabilize the industry. Thus comparative figures reveal little change in the share of business among the three groups from 1935 to 1951.

<table>
<thead>
<tr>
<th>Size</th>
<th>1935</th>
<th>1951</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large chain</td>
<td>26</td>
<td>28</td>
</tr>
<tr>
<td>Small chain</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Independent</td>
<td>66</td>
<td>62</td>
</tr>
</tbody>
</table>

From the early thirties to the early forties the trend to supermarkets continued apace. The impending war introduced a note of caution, and the building restriction which ensued temporarily slowed the physical plant expansion. It did not however, interfere with the rapidly developing advantages of the supermarket method. Food shortages and increased
incomes made the grocery business a more highly profitable field than it had ever been. The urge to expand was by necessity restrained by the war and the grocer marked time. With the end of hostility however, this new force was let loose, and the overwhelming swing to supermarkets proceeded rapidly. The development in the past six years has been almost too swift to assess properly. However, several general views are available at this time on the nature of the supermarket as it emerges today.

The Supermarket Today

In this year 1952, what then is a typical supermarket? According to recent surveys, the general characteristics are:

- Size: 10,200 sq.ft.
- Parking: 28,000 sq.ft.
- Employees: 30
- Customers: 7,360
- Checkouts: 5
- Annual Volume: $803,220 e

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Supermarket Merchandising, Feb. 1952, p. 35
The merchandise breakdown is:

<table>
<thead>
<tr>
<th>Line of Merchandise</th>
<th>Percent of Total Stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat, Poultry, Seafood</td>
<td>24.96</td>
</tr>
<tr>
<td>Produce</td>
<td>11.74</td>
</tr>
<tr>
<td>Dairy Products</td>
<td>9.93</td>
</tr>
<tr>
<td>Baked Goods</td>
<td>7.91</td>
</tr>
<tr>
<td>Frozen Foods</td>
<td>1.86</td>
</tr>
<tr>
<td>Confectionary</td>
<td>1.33</td>
</tr>
<tr>
<td>Dry Groceries</td>
<td>30.45</td>
</tr>
<tr>
<td><strong>Non-Foods</strong></td>
<td></td>
</tr>
<tr>
<td>Household Supplies</td>
<td>6.66</td>
</tr>
<tr>
<td>Tobacco</td>
<td>3.86</td>
</tr>
<tr>
<td>Pet Food</td>
<td>0.40</td>
</tr>
<tr>
<td>Drugs</td>
<td>0.90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

What the Public Spends for Grocery Store Products, Food Topics Research, 1950.
The percentage of grocers handling various items is:

<table>
<thead>
<tr>
<th>Item</th>
<th>Total</th>
<th>Chain</th>
<th>Ind.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Meat</td>
<td>89.3%</td>
<td>87.9%</td>
<td>89.6%</td>
</tr>
<tr>
<td>Delicatessen Items</td>
<td>55.4</td>
<td>52.6</td>
<td>55.8</td>
</tr>
<tr>
<td>Fresh &amp; Frozen Seafood</td>
<td>80.3</td>
<td>85.4</td>
<td>79.5</td>
</tr>
<tr>
<td>Produce</td>
<td>95.6</td>
<td>97.8</td>
<td>95.2</td>
</tr>
<tr>
<td>Dairy Products</td>
<td>98.1</td>
<td>98.7</td>
<td>98.0</td>
</tr>
<tr>
<td>Margarine</td>
<td>94.6</td>
<td>98.0</td>
<td>94.1</td>
</tr>
<tr>
<td>Frozen Fruit Juices</td>
<td>83.9</td>
<td>88.4</td>
<td>83.1</td>
</tr>
<tr>
<td>Frozen Foods</td>
<td>84.6</td>
<td>87.9</td>
<td>84.1</td>
</tr>
<tr>
<td>Packaged Ice Cream</td>
<td>84.3</td>
<td>80.9</td>
<td>84.9</td>
</tr>
<tr>
<td>Cakes, Pies, etc.</td>
<td>89.9</td>
<td>78.5</td>
<td>91.8</td>
</tr>
<tr>
<td>Baby Foods</td>
<td>95.6</td>
<td>98.6</td>
<td>95.1</td>
</tr>
<tr>
<td>Infant Cereals</td>
<td>92.7</td>
<td>98.3</td>
<td>91.7</td>
</tr>
<tr>
<td>Dried Fruits &amp; Veg.</td>
<td>94.5</td>
<td>97.8</td>
<td>94.0</td>
</tr>
<tr>
<td>Nuts</td>
<td>96.0</td>
<td>98.0</td>
<td>95.7</td>
</tr>
<tr>
<td>Soft Drinks</td>
<td>96.6</td>
<td>96.7</td>
<td>96.6</td>
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<tr>
<td>Beer</td>
<td>29.7</td>
<td>34.4</td>
<td>28.9</td>
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<tr>
<td>Wine</td>
<td>13.6</td>
<td>17.3</td>
<td>13.0</td>
</tr>
<tr>
<td>Liquor</td>
<td>3.9</td>
<td>4.2</td>
<td>3.9</td>
</tr>
<tr>
<td>Cigarettes</td>
<td>94.7</td>
<td>97.2</td>
<td>94.3</td>
</tr>
<tr>
<td>Bar Candy</td>
<td>96.3</td>
<td>97.5</td>
<td>96.1</td>
</tr>
<tr>
<td>Boxxed &amp; Bagged Candy</td>
<td>91.8</td>
<td>97.2</td>
<td>90.9</td>
</tr>
<tr>
<td>Bulk Candy</td>
<td>50.1</td>
<td>39.0</td>
<td>51.9</td>
</tr>
<tr>
<td>Chewing Gums</td>
<td>96.4</td>
<td>97.2</td>
<td>96.3</td>
</tr>
<tr>
<td>Brooms &amp; Hops</td>
<td>95.4</td>
<td>97.3</td>
<td>95.1</td>
</tr>
<tr>
<td>Floor Waxes</td>
<td>97.0</td>
<td>97.6</td>
<td>96.8</td>
</tr>
<tr>
<td>Metal &amp; Silver Polish</td>
<td>86.6</td>
<td>95.5</td>
<td>85.1</td>
</tr>
<tr>
<td>Household Tints &amp; Dyes</td>
<td>42.3</td>
<td>31.9</td>
<td>44.1</td>
</tr>
<tr>
<td>Furniture Polish</td>
<td>95.3</td>
<td>97.0</td>
<td>95.0</td>
</tr>
<tr>
<td>Household Insecticides</td>
<td>89.5</td>
<td>91.4</td>
<td>89.2</td>
</tr>
<tr>
<td>Item</td>
<td>Total</td>
<td>Chain</td>
<td>Ind.</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Aer-sol type Bombs</td>
<td>68.2%</td>
<td>73.6%</td>
<td>67.4%</td>
</tr>
<tr>
<td>Household Disinfectants</td>
<td>86.0</td>
<td>88.0</td>
<td>85.6</td>
</tr>
<tr>
<td>Shoe Polishes</td>
<td>94.8</td>
<td>96.5</td>
<td>94.5</td>
</tr>
<tr>
<td>Window Cleaning Items</td>
<td>94.8</td>
<td>96.6</td>
<td>94.5</td>
</tr>
<tr>
<td>Household Brushes</td>
<td>67.0</td>
<td>80.0</td>
<td>64.9</td>
</tr>
<tr>
<td>Spot Cleaning Fluids</td>
<td>70.2</td>
<td>85.1</td>
<td>67.8</td>
</tr>
<tr>
<td>Home Dry Cleaning Fluids</td>
<td>61.9</td>
<td>83.0</td>
<td>58.4</td>
</tr>
<tr>
<td>Paper Napkins</td>
<td>97.9</td>
<td>97.8</td>
<td>97.9</td>
</tr>
<tr>
<td>Cleansing Tissues</td>
<td>97.7</td>
<td>97.6</td>
<td>97.8</td>
</tr>
<tr>
<td>Waxed Paper</td>
<td>98.1</td>
<td>97.4</td>
<td>98.3</td>
</tr>
<tr>
<td>Paper Plates</td>
<td>92.0</td>
<td>95.4</td>
<td>93.4</td>
</tr>
<tr>
<td>Aluminum Foil</td>
<td>85.0</td>
<td>96.2</td>
<td>83.2</td>
</tr>
<tr>
<td>Shelf Paper</td>
<td>62.1</td>
<td>60.7</td>
<td>62.3</td>
</tr>
<tr>
<td>Home Canning Supplies</td>
<td>88.6</td>
<td>94.5</td>
<td>87.7</td>
</tr>
<tr>
<td>Dog Food</td>
<td>97.4</td>
<td>97.6</td>
<td>97.3</td>
</tr>
<tr>
<td>Cellophane Tape</td>
<td>83.1</td>
<td>72.5</td>
<td>84.8</td>
</tr>
<tr>
<td>Sponges</td>
<td>55.2</td>
<td>67.6</td>
<td>53.2</td>
</tr>
<tr>
<td>Electric Light Bulbs</td>
<td>88.4</td>
<td>91.1</td>
<td>88.0</td>
</tr>
<tr>
<td>Flashlight Batteries</td>
<td>54.5</td>
<td>37.8</td>
<td>57.2</td>
</tr>
<tr>
<td>Garden Seed</td>
<td>68.1</td>
<td>67.5</td>
<td>68.2</td>
</tr>
<tr>
<td>Plant Insecticides</td>
<td>33.8</td>
<td>26.5</td>
<td>35.1</td>
</tr>
<tr>
<td>Kitchenware</td>
<td>26.4</td>
<td>36.5</td>
<td>24.7</td>
</tr>
<tr>
<td>Glass Tumblers</td>
<td>19.1</td>
<td>27.0</td>
<td>17.8</td>
</tr>
<tr>
<td>Household Glue &amp; Cement</td>
<td>48.9</td>
<td>29.6</td>
<td>52.1</td>
</tr>
<tr>
<td>Clothes Pins</td>
<td>94.2</td>
<td>90.2</td>
<td>94.8</td>
</tr>
<tr>
<td>Clothes Line</td>
<td>81.5</td>
<td>85.1</td>
<td>80.9</td>
</tr>
<tr>
<td>Dish Cloths &amp; Towels</td>
<td>43.7</td>
<td>72.4</td>
<td>38.9</td>
</tr>
<tr>
<td>Razor Blades</td>
<td>84.2</td>
<td>67.3</td>
<td>87.1</td>
</tr>
<tr>
<td>Work Gloves</td>
<td>72.5</td>
<td>65.7</td>
<td>73.6</td>
</tr>
</tbody>
</table>

*1951 Grocery Distribution Study, Food Topics Research.*
These supermarkets emerge as three general types: 

The **Urban Type**, characterized by high concentration of sales in relatively small space. Its limited space and nearby competition tend to restrain this type from non-food lines. However, due to its heavy traffic, it is in a good position to assimilate the functions of the newsstand, cigar store, candy store, delicatessen, and drug store.

The **big general store**, typified by some of the fabulous western supers. There are actually only a few of these, and they will continue to flourish mainly in rural areas where they function as a complete shopping center under one roof.

The **suburban type**, which may eventually become the dominant form of the supermarket. It is big, has plenty of parking space, and, most significantly, is usually located in a shopping center.

**The Supermarket Tomorrow**

After two decades of magic success, during which everything the supermarkets touched turned to gold, the operators are beginning to find the going tough. Increased expenses, higher margins, more competition, and decreasing efficiency all have added

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Business Week, op.cit., p.50
to their worries. Many are now beginning to wonder if they have not over-expanded; how well these expensive plants will do if volume drops.

This attitude is best expressed by one of the larger operators: "In some areas they are now opening supermarkets of 30,000 square feet. But I think you can do enough business in a 6,000 square foot store, and in the long run you will have a smaller overhead and show a better net. You may have a big store that is well established, but when somebody else puts up another big store next to yours, there may not be sufficient business for both. I am painting a very gloomy picture, but I am very much concerned there will be so many big supermarkets they will not be able to get the volume they were built for."

The golden age seems to have been reached and all are now concentrating on cost cutting procedures to increase efficiency, while some are turning their attention to complete self-service and increased mechanization. This probing of the future is exemplified by the following statement of M.P. McNair, Lincoln Filene Professor of Retailing, Graduate School of Business Administration, Harvard:

1 Supermarket Institute Mid-Year Meeting, Proc. of, S.M.I., 1951.
"Outstanding characteristics of retail distribution over the next twenty five years:

a. Greater rise of automatic vending, self-service, and preselection, with an accompanying further decrease in the ratio of employees actually engaged in selling.

b. Greater emphasis on speed and convenience of consumer sales transactions.

c. Wider use of mechanical methods of merchandise handling and record keeping."

From this period of introspection the supermarket of tomorrow will emerge.

PROPOSAL
As stated in the thesis, the objective under consideration is the redevelopment of a real estate investment which is no longer returning a desirable income, and the justification of a supermarket as the means of redevelopment. In this section, after a brief description of the site, the choice of a supermarket is explained and a financial analysis is outlined.

The Site

The site is a group of four lots totaling 105 feet by 150 feet on a southeast corner location just one-quarter of a mile from the business center of Fort Wayne, Indiana. This places it in the commercial-residential fringe of the city. It may well be described as a good strategic location, situated as it is between the two main east-west arteries of the city. Also, standing on the in-town edge of a dense residential area, it straddles the pedestrian paths to the shopping district. As with most land in this area, the terrain is flat, and, being at one of the higher elevations in Fort Wayne, no complication from ground water is expected. Excavation poses no difficulties, and,
of course, the required utilities are available.

At present there are several old structures on the four lots. Two, almost obsolete brick dwellings plus a garage, a small frame office for a used car lot, and a recently erected, simple, concrete-block structure used as a laundry and dry cleaning shop.

The revenue from these buildings is not commensurate with their location, though it is all that may be justly expected, due to their condition, even should rent controls be eased. Over the years, due to mounting maintenance charges, rising taxes and inflationary pressures, the net income has steadily diminished. The landlord is thus faced with the necessity of re-developing his land at a time of rising building costs, with limited financial resources, all of which inclines him to seek that solution which would minimize his capital outlay yet obtain a proper return. This restricts the range of possibilities for new development. Projects which might normally be considered for this site are:

1. Drugs — shops
2. Apartments
3. Cinema
4. Supermarket
5. Restaurant
6. Auto Sales room
Argument for a Supermarket

A supermarket was chosen as the instrument of development, not because it alone of all the possibilities promised the most success, but for the reason that of the several equally promising opportunities, it alone has been advanced as an actual proposal in the past, and as a probability stands foremost. This is not to endorse the notion that the most readily accepted plan is necessarily the best; the converse is frequently true. However, in this particular instance the intuitive preference of the landlord has been a determining factor.

What are the prospects for a supermarket on this site? Let us first consider the Fort Wayne market. In the year 1950, the total food sales in the city were $35,565,000.00. Of this 62% was by independent grocers while 38% or $13,465,000.00 was sold by two chains, A&P, and Kroger. Inasmuch as the operation of the chains in Fort Wayne consists wholly of nine supermarkets and two superettes, an examination of their sales would afford a good estimate of sales to be expected by the proposed market. Assuming the volume of the
two superettes to equal that of one supermarket, then including the proposed market, the total sales would be divided among eleven markets, giving an annual expected volume of $1,236,000.00; a highly desirable weekly gross of $23,800.00.

Is this location accessible to the number of families required to make up this volume? Examination of the statistics for 1950 shows that in the city of Fort Wayne there were 41,000 families. Now 38% (the chain's share) of this would be 15,600 and one-eleventh of this would require a clientele of 1,435 families for the proposed market. Let us examine the immediate neighborhood of the site. We find that within walking distance there are approximately 1,000 families. Another 1,000 families are within easy bus commuting distance, and a large volume of east-west traffic on Washington and Wayne Streets makes this site convenient to auto shoppers. Thus it appears that the requisite number of customers is readily available to the proposed market.

The business of predicting a market is not the easy rule-of-thumb process that the foregoing discussion would indicate. Numerous research staffs
of the larger chains have developed highly scientific methods of analysis. In the absence of their resources, I have presumed to simplify this process.

For a clearer view of the prospects, I would further attempt to subdivide this expected trade. Based upon a long familiarity with this neighborhood, I would expect the following breakdown:

- 40% pedestrian
- 20% public conveyance
- 40% auto drive-in

It must be reiterated here that these figures are rough estimates, presented merely to aid in further planning.

The remainder of this argument concerns the nature of the competition. Within the general area of the proposed market are two other supermarkets. They are located one-half mile from this site, and, more significantly, they are on the western fringe of the commercial district. This leaves the eastern fringe and the residential area adjoining it without a convienently located supermarket. Residents in this neighborhood are required to cross town to the above markets, to drive east to outlying markets,
or else to rely on the several small yet inadequate independents. There is certainly an opening here for the proposed market.

Financial Analysis

The financial analysis has been organized into two presentations intended to convince the landlord and the client of the profitable nature of this proposal.

Presentation to the Landlord

Two alternatives are offered: either the landlord finances the whole project, or an arrangement is made whereby the client finances the construction with rent adjusted accordingly. The figures for either arrangement are presented below. It is seen that in either case the landlord receives a fair return on his investment. In the first instance, where the investment and consequent risk is greater, the expected return is correspondingly higher. In the second case, the return is less, but at the termination of the lease period, the property will have been developed into a satisfactory capital gain at little risk.
Presentation to the Landlord

### A. Client Builds

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent available 1%</td>
<td>$12,000</td>
</tr>
<tr>
<td>Amortization of Building 4% of $75,000 (25 yr.)</td>
<td>$3,000</td>
</tr>
<tr>
<td>Rent to landlord</td>
<td>$9,000</td>
</tr>
<tr>
<td>Tax on land 4% of $50,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>Tax on Bldg. 4% of $75,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Net rent</td>
<td>$4,000</td>
</tr>
<tr>
<td>Capital Gain after 25 yrs. $75,000</td>
<td></td>
</tr>
<tr>
<td>less depreciation 2/3 $50,000</td>
<td></td>
</tr>
<tr>
<td>Annual gain</td>
<td>$1,000</td>
</tr>
<tr>
<td>Net income</td>
<td>$5,000</td>
</tr>
</tbody>
</table>

### B. Landlord Builds

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent to landlord</td>
<td>$12,000</td>
</tr>
<tr>
<td>Amortization Charges</td>
<td>$3,000</td>
</tr>
<tr>
<td>Tax charges</td>
<td>$5,000</td>
</tr>
<tr>
<td>Net rent</td>
<td>$4,000</td>
</tr>
<tr>
<td>Capital gain</td>
<td>$1,000</td>
</tr>
<tr>
<td>Net income</td>
<td>$5,000</td>
</tr>
</tbody>
</table>

* Tax rate Ft. Wayne, Ind. 1951, $39.60 per $1,000 valuation
Presentation to the Client

In deciding whether or not this project would be profitable, the client would be interested in whatever statistics can be cited in its support. Therefore the following analysis has been based on two sources: first, the national, regional, and local market surveys available; and second, the results of a survey which was made of eleven supermarkets having similar spatial, financial, and locational characteristics.

<table>
<thead>
<tr>
<th></th>
<th>$1,200,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Volume</td>
<td></td>
</tr>
<tr>
<td>Margin 16%</td>
<td>192,000</td>
</tr>
<tr>
<td>Overhead 11% (Includes 1% rent)</td>
<td>132,000</td>
</tr>
<tr>
<td>Net 5%</td>
<td>60,000</td>
</tr>
</tbody>
</table>

Both surveys cited below.
In the proceeding sections the general characteristics which form the background of this thesis have been presented. The site has been discussed, and the story of the supermarket has been related. An attempt has been made towards a realistic approach to the redevelopment of this site as a supermarket. The discussion now turns to the formulation of a program for this project.

**The Client**

What client shall be sought for this location? The available alternatives are either an independent operator or one of the two chains operating in Fort Wayne. As for the independent operator, he would at first seem the logical choice due to his traditionally accepted mobility. It has always been argued that the independent can and does outmaneuver the chain. However true this may be of a smaller grocery, the reasoning does not hold for a supermarket.

In the first place, the independent is more cautious, the limited nature of his operations and of his capital makes him so. In the second place the independent relies heavily on the personality with which he endows his store to draw trade.
a consequence, he prefers a neighborhood with which he is familiar, or one whose "character" is homogeneous and well-known, one to which he can direct this personality. Finally, he avoids innovations. He does not open a supermarket every year, perhaps only a few in his lifetime; therefore if new ideas are to be tried, let the chains test them — if successful then he will consider a change. It needs to be said here that this is not true in 100% of the cases — for weren't the originators of supermarkets independents? But the large multitude of grocers today lack the marketing genius of King Kullen; anyone familiar with the operation of any business on a narrow margin will readily testify to the in-bred conservatism of the operator. Thus it is a rare grocer today who will entertain any but tried and tested marketing methods.

Since the problem at hand is not open to solution by conventional means, since the clientele sought is by no means homogeneous, and since chain stores as well as the mechanized approach to be suggested, both bear the imprint of anti-personal efficiency; the obvious course has been to turn to the chains. Therefore this project is intended as
another unit for one of the two national chains: A.&P. or Kroger.

Further bases for decision

As a result of a survey of the Fort Wayne market, it has already been estimated that the proposed store would have a volume in the neighborhood of $1,200,000 annually. It is open to question then, whether in the light of local, regional, and national statistics, this site can be justified, both as to location, and as to the possibility of providing the proper sized market for this volume.

We have seen that as of the latest statistics \(^1\) the typical supermarket today has these characteristics:

- **Size**: 10,200 square feet
- **Parking**: 28,000 square feet
- **Employees**: 30
- **Checkouts**: 5
- **Customers**: 7,360
- **Volume**: $803,220

For the State of Indiana, the average volume per supermarket in 1951 was $795,190.00. The breakdown

\(^1\) Industry Still on the Ascent, Supermarket Merchandising, Feb. 1952, p.35 ff.
of all markets into their sales volumes is given in
the following table:

Table 1: Supermarket Sales 1951

<table>
<thead>
<tr>
<th>1951 Vol./ Mkt.</th>
<th>% of all Mkts.</th>
<th>Ave. Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>$375,000 - 599,999</td>
<td>12.7</td>
<td>$428,000</td>
</tr>
<tr>
<td>600,000 - 799,999</td>
<td>44.0</td>
<td>727,000</td>
</tr>
<tr>
<td>800,000 - 999,999</td>
<td>10.6</td>
<td>835,000</td>
</tr>
<tr>
<td>1,000,000 - 1,249,999</td>
<td>11.7</td>
<td>1,072,000</td>
</tr>
<tr>
<td>1,250,000 - 1,499,999</td>
<td>3.4</td>
<td>1,270,000</td>
</tr>
<tr>
<td>1,500,000 - 1,999,999</td>
<td>15.8</td>
<td>1,752,000</td>
</tr>
<tr>
<td>over 2,000,000</td>
<td>1.8</td>
<td>3,385,000</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>$803,220</td>
</tr>
</tbody>
</table>

Thus we have here the prospect of a better than average
volume.

Turning to size considerations and anticipating
for the moment a size of 9 - 10,000 square feet for
this store, the correlation with population (pop.
Fort Wayne = 120,000 ) is shown to be good in table 2:
Table 2: Size and location of 1951 Supers According to Population

<table>
<thead>
<tr>
<th>City Population</th>
<th>% Located in</th>
<th>Size (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 2,500</td>
<td>5.6</td>
<td>5,000</td>
</tr>
<tr>
<td>2,500 – 10,000</td>
<td>13.5</td>
<td>6,000</td>
</tr>
<tr>
<td>10,000 – 25,000</td>
<td>19.1</td>
<td>7,500</td>
</tr>
<tr>
<td>25,000 – 100,000</td>
<td>24.7</td>
<td>8,300</td>
</tr>
<tr>
<td>100,000 – 500,000</td>
<td>20.4</td>
<td>9,900</td>
</tr>
<tr>
<td>Over 500,000</td>
<td>16.7</td>
<td>12,750</td>
</tr>
</tbody>
</table>

The proposed market, as shown in table 3 would be classified as medium - large:

Table 3: Size distribution of Supermarkets

<table>
<thead>
<tr>
<th>Size</th>
<th>Square Feet</th>
<th>Class</th>
<th>% Mks.</th>
<th>Ave. Size – sq.ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 5,000</td>
<td>Small</td>
<td>22.2</td>
<td>3,410</td>
<td></td>
</tr>
<tr>
<td>5 – 10,000</td>
<td>Medium</td>
<td>37.7</td>
<td>7,310</td>
<td></td>
</tr>
<tr>
<td>10 – 15,000</td>
<td>Large</td>
<td>23.5</td>
<td>11,800</td>
<td></td>
</tr>
<tr>
<td>15 – 20,000</td>
<td>Extra-large</td>
<td>7.3</td>
<td>16,600</td>
<td></td>
</tr>
<tr>
<td>Over 20,000</td>
<td>Colossal</td>
<td>9.3</td>
<td>28,600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td></td>
<td>10,200</td>
<td></td>
</tr>
</tbody>
</table>

The metropolitan location of the site is further supported by the figures of table 4:
### Table 4: Location of Markets by Community

<table>
<thead>
<tr>
<th>Size</th>
<th>Metropolitan</th>
<th>Suburban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>18.3</td>
<td>18.2</td>
<td>64.3</td>
</tr>
<tr>
<td>Medium</td>
<td>48.3</td>
<td>31.8</td>
<td>28.6</td>
</tr>
<tr>
<td>Large</td>
<td>16.7</td>
<td>30.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Extra-large</td>
<td>8.3</td>
<td>8.0</td>
<td>-</td>
</tr>
<tr>
<td>Colossal</td>
<td>8.3</td>
<td>11.4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

A final quotation from the same source will serve to strengthen our position both as to size and as to client: "it is apparent that the bigger chains are concentrating on medium and large-size markets, that is to say, from 5 to 15,000 square feet; since 83.2% are in those two size groups when built by bigger chains".

### Space Requirements

We now approach one of the main issues of this thesis, namely, to what degree is it possible on this limited site to provide the services normally requiring a site twice as large. Further, if this is possible, to what extent can it be justified. This problem resolves
itself into consideration of space distribution in the building and parking arrangements on the remaining land.

Considering the building first — is it possible to carry on a 9 - 10,000 square foot operation in a 6,000 square foot building? Before arriving at an answer to this question an attempt was made to assemble numerical data for as many supermarkets as possible, all having comparable spatial, financial, and locational characteristics. Useful data on eleven such stores was found.

These data have been assembled and evaluated on accompanying tables so that a discussion of their significance may be undertaken. To avoid ambiguity all figures have been related to the basic unit of 1,000 square feet of selling space (which includes entrance and aisle space).
Table 5: Breakdown of Similar Markets

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3,000</td>
<td>1,300</td>
<td>10,000</td>
</tr>
<tr>
<td>B</td>
<td>5,600</td>
<td>1,750</td>
<td>12,500</td>
</tr>
<tr>
<td>C</td>
<td>3,800</td>
<td>1,330</td>
<td>14,500</td>
</tr>
<tr>
<td>D</td>
<td>2,750</td>
<td>2,750</td>
<td>12,500</td>
</tr>
<tr>
<td>E</td>
<td>1,330</td>
<td>2,750</td>
<td>12,500</td>
</tr>
<tr>
<td>F</td>
<td>1,400</td>
<td>10,500</td>
<td>5,750</td>
</tr>
<tr>
<td>G</td>
<td>3,100</td>
<td>1,635</td>
<td>11,150</td>
</tr>
<tr>
<td>H</td>
<td>1,400</td>
<td>1,635</td>
<td>11,150</td>
</tr>
<tr>
<td>I</td>
<td>5,400</td>
<td>1,590</td>
<td>11,900</td>
</tr>
<tr>
<td>J</td>
<td>1,430</td>
<td>13,000</td>
<td>11,900</td>
</tr>
<tr>
<td>K</td>
<td>2,280</td>
<td>1,350</td>
<td>11,200</td>
</tr>
<tr>
<td>Ave.</td>
<td>3,860</td>
<td>1,450</td>
<td>11,850</td>
</tr>
</tbody>
</table>

* These stores identified in the Appendix.
Table 6: Breakdown of Sales Space

<table>
<thead>
<tr>
<th>Department</th>
<th>Store</th>
<th>A</th>
<th>B</th>
<th>D</th>
<th>F</th>
<th>H</th>
<th>J</th>
<th>K Ave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groceries</td>
<td></td>
<td>63.0</td>
<td>59.0</td>
<td>54.0</td>
<td>76.0</td>
<td>70.0</td>
<td>61.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Produce</td>
<td></td>
<td>14.4</td>
<td>24.0</td>
<td>18.7</td>
<td>14.9</td>
<td>11.7</td>
<td>8.7</td>
<td>11.2</td>
</tr>
<tr>
<td>Meat</td>
<td></td>
<td>7.2</td>
<td>11.2</td>
<td>8.3</td>
<td>10.8</td>
<td>15.5</td>
<td>12.6</td>
<td>8.9</td>
</tr>
<tr>
<td>Dairy</td>
<td></td>
<td>2.4</td>
<td>4.5</td>
<td>3.1</td>
<td>3.4</td>
<td>6.2</td>
<td>4.3</td>
<td>4.5</td>
</tr>
<tr>
<td>Frozen Food</td>
<td></td>
<td>1.6</td>
<td>3.3</td>
<td>3.3</td>
<td>3.9</td>
<td>6.2</td>
<td>6.1</td>
<td>3.8</td>
</tr>
<tr>
<td>Baked Goods</td>
<td></td>
<td>6.4</td>
<td>7.5</td>
<td>8.3</td>
<td>6.4</td>
<td>6.4</td>
<td>7.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Candy</td>
<td></td>
<td>1.2</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>2.2</td>
<td>--</td>
</tr>
<tr>
<td>Drugs</td>
<td></td>
<td>2.4</td>
<td>2.3</td>
<td>2.1</td>
<td>1.7</td>
<td>--</td>
<td>2.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Housewares</td>
<td></td>
<td>5.0</td>
<td>3.5</td>
<td>2.5</td>
<td>3.5</td>
<td>3.1</td>
<td>3.5</td>
<td>--</td>
</tr>
</tbody>
</table>

It is seen that 1,450 square feet of total building are required for each 1,000 square feet of selling space, so that if a 10,000 square foot building is desired, it would have \( \frac{10,000 \times 6,900}{1,450} \) square feet of selling space.

The first step in solving this problem was to restrict the ground floor to selling space and the
absolute minimum of service space, relegating all other operations to a full basement. Now admittedly this is no sweeping innovation, but it departs from the custom of most supermarkets to operate all on one floor, or at least to use but a partial basement. However in this case a full basement is necessary.

This still leaves more selling space (6,900 square feet) than is available (6,000 square feet). So the next step was to investigate and install as many mechanical merchandising devices as practicable. Thus through the use of Food-O-Mat installations, the area requirements of grocery, drug, candy, and frozen food departments are reduced at least 50%. These installations are integrated with portable floor to floor conveyor systems to facilitate their loading. Precedence for this type of servicing is to be found in the highly successful operation of the Grand Union Markets in and around New York City.

Further support is found in a statement made at the annual convention of the Super Market Institute: "We have had a good deal of success with a comparatively high volume store in a small amount of space only

\[\text{Chain Store Age, Grocers Edition, Jan. 1952, p.60ff.}\]
because we have installed an automatic grocery dispenser which minimizes the need for grocery footage. If we can find a good location that lends itself only to a small space, I believe we would be tempted to put in a Food-O-Mat. Also, according to another operator, "If you have limited space — 6,000 to 7,000 square feet — you can go to a Food-O-Mat. That will give you some space in the back. And if you have a basement, then you are in business as a supermarket; otherwise you are not."

A further reduction in space requirements is easily effected by the use of the conveyors to service the Produce, Meat and Dairy departments. This is a procedure ordinarily used for dry groceries, when storage is in the basement, but it has been used as intended here. It accomplishes another great advantage (just as do the Food-O-Mats), by removing stocking operations from the selling floor, of freeing the circulation from that added handicap.

Two other methods of floor to floor handling conserve selling floor space and at the same time eliminate two common grocery headaches. The first

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H. Kline, Food Fair Stores Inc., ibid
is a vertical conveyor to handle bottle returns. This device delivers the empties directly to a rotary bin in the basement which may be emptied at convenient times. The other is a "box well" for the empty boxes which are used to assemble grocery orders. This well has an adjustable floor which can be lowered to basement level where the empty boxes are loaded, then it is raised as needed to keep a supply of boxes handy.
<table>
<thead>
<tr>
<th>ADVANTAGES TO CUSTOMERS</th>
<th>ADVANTAGES TO OPERATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Items well departmentalized, saves shopping time</td>
<td>1. Store kept neat and clean appearing at all hours</td>
</tr>
<tr>
<td>2. Clean, neat store appeals to good housekeeper</td>
<td>2. Housekeeping problems simplified</td>
</tr>
<tr>
<td></td>
<td>3. Saves labor of stockmen fronting shelves</td>
</tr>
<tr>
<td></td>
<td>4. Saves labor when changing prices</td>
</tr>
<tr>
<td></td>
<td>5. Eliminates need of straightening up stock after closing</td>
</tr>
<tr>
<td></td>
<td>1. Assures fresh merchandise</td>
</tr>
<tr>
<td></td>
<td>2. Improves store appearance</td>
</tr>
<tr>
<td></td>
<td>1. Builds customer goodwill due to receiving fresh merchandise</td>
</tr>
<tr>
<td></td>
<td>2. Eliminates poor customer reaction from seeing dirty, rusty, unrotated merchandise</td>
</tr>
<tr>
<td></td>
<td>3. Eliminates extra labor by stock clerks to rotate merchandise</td>
</tr>
<tr>
<td></td>
<td>1. No “sold out” spaces. Grocery display complete at all hours</td>
</tr>
<tr>
<td></td>
<td>2. All items visible, eliminates searching</td>
</tr>
<tr>
<td></td>
<td>3. Easier to make value comparisons</td>
</tr>
<tr>
<td></td>
<td>1. Stimulates impulse sales of higher profit merchandise</td>
</tr>
<tr>
<td></td>
<td>2. Gives better display to all items and results in “full line” sales</td>
</tr>
<tr>
<td></td>
<td>3. Reduces amount of inventory needed to give store completely stocked appearance</td>
</tr>
<tr>
<td></td>
<td>4. Saves labor of stockmen rearranging shelves</td>
</tr>
<tr>
<td></td>
<td>1. Cuts walking up to 75%</td>
</tr>
<tr>
<td></td>
<td>2. Cuts shopping time</td>
</tr>
<tr>
<td></td>
<td>3. Easier to make selection, all items within vision</td>
</tr>
<tr>
<td></td>
<td>4. All brands of any single item visible at the same time. Heightens impression of variety</td>
</tr>
<tr>
<td></td>
<td>5. Simplifies shopping by reducing number of aisles</td>
</tr>
<tr>
<td></td>
<td>6. Customers prefer shopping in straight line</td>
</tr>
<tr>
<td></td>
<td>7. Allows for wider aisles which facilitate shopping</td>
</tr>
<tr>
<td></td>
<td>1. Allows more space for mass displays</td>
</tr>
<tr>
<td></td>
<td>2. Floor space made available for addition of highly profitable new departments</td>
</tr>
<tr>
<td></td>
<td>3. Floor space made available for expansion of present profitable departments</td>
</tr>
<tr>
<td></td>
<td>4. Increases volume and profit per square foot of floor space</td>
</tr>
<tr>
<td></td>
<td>5. Wider aisles expedite traffic</td>
</tr>
<tr>
<td></td>
<td>6. Allows store to display wider variety of items</td>
</tr>
<tr>
<td></td>
<td>7. Eliminates need for use of excessively high center gondolas that obstruct vision</td>
</tr>
<tr>
<td></td>
<td>8. Allows for more space at checkout area</td>
</tr>
<tr>
<td></td>
<td>1. Full stock of every item always in view</td>
</tr>
<tr>
<td></td>
<td>2. Fresh display for each customer</td>
</tr>
<tr>
<td></td>
<td>3. Aisles not cluttered with cartons</td>
</tr>
<tr>
<td></td>
<td>4. No stockboys or grocery handcarts in the aisles</td>
</tr>
<tr>
<td></td>
<td>1. Stockmen can work unhindered</td>
</tr>
<tr>
<td></td>
<td>2. Stock can be replenished during store hours regardless of crowd in store</td>
</tr>
<tr>
<td></td>
<td>3. Eliminates need for overtime stocking</td>
</tr>
<tr>
<td></td>
<td>4. Makes possible use of mechanical equipment to bring merchandise from reserve to stocking area, cutting labor costs.</td>
</tr>
</tbody>
</table>
Parking Considerations

Whenever the question of parking for supermarkets arises, there is a natural tendency to think of the colossal-size markets with their vast parking areas. A hasty judgement might well overlook the important locational factor involved, and conclude that all supermarkets need acres of parking. Of course, this is true in some cases, but the location of the store should be seriously evaluated before a decision is made. According to one authority, "The farther the merchant is from city conveniences .... the more dependent he is on drive-in trade .... a recent article recommended a four to one parking ratio." This states the case for the colossal-size market, in a suburban or fringe location. And the generally accepted average ratio for parking is two or three to one.

However in the present case the centrally located site introduces factors which require a different approach. Quoting the same authority, "There are locations accessible to walk-in trade and publicly-transported trade that can get by very nicely with a one to two parking ratio (1 foot of parking space to 2 feet of sales space). Others not so fortunately

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situated must go to a one to one ratio."

Thus for the proposed market a ratio of one to one would be acceptable and anything more would add a desirable margin of safety. Let us consider the situation in terms of available parking area. In tabular form we would have:

<table>
<thead>
<tr>
<th>Description</th>
<th>Dimensions</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Area of Site</td>
<td>105x150</td>
<td>15,750</td>
</tr>
<tr>
<td>&quot; of Building</td>
<td>60x105</td>
<td>6,300</td>
</tr>
<tr>
<td>&quot; Delivery Area</td>
<td>20x90</td>
<td>1,800</td>
</tr>
<tr>
<td>Parking Area Available</td>
<td></td>
<td>7,650</td>
</tr>
</tbody>
</table>

Thus we arrive at a ratio slightly above one to one, and allowing 250 square feet per car, the lot should easily accommodate 25 cars.

**Steps in Planning**

Several schemes have been advanced for the laying out of the parking lot. These involve different parking angles and various lane widths. I have selected the following three as most adaptable to this problem:

---

X ibid
Parking Plans

Plan A
45° Parking
280 sq.ft./car

Plan B
60° Parking
270 sq.ft./car

Plan C
90° Parking
224 sq.ft./car
Many solutions to the parking problem were considered, and the most likely ones will be discussed. In as much as this involves the whole problem of planning the site, the discussion will not be limited to parking.

Site Planning

Several general considerations exerted a strong influence upon the site plan. The first was the nature of traffic passing the site and its influence upon orientation of the market. The two one-way streets passing the site are both heavily travelled. However, the nature of the traffic is not the same for each. Lafayette Street, running north, is mainly used by through trucking. In the past there was a trolley line on this street, but as the center of gravity of the business district shifted south, this was discontinued. Washington Street, on the other hand, carries most of the inbound traffic to the heart of the business district. The outbound (east) traffic follows either Wayne or Jefferson Streets. Therefore since most of the potential customers would be travelling (by auto or bus) westward on Washington Street,
it was decided to orient the most imposing facade of the market to this street, both for convenience and for advertisement.

The second consideration involved the design of the structure and its solar orientation. In the design, it was intended to provide a large, open, light, airy space, and hence the two long sides developed as glass walls. Now to face these walls east and west would be to impose a difficult afternoon sun problem. The fact that the short sides were masonry walls lent added conviction to their east-west orientation. Also since a brick shop stands on a lot west of the site, the east facade could have little impact on west bound traffic. The south facade sun problem is mitigated by the use of heat absorbent glass.

Accepting this orientation then, the parking relationship must then be determined. The building could be placed to the rear of the lot with parking in front. It could be near the center with parking in front and back. Or it could be at the Washington Street end with parking in the rear.

Placing the building to the rear creates a long walk from the corner (bus stop) for pedestrians, which
are expected to provide more than half the trade. It further presents the problem of a possible unsightly parking lot in front. Admittedly this problem may be eliminated by clever design of the parking area, but this is most easily accomplished on a more spacious site. Finally, this location sacrifices whatever advertising advantage might accrue from Washington Street, since it would not be seen until the passer-by was directly in front of the building and even then not fully.

Location at the center of the site is at best a poor compromise. The third alternative, placing the building near Washington Street seems to obtain the most advantages. It is not hidden from the main traffic flow. It is convenient for pedestrians, and it harmonizes with the one way traffic system to provide smooth auto access to parking.

Roof parking and basement parking were eliminated from consideration, since at the best they would provide for only ten additional cars and at a much greater cost. On the following pages, the various schemes are presented diagrammatically, with brief comments on each.
Main Traffic

West

Building Concealed
Parking lot Facade
Distant from bus stop
Car-foot traffic conflict

Parking poor
Car-foot traffic conflict
Otherwise fair
Main Traffic

West sun problem
Parking entrance concealed
Otherwise good

West sun problem
East light blocked
Parking lot facade
Building concealed
Car-foot traffic conflict
Main Traffic  

Preferred Scheme
Features of the Plan

One characteristic which is common to almost all supermarkets is clutter and confusion. Rarely is a store encountered which gives a restful appearance. In those few cases where the design provides "waste" space for this purpose, the grocers instinct has been to violate that intent with confusion added to confusion. Perhaps this is best explained by the nature of the grocer himself. Growing up in a business where extra pennies often mean the difference between success and failure, he is unable to resist the urge to make each square foot pay; "luxury space" has become an acknowledged evil. Thus we see foyers crowded with beer and wine displays, watermelon, plants, shrubs, seeds, magazines, dog food, cat food, and bird food. We see twelve foot aisles reduced to a bare five foot minimum by dump displays of sponges, pots, pans, and chlorophyll toothpaste. Frozen food fixtures are added where they were not planned, potatoes impinge on cart storage space, and in the end the store is crammed.

This drawback was mentioned during an interview
with a researcher on the staff of one of Boston's large chains, and the surprising reply was, "I have never heard a grocer complain that his store was crowded — our stores can never be too crowded to suit us." So that seems to be the accepted attitude, regardless of whether or not the original intentions were good. This seems an intolerable viewpoint, and one cannot help but feel that it is a damaging one also. The grocer may accept this situation, but his customers will not, once there is an opportunity for choice.

An attempt has been made to overcome this shortcoming in all features of the plan. Attention is first directed to the general interior appearance.

**Interior**

Consider the qualities of color, pattern, texture, and scale. When there are thousands of items of every size in slick containers of many colors forming various patterns, there is already too much of all four categories, and the appearance is not restful. But these items are the business and little
can be done to change their impact. The Food-O-Mat is helpful somewhat, in that it presents one of each item at a time, and thus spares the customer of the onslaught of three shelves of Campbell's Tomato Soup. To really counter-balance this display however, it seems necessary at the outset to exclude the following:

- Patterned Wall Decorations
- Discordant Slogans and Labels
- Indiscreet Price tags
- Obtruding displays
- Ill-advised directional signs
- Irregular wall openings
- Inharmonious fixtures

Further details will be discussed below, however in regard to the interior decor, it seems highly desirable to seek:
- "Quiet" or "cool" colors
- Modulated lighting effects
- Simple wall treatment
- Modest price and department indications
- In-scale, harmonious fixtures

In short everything possible that would "de-agitate" the customers, let them relax and think and enjoy
shopping. This is not pure altruism, rather it is altruistic self-interest, for a pleased customer is a permanent customer.

**Circulation**

Anything that simplifies and opens up the circulation is to be desired. Space should be provided at the entrance for children, for waiting and for orientation. A simple plan is soon assimilated by the customer and eliminates many signs and arrows. In line with the argument above, the aisles should be of a type serviceable from behind to restrict on-the-floor stocking to a minimum. These are not innovations, they are available. Food-O-Mat and Shop-O-Mat for groceries, drugs and candy; storage produce and dairy cases; rear-serviced meat cases: these are all in use today. The layout should be planned for utmost simplicity, efficiency, and clarity. Customers resent being herded down narrow canyons bounded by gondolas stacked to the ceiling with groceries. Such features are commonplace today; they belong in the past. The eye as well as the foot must be free to roam.
Flooring

The requirements for flooring in a supermarket necessarily involve durability, sanitation, resilience, and visual and acoustical factors. There is a wide choice available, including the following:

Tiles
Asphalt
Rubber
Plastic
Asbestos
Clay
Linoleum
Cork
Wood block

Rolls
Linoleum
Plastic
Rubber

Cements
Terrazo
Magnesite
Finished Concrete

As the first step in selection, I have rejected all tiles, not withstanding their popularity in store use. Their main appeal has been from cost and decorating considerations. Since the aim here is to avoid excess of pattern and confusion, the decorative considerations are rejected. The cost argument is not so
easy to dismiss. However, there are definite objections to tiles. First of all, no matter how fine the installation, there will be cracks and bumps which result in an amplification of the bascart noise output, a sanitation obstacle, and a maintenance liability. The obvious answer would be to use the sheet floorings. Here we encounter, along with higher costs, inherent material disadvantages, namely, susceptibility to grease and oil stains (rubber), and to indentation (linoleum). Newly developed plastic types are said to be acceptable in both respects, as well as having many other advantages, so that they cannot be easily dismissed from consideration. Their present cost however, is still high.

This leaves the monolithic finishes, either terrazos or plain or colored concrete. These qualify in all respects save resilience, and since only the magnesite finish can be classed resilient, it has been selected. In the children's and waiting areas cork tile flooring has been chosen for comfort and noise reduction.
Ceiling Treatment

The ceiling of today's supermarket, almost universally consists of a "Celotex approved" layer of acoustical tile upon which has been superimposed lines of fluorescent lamps, for the most part exposed and, popularly, slimline fixtures. This reveals the engineering impact of the need for sound reduction and adequate light. It shows no consideration for the delight of the customer. Some stores have recently adopted the egg crate system to conceal the glaring slimlines, a hopeful step in the right direction.

It seems that a little thought can produce a much better solution and consequently new trends in area illumination have been considered. A notable example is a new German supermarket in Westphalia. The aim must be for a design which does not add to the store's confusions, but seeks a unifying influence.

Likewise, the acoustical solution does not

p

q
lie in the simple Celotex approach. Noise sources must be carefully investigated, and all elements of the structure which provide amplification deserve consideration. Low ceilings (often untreated) are a common noise amplifier, therefore this design uses a ceiling height of eighteen feet. Noisy operations (from typing to uncrating) have been relegated to the basement. The re-stocking operation has been taken off the aisles as far as practicable. That portion of the conveyor system used in unloading deliveries has been selected for least noise. The air conditioning system is located in the basement, and the small amount of ductwork which is exposed on the main floor has been sound insulated. The rest of the supply ducts are above the dropped ceiling, while the return ducts pass under the floor.

Air Conditioning

A central plant year round air conditioning system has been selected. The quantitative design upon which the selection was based is given in the appendix. Other makes would be equally acceptable,
this particular manufacturer happened to be most helpful in supplying technical data.

**Store Equipment**

No attempt has been made to select the products of a particular manufacturer, as it is most likely that the operator would have personal preferences. The various types are all strikingly similar in dimension, capacity, and appearance. Several of the systems which have been mentioned are illustrated below. The over-riding consideration here would be to install harmonious fixtures.

As a means of preventative sanitation, whatever fixtures are selected will be raised off the floor on six inch fittings or "stilts" as they have been named by their innovator. This prevents conditions which encourage such sanitation problems as dust, dirt, vermin, and rodents. It also allows for return air ducts to be placed at floor level through the store.

---

"Store on Stilts", Chain Store Age, Grocers Edition, Jan. 1952, p.68
Checkout Systems

Despite the fact that the typical grocer is happy to see a crowded store, there is one spot where even the grocer frowns at congestion. Once the customer has finished shopping, it is pointless and aggravating to have to wait in order to pay a bill which is always dismayingly high. Realizing this predicament, the vast brotherhood of grocers has expended no end of time, effort, genius, and chrome pipe to attain the elusive checkout system that works. To enumerate the various types would be to catalogue the food markets of America. They range from the single harried clerk wilting 'neath the frown of waiting customers from his multiple duties, to the deluxe five-man organization deployed into such a fussy division of labor that hardly anyone does anything and the process is just as long. The problem continues to plague the grocers and the public.

In 1950, the United States Department of Agriculture (evidently dismayed at the quantity of food spoilage while waiting at the checkout) launched a series of experiments in search of the ideal
checkout. After much research the U.S.D.A. came up with a flexible system which is fairly good. One to three clerks are used according to the need, and the cost per grocery order is kept at a satisfactory low figure.

Instead of ending the confusion, this merely set off a new series of experiments by individuals still seeking the ultimate checkout. While many adopted the U.S.D.A. system, more adapted it. Of the new developments, two have been selected and compared to the U.S.D.A. and normal checkout systems in table 7:

<table>
<thead>
<tr>
<th>No. of employees</th>
<th>Orders per hr.</th>
<th>Cost per Order in $</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ $1 per hour</td>
<td>$4.50 each</td>
<td></td>
</tr>
<tr>
<td>1 (Normal)</td>
<td>32</td>
<td>3.1</td>
</tr>
<tr>
<td>1 (U.S.D.A. Simplex)</td>
<td>44</td>
<td>2.3</td>
</tr>
<tr>
<td>2 (U.S.D.A. Rapi Check)</td>
<td>61</td>
<td>3.3</td>
</tr>
<tr>
<td>3 (      )</td>
<td>67</td>
<td>4.5</td>
</tr>
<tr>
<td>t</td>
<td>84</td>
<td>2.4</td>
</tr>
<tr>
<td>5 (Smith's No-Wait) ^</td>
<td>180</td>
<td>2.8</td>
</tr>
</tbody>
</table>

"Improving the Checkout System" J.S.D.A. Checkout Super Market Merchandising, Oct. 1950, p.141


"No-Wait" George T. Smith, Progressive Grocer, July 1951.
The last mentioned checkstand, the "No-Wait" was devised by a grocer named George T. Smith, and he has been so successful that he is now a manufacturer named George T. Smith. In as much as congestion at the checkouts would be fatal to the proper operation of the proposed market, this system has been selected.

**Pilferage**

There is hardly a single issue of the trade journals which fails to make some comment on the problem of pilferage. Many ingenious "underground" methods have been devised and discussed. The once-esteemed public rest room has been almost universally abolished since it is a nest for pilferers. See-through mirrors and mezzanine offices have been employed.

In this design, it is hoped that the simple open plan, by eliminating the multiple narrow aisles will reduce pilferage appreciably. The grocer is free to add his own secret devices.
Backroom Space

Backroom space is the general term which applies to that area used for the following purposes:

- Meat, Produce, and Dairy Coolers
- Meat and Produce preparation
- Dry Storage
- Delivery, receiving, unpacking
- Employees' rest rooms
- Mechanical Equipment

Results of the survey of similar supermarkets on backroom space requirements are given in Table 8:

<table>
<thead>
<tr>
<th>Department</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Ave.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td>80</td>
<td>75</td>
<td>--</td>
<td>85</td>
<td>130</td>
<td>62</td>
<td>--</td>
<td>86</td>
</tr>
<tr>
<td>Meat Cooler</td>
<td>40</td>
<td>50</td>
<td>83</td>
<td>57</td>
<td>62</td>
<td>96</td>
<td>62</td>
<td>71</td>
</tr>
<tr>
<td>Meat Prep.</td>
<td>24</td>
<td>35</td>
<td>25</td>
<td>34</td>
<td>26</td>
<td>50</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Produce</td>
<td>20</td>
<td>45</td>
<td>--</td>
<td>17</td>
<td>37</td>
<td>25</td>
<td>--</td>
<td>29</td>
</tr>
<tr>
<td>Dry Storage</td>
<td>40</td>
<td>37</td>
<td>--</td>
<td>125</td>
<td>224</td>
<td>147</td>
<td>--</td>
<td>115</td>
</tr>
<tr>
<td>Equipment</td>
<td>20</td>
<td>--</td>
<td>57</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>38</td>
</tr>
</tbody>
</table>

As may be seen some of these backrooms are rather grim spaces.
power conveyors for moving

inter-floor

Fixed
Floor-Veyor or Floor-Veyor, Jr.
movable
Rapid Power Booster

stacking use

Stevedore, Jr.
or Aluminum Stevedore
Rapid Power Booster

truck loading

Stevedore, Jr.
Aluminum Stevedore

bags, cartons, crates by low cost power

system booster

Fixed
Floor-Veyor, Jr.
movable
Stevedore, Jr.
movable
Rapid Power Booster

movable

Stevedore, Jr.
Rapid Power Booster

horizontal use

Table-Veyor

fixed

Floor-Veyor or Floor-Veyor, Jr.

Power-Veyor

Table-Veyor
In the proposed market, conditions previously noted have determined the use of a full basement. This is admirably suited to the installation of automatic systems, and the conveyors that they involve. An attempt has been made to obtain a logical and orderly progression of merchandise from the truck to the shelf. In addition a records office and adequate restrooms have become possible.

**Entrance and Orientation**

Access to the store has been provided from the bus stop and the main street for pedestrians, and from the parking lot for auto shoppers. On entering the store it is not necessary to fight through a cross current of empty bascarts, children, waiting people and leaving shoppers. An entry to the sales floor is convenient to each door. A service office is available for check cashing, bill paying, and information. A bottle return booth relieves the customer of empty bottles promptly. Waiting room for busses and friends is provided near the street entrance, also a tot's lot for the relief of harried mothers. These hardly need
justification, but it seems fitting to close this
dissertation with the comment of an enthusiastic
operator: "We have installed Kiddie Corrals. They
have been terrific. We provide comic books, the
head cashier gives the kids a sucker, and the kids
get their parents to bring them back to our store."
Structural Design

Roof Joists

Built up t & g roof on holorib steel deck with one inch insulation. B.S. longspan joists spaced 7.5 feet on center. Allowable snow load is 30 psf.

Live load 30 psf  
Dead load 6 psf  
Total load 36 psf  

Load per running foot is 36 x 7.5 or 273 prf  
Select B.S. #3212: Wt. per ft. 32 prf  
Total load 310 prf  
Allowable load 335 prf  
Balance for hung ceiling, etc. 25 prf  
or 3.5 psf.

End reaction is 60 x 335 or 10050 #

Roof Girder

Use rectangular section built up of two channel beams. Central load of 10.05 kips equivalent to uniform load of 20.1 kips. For a span of 15' laterally unsupported, the allowable load must be reduced.

Try 2 - 12 x 3 channels at 20.7 #/ft each.  
Allowable load is 2 x 19.0 or 38.0 kips.
\[ \frac{1}{b} = \frac{180}{6} = 30 \]

Reduction factor is 0.750

Net allowable load is \(0.750 \times 38.0\) or 28.5 kips.

Weight of channels is \(2 \times 15 \times 20.7\) or 0.62 kip.

Therefore, use 2 - 12 x 3 channels at 20.7 #/ft each.

**Columns**

Use rectangular section built up of two channel beams. Concentric load is the end reaction of two joists plus weight of girder or \(2 \times 10.05 + 0.62\) = 20.72 kips.

Height of columns is 19', hence the critical design factor will be the resistance to buckling on the unsupported side. Since the built-up sections will be used with the flat or under side unsupported, the radius of gyration about the \(y-y\) axis must be determined. Calculations are given only for the selected section.

Try 2 - 9 x 2\(\frac{1}{2}\) channels at 26.4 #/ft.

\[
\begin{align*}
I &= 3.6 \text{ in}^4 \\
A &= 7.78 \text{ in}^2 \\
z &= 1.82 \text{ in} \\
Az^2 &= 25.8 \text{ in}^4 \\
r^2 &= \frac{(I + Az^2)}{A} \\
r &= 1.94 \text{ in.} \\
\frac{1}{r} &= \frac{228}{1.94} \text{ or } 117.5
\end{align*}
\]
Allowable stress is 10.3 ksi
Allowable load is 10.3 x 7.78 or 80 kips
Therefore use 2 - 9 x 2\(\frac{1}{2}\) channels at 26.4#/ft
to form a rectangular section.

**Floor Slab**

Live loads in supermarkets often come high due to heavy stocking, therefore a live load of 250 psf will be taken. A two-way reinforced concrete flat slab subdivided into 15' square panels supported on r.c. columns (without drop panels) will be designed.

Concretes:  \(f'_c = 2500\) psi
\(f_c = 1150\) psi
\(k = 0.196\)

Loading:  Live load = 250 psf
Dead load = 100 psf (8" slab)
Total panel load=15 x 15 x 350
or 79 kips.

Moments: Positive and negative moments \(M\)
\(M_c=0.09WL(1-\frac{a}{2L})^2=80\) kips
\(M_{max}(Col.\ stripe,\ interior\ neg.)\)
\(=0.50\times80=40\) kips.
Depth:  
\( b = \text{width of flexural member} = \frac{3}{4} \times 7.5 \times 12. \)

\( b = 67.5" \)

\( d = \frac{(M_{\text{max}})^{\frac{1}{2}}}{bk} = 6.02" \)

Add clearance 0.75"

Add steel \( \left( \frac{1}{2} \times \#6 \right) 0.38" \)

---

Depth \( d = 7.15" \)

Use 8" slab

So \( d = 8 - 0.75 - 0.38 = 6.87" \)

**Shear**

Unit stress shall not exceed 0.03 \( f_c' \) or 75 psi.

Use a 3' square capital on a 1' square column.

\( b/4 = 36 + 2(8 - 1.5) = 49" \)

\( b = 196" \)

\( d = 6.87" \)

\( j = 0.87 \)

\( V = 79 \text{ kips} \)

\( v = \frac{V}{bjd} = 67.5 \text{ psi}, \text{ therefore o.k.} \)

Minimum steel:

\( A_s = 0.0025 \times 6.87 \times 12 = 0.206 \text{ sq.in./ft.} \)

**Reinforcing Rod Schedule:**

\( j = 0.87 \)
\[ f_s = 20000 \text{ psi} \]
\[ d = 6.87 \text{ in.} \]
\[ M_o = 80 \text{ k} \]
\[ A_s = \frac{M}{f_s j d} \]

<table>
<thead>
<tr>
<th>Col. Strip Ext. Panel</th>
<th>Coeff.</th>
<th>M</th>
<th>(A_s) (E-W)</th>
<th>(A_s) (N-S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Ext. Neg.</td>
<td>0.41</td>
<td>32.8</td>
<td>3.32</td>
<td>3.72</td>
</tr>
<tr>
<td>Top Int. Neg.</td>
<td>0.50</td>
<td>40.0</td>
<td>4.05</td>
<td>4.53</td>
</tr>
<tr>
<td>Bottom Pos.</td>
<td>0.28</td>
<td>22.4</td>
<td>2.27</td>
<td>2.54</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Col. Strip Int. Panel</th>
<th>Coeff.</th>
<th>M</th>
<th>(A_s) (E-W)</th>
<th>(A_s) (N-S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Neg. Support</td>
<td>0.46</td>
<td>36.8</td>
<td>3.72</td>
<td>4.17</td>
</tr>
<tr>
<td>Bottom Pos.</td>
<td>0.22</td>
<td>17.6</td>
<td>1.78</td>
<td>2.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mid Strip Ext. Panel</th>
<th>Coeff.</th>
<th>M</th>
<th>(A_s) (E-W)</th>
<th>(A_s) (N-S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Ext. Neg.</td>
<td>0.10</td>
<td>8.0</td>
<td>0.81*</td>
<td>0.91*</td>
</tr>
<tr>
<td>Top Int. Neg.</td>
<td>0.176</td>
<td>14.1</td>
<td>1.43*</td>
<td>1.62</td>
</tr>
<tr>
<td>Bottom Pos.</td>
<td>0.20</td>
<td>16.1</td>
<td>1.62</td>
<td>1.82</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mid Strip Int. Panel</th>
<th>Coeff.</th>
<th>M</th>
<th>(A_s) (E-W)</th>
<th>(A_s) (N-S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Neg. Support</td>
<td>0.16</td>
<td>12.8</td>
<td>1.30*</td>
<td>1.45*</td>
</tr>
<tr>
<td>Bottom Pos.</td>
<td>0.16</td>
<td>12.8</td>
<td>1.30*</td>
<td>1.45*</td>
</tr>
</tbody>
</table>

* Use minimum steel in these cases, or 1.50 sq. in.
Basement Columns

Design by formula

\[ P = 0.8 A_g (0.225 f'_c + f_s p_g) \]

where \( P \) = load = 79000#

\( A_g = \) gross cross section = 144 sq. in.

\( f'_c = 2500 \) psi

\( f_s = 20000 \) psi

\( p_g = \) ratio steel to concrete on horizontal section.

\( p_g = 0.00615 \)

\( A_s = p_g A_g = 0.00615 \times 144 = 0.885 \) sq. in.
DESIGN CALCULATIONS FOR CENTRAL SYSTEM AIR-CONDITIONING

Cooling Load

**Step 1** Selection of temperature and relative humidity which are to be maintained in the conditioned space.
- Dry-bulb temperature (dbt) 80° F
- Relative humidity (rel. hum.) 50%

**Step 2** Selection of outdoor dry-bulb and wet-bulb temperatures to be assumed.
- dbt = 92° F
- wbt = 77.2° F

**Step 3** Estimation of maximum heat gains.

a. Sensible heat gain through south windows and door.
   - A = 2100 sq. ft.
   - Heat gain 3 p.m. Aug. 1 = 23 BTU/sq. ft./hr. (Heat absorbing glass).
   - \( H_a = 23 \times 2100 = 48000 \) BTU/hr.

b. West wall.
   - \( A_b = 60 \times 20 = 1200 \) sq. ft.
   - Heat gain = 2 BTU/sq. ft./hr. (Masonry, 12 in., insulated)
   - \( H_b = 2 \times 1200 = 2400 \) BTU/hr.

c. North windows.
   - \( H_c = 8 \times 2000 = 16000 \) BTU/hr.
d. East wall.

\[ H_d = 1 \times 1200 = 1200 \text{ BTU/hr.} \]

e. Roof.

\[ A = 60 \times 105 = 6300 \text{ sq. ft.} \]
\[ U = 0.16 \text{ BTU/sq. ft./hr. (summer)} \]
\[ \Delta t = 92-80 = 12 \]
\[ H_c = 6300 \times 0.16 \times 12 = 12100 \text{ BTU/hr.} \]

f. Interior lighting.

Fluorescent lamps and spotlights @ 26 kw.

\[ H_f = 3.416 \times 26000 = 89000 \text{ BTU/hr.} \]

g. Occupants, @ 150.

Sensible \( H_o = 225 \times 150 = 33600 \text{ BTU/hr.} \)

Latent \( H_l = 375 \times 150 = 56200 \text{ BTU/hr.} \)

h. Outside air (10 cfm/person)

Weight of dry air \[ = \frac{150 \times 10 \times 60}{14.27} = 6300 \text{ #/hr.} \]

Total heat gain \[ = W(h_o - h_v) = 6300(40.6 - 31.4) = 56000 \text{ BTU/hr.} \]

Moisture \[ = \frac{W(m_o - m_i)}{7000} = \frac{6300(118 - 76.5)}{7000} \]
\[ = 37.4 \text{ #/hr.} \]

Latent \( H_h = W \times f_{h_d} = 37.4 \times 1050 = 39200 \text{ BTU/hr.} \)

Sensible \( H_s = 58000 - 39200 = 18800 \text{ BTU/hr.} \)
### Heat gain BTU/hr.

<table>
<thead>
<tr>
<th>Heat gain BTU/hr.</th>
<th>Sensible</th>
<th>Latent</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_a$</td>
<td>46000</td>
<td></td>
</tr>
<tr>
<td>$H_b$</td>
<td>2400</td>
<td></td>
</tr>
<tr>
<td>$H_c$</td>
<td>16000</td>
<td></td>
</tr>
<tr>
<td>$H_d$</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>$H_e$</td>
<td>12100</td>
<td></td>
</tr>
<tr>
<td>$H_f$</td>
<td>89000</td>
<td></td>
</tr>
<tr>
<td>$H_g$</td>
<td>33600</td>
<td>36200</td>
</tr>
<tr>
<td>$H_h$</td>
<td>12300</td>
<td>39200</td>
</tr>
<tr>
<td>$H$</td>
<td>222400</td>
<td>95400</td>
</tr>
</tbody>
</table>

(+) Latent 95400

Max. Heat Gain 317500

(-) Ventilating Air 58000

Cooling Load 259000 BTU/hr.

**Step 4**

Calculation of sensible heat factor and dew point temperature for summer conditions.

$$\text{Factor} = \frac{\text{sensible heat load}}{\text{total load}} = \frac{203600}{259000} = 0.785$$

Dew point temperature, from chart @ 55°F.

**Step 5**

Calculation of weight of dry air to be cooled and dehumidified under summer conditions.

$$W = \frac{\text{Total heat}}{(h_r - h_c)} = \frac{259000}{(31.2 - 23.2)} = 32500 \text{#/hr.}$$
Step 6  Calculation of weights and volumes of air to be handled by the different parts of the system.

Weight of dry air:  6300 #/hr.

Volume of dry air:  $6300 \times \frac{14.27}{60} = 1500 \text{ cfm}$

Weight of recirculated air:  32500 - 6300 = 26200 #/hr.

Volume of recirculated air:  $26200 \times \frac{13.84}{60} = 6050 \text{ cfm}$

Weight of dry and recirculated air:  32500 #/hr.

Specific volume of recirculated air:  13.95 cu.ft./#

Dry bulb temperature of recirculated air:  83.2° F

Volume of mixture air to dehumidifying section:

$32500 \times \frac{13.95}{60} = 7550 \text{ cfm}$

Specific volume of cooled and dehumidified air at 55° F:  13.16 cu.ft./#

Volume of cooled and dehumidified air:

$32500 \times \frac{13.16}{60} = 7100 \text{ cfm}$

Volume of by-passed air:  $32500 \times \frac{13.64}{60} = 7500 \text{ cfm}$

at 68° F and 13.51 cu.ft./#

Fan and discharge duct volume:

$65000 \times \frac{13.51}{60} = 14650 \text{ cfm}$

Step 7  Calculation of refrigeration capacity required.

Heat to be removed from mixture of fresh and recirculated air:
\[ H_c = (\dot{m}_o h_o + \dot{m}_r h_r) - (\dot{m}_o + \dot{m}_r) h_{\infty} \]

\( h_o \) = outside air enthalpy \\
\( h_r \) = room air enthalpy \\
\( h_{\infty} \) = entering air enthalpy

\[ H_c = (6300 \times 40.6) + (26200 \times 31.2) - 32500 \times 23.2 \]

\( H_c = 318000 \) BTU/hr.

This checks with total load of 317800 BTU/hr.

Refrigeration capacity required:

\[ \frac{318000}{12000} = 26.5 \text{ tons}. \]

**Heating Load**

**Step 8**

Selection of indoor temperature and relative humidity for winter operation.

Rel. hum. not practical above 30%

Dry bulb temp. at 72° F

Effective temp. is 66° F

**Step 9**

Selection of winter outdoor design temperature.

Assume -8° F

**Step 10**

Estimation of heat losses.

a. Glass walls.
   \[ A = 3705 \text{ sq. ft.} \]
   \[ U = 1.13 \text{ BTU/sq. ft./hr} \]
   \[ \Delta t = 72 - (-8) = 80° \]
   \[ H_a = 3705 \times 1.13 \times 80 = 335000 \text{ BTU/hr}. \]

b. Masonry Walls (12").
\[ A = 2400 \quad U = 0.19 \quad \Delta t = 80 \]
\[ H_b = 2400 \times 0.19 \times 80 = 36500 \text{ BTU/hr.} \]

c. Roof (built-up insulated)
\[ A = 6300 \quad V = 0.19 \quad \Delta t = 80 \]
\[ H_c = 6300 \times 0.19 \times 80 = 95500 \text{ BTU/hr.} \]

d. Basement wall (assume ground temp. of 32° F)
\[ A = 3300 \quad U = 0.1 \quad \Delta t = 72 - 32 = 40 \]
\[ H_d = 3300 \times 0.1 \times 40 = 13200 \text{ BTU/hr.} \]

e. Basement floor (assume ground temp. of 52° F)
\[ A = 6300 \quad U = 0.1 \quad \Delta t = 72 - 52 = 20 \]
\[ H_e = 6300 \times 0.1 \times 20 = 12600 \text{ BTU/hr.} \]

f. Infiltration loss.

Total volume lost calculated at 9387 cu.ft./hr but since fresh air used is 90000 cu.ft./hr the infiltration loss may be neglected.

Total heat loss is 492800 BTU/hr.

**Step 11**

Calculations of the weights and volumes of air handled under winter design conditions.

Specific volume of saturated air at -8° F
11.39 cu.ft./#

Allowing 10 cfm per person, weight of air
\[
\frac{10 \times 150 \times 60}{11.39} = 7900 \text{ #/hr.} \]

Weight of air processed
\[
\frac{7100 \times 60}{14.2} = 29300 \text{ #/hr.} \]

Weight of recirculated air
\[
29300 - 7900 = 21400 \text{ #/hr.} \]
Volume of recirculated air:

\[ 21400 \times 13.5 = 4820 \text{ cfm.} \]

\[ \frac{4820}{60} \]

**Step 12** Estimation of heating capacity required in the preheater coil. Dew point temp. of indoor air is 38.5° F.

Enthalpy of mixture air (outdoor plus recirculated)

\[ \frac{(7800 \times 0.5) + (21400 \times 22.8)}{29300} = 16.8 \text{ BTU/\# dry air} \]

Since this is greater than the enthalpy at 38.5° F, no preheating is required.

**Step 13** Estimation of amount of steam required for heating the spray water.

None required as in step 12.

**Step 14** Estimation of the heating capacity required in the reheating coil.

Maximum heat required from air delivered to room:

\[ \frac{492300}{29300} = 16.8 \text{ BTU/\#} \]

Enthalpy of air leaving reheater coil

\[ 22.8 + 16.8 = 39.6 \text{ BTU/\#} \]

Maximum heat output of reheat coil

\[ 29300 (39.6 - 16.8) = 668000 \text{ BTU/hr.} \]

Air temperature leaving coil @ 115° F.

**Air Duct Design**
Step 15  Ductwork from fan to outlet. Air volume handled, 

\[ Q = 14650 \text{ cfm}. \]  
At STP

\[ Q = 14650 \left( \frac{0.0745}{0.075} \right) = 14550 \text{ cfm}. \]

With eight outlets each handles 2430 cfm. For minimum noise trunk duct velocity is selected at 1400 fpm. The equal friction method will be used throughout.

a. Sizing to plenum. (Using Friction Charts).

\[ Q \text{ is } 14550 \text{ cfm}. \quad V \text{ is } 1400 \text{ fpm}. \]

Diameter of duct is 43".

Static pressure loss is 0.05"/100' 

b. To outlet.

\[ Q \text{ is } 2430 \text{ cfm}. \]

D is 22" or 20" x 20"

\[ V \text{ is } 900 \text{ fpm} \]

Grille velocity is 600 fpm.

Step 16  Ducts from room to system (return). Air volume handled is 13600 cfm. Six returns. Static pressure loss is 0.05"/100' (constant).

a. Grille velocity is 300 fpm. Sizing to first branch.

\[ Q \text{ is } 3400 \text{ cfm}. \]

\[ V \text{ is } 1000 \text{ fpm} \]

D is 25".
b. To second branch.
   \[ Q = 6800 \text{ cfm} \]
   \[ V = 1150 \text{ fpm} \]
   \[ D = 32" \]

c. To trunk duct
   \[ Q = 13600 \text{ cfm} \]
   \[ V = 1400 \text{ fpm} \]
   \[ D = 43" \]

**Step 17**  
Duct for fresh air. Volume is 1500 cfm. Grille velocity is 300 fpm. Static pressure loss remains constant.
   \[ V = 800 \text{ fpm} \]
   \[ D = 19" \]

**Step 18**  
Calculation of static pressure losses in supply duct system.

a. Trunk duct.
   Length is 24'.
   Pressure loss is \[ \frac{24}{100} \times 0.05 = 0.12" \]

b. Plenum.
   Pressure loss is \[ C \left( \frac{V}{4005} \right)^2 \approx 0.039" \]

c. Longest run straight duct is 100'.
   Pressure loss is \[ \frac{100}{100} \times 0.05 = 0.050" \]
Two elbows

\[ 2 \times 0.18 \times \left( \frac{900}{1096} \right)^2 \times 0.075 \text{ or } 0.019" \]

Grille

\[ 1.25 \times \left( \frac{600}{1096} \right)^2 \times 0.075 \text{ or } 0.028" \]

d. Total (abc) is 0.148"

**Step 19** Calculation of static pressure loss in return duct system.

a. Straight duct work

Length is 92 ft.

Loss is \((92/100) \times 0.05 = 0.046"\)

b. Elbows as above

\#1 and \#2 \( VP = \left( \frac{1000}{1096} \right)^2 \times 0.075 \)

VP is 0.062" each or 0.124"

\#3 and \#4 \( VP = \left( \frac{1400}{1096} \right)^2 \times 0.075 \)

VP is 0.122" each or 0.244"

Elbow loss is 0.18(0.124 + 0.244) = 0.066".

c. Grille loss

\[ VP \text{ is } \left( \frac{300}{1096} \right)^2 \times 0.075 = 0.0056" \]

Loss is 1.25 \times 0.0056 = 0.007"

d. Total of abc is 0.102"

**Step 20** Calculation of static pressure loss in fresh air duct system.
a. Straight duct length is 50 ft.
   Loss is \( \frac{50}{100} \times 0.05 = 0.025" \)

b. Elbows as above
   
   \#1 and \#2 \( VP = \left(\frac{800}{1096}\right)^2 \times 0.075 \)
   
   VP is 0.04 each or 0.08
   
   Loss is 0.18 x 0.08 or 0.014"

c. Grille loss is 1.25 VP

   \( VP = \left(\frac{300}{1096}\right)^2 \times 0.075 \) or 0.0056
   
   Loss is 1.25 \times 0.0056 or 0.007"

d. Total abc is 0.046"

**Step 21** Calculation of static pressure loss in equipment.

<table>
<thead>
<tr>
<th>Component</th>
<th>Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter</td>
<td>0.14&quot;</td>
</tr>
<tr>
<td>(mfg)*</td>
<td></td>
</tr>
<tr>
<td>Heater (2 rows)</td>
<td>0.08&quot;</td>
</tr>
<tr>
<td>(mfg)</td>
<td></td>
</tr>
<tr>
<td>Cooler (6 rows)</td>
<td>0.36&quot;</td>
</tr>
<tr>
<td>(mfg)</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.58&quot;</td>
</tr>
</tbody>
</table>

**Step 22** Selection of fan for system.

Equipment loss plus duct loss gives total loss of 0.876" of water.

Select unit no. AH 150, 5 hp motor to operate at 475 RPM with air volume of 15000 cfm and fan diameter of 21". Use 2 fans.

---

* Bush Manufacturing Co., West Hartford, Conn.*
Step 23  Selection of equipment.

a. Water coil, 6 rows, capacity 320000 BTU/hr at required conditions.

b. Heater coil, 2 rows, standard steam coils at 5# steam, capacity 745503 BTU/hr at required conditions.

c. Vertical air handling unit, model no. VAH 150 with humidifiers and flat type filter sections.
IDENTIFICATION OF STORES USED IN SURVEY FOR THIS THESIS

A. "This is the store I'd like to own." by R.O. Harb, National Service Manager, Red & White Stores - National Grocers Bulletin, Apr. 49, p. 38.


H. "Josephs Food Town", Toledo, Ohio, Progressive Grocer, Feb. 50, p. 75.


K. Park Save Super Market, Tiffin, Ohio, National Grocers Bulletin, Apr. 52, p. 32.
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Bush Manufacturing Co. Catalogue No. 425
July 15, 1952

Mr. Salem K. Shaheen
6 Westgate
Cambridge, Massachusetts

Dear Mr. Shaheen:

We acknowledge receipt of your recent letter requesting Data on Conveyors for use in Super Markets.

To date, our activity in this Field has been confined primarily to Portable and Stationary Conveyors for Floor to Floor Operation. Literature is enclosed covering our various Package Handling Conveyors, and we call your attention to the Model "436" shown on page eight. This is the Model that has been furnished to most Super Markets. We are also enclosing a copy of a new Publication entitled "Owners Report", which we also think will be of interest to you. The Photograph in the lower right hand corner on page six illustrates a Conveyor handling Cases of Merchandise from Basement Storage to the first floor Sales Room. In some instances, this Conveyor comes onto the Sales Floor in the rear, while in other instances, it comes right into the center of the Store and has Display Cases built around it to conceal it when not in use.

Most of the Floor to Floor Conveyors that we have furnished are permanently installed, however, there is one Chain who is using Portable Units, which can be moved in and out of position, and even transferred from one Store to another, if necessary.

Conveyors are being used for some other Super Market Operations, however, we have not gotten into those to date. Such Operations include a little light machine for use on the Cashier's Counter in checking Merchandise. One Chain has gone into the Installation of long Conveyors from the check out point to a certain point in a Parking Lot. You have probably received the same information that we have about that type of unit.
July 15, 1952

Salem K. Shaheen  
6 Westgate  
Cambridge, Massachusetts  

Dear Mr. Shaheen:  

In regards to your letter of July 10th, enclosed please find all our latest circulars on our "Quik-Chek" Conveyor Checkout Counters.  

We believe that these circulars will help you considerably with your thesis and if there is any additional information you need in regard to our unit, please advise and we would be only too pleased to be of further service.  

Yours very truly,  

THE ROBERT BECHT COMPANY

RHB:gm

Encls.
July 10, 1952

Mr. Salem K. Shaheen  
6 Westgate  
Cambridge, Mass.

Dear Mr. Shaheen:

We were very flattered to learn from your letter that while preparing your thesis on automatic merchandising in supermarkets, you have run into numerous references to our equipment.

At the present time Food-O-Mats are being used in four or five hundred supermarkets, both large and small, and both independently and by chain store organizations throughout the country. We have also have several units in operation in foreign countries, such as Venezuela, Bermuda, The Virgin Islands, Cuba and Switzerland.

The enclosed informational brochure will give you dimensions of our equipment, together with pictures and points which I feel will be helpful to you.

Our most recent development has been the new Deluxe Model Unit, which is described in the brochure. While we are constantly working on the improvement in design and use of our fixtures, we do not have any definite project for our supermarket unit under way at the present time.

You might like to know that there is a very lively interest in the self-service method of merchandising on the part of drug operators throughout the country. A number of installations of our equipment have already been made in drug stores and drug departments of department stores. At the present time we are working on a modification of our basic equipment, which will make it even more suitable for use in a smaller drug store.

I hope this information will prove of value to you and if in the further preparation of your thesis we can furnish you with any further information, do not hesitate to write us.

Cordially yours,

William L. Greville  
Sales Manager

Encls.
Mr. Salem K. Shaheen
6 Westgate
Cambridge, Mass.

Dear Mr. Shaheen:

Thank you for your letter requesting a copy of our 1952 Market Book.

Unfortunately, the printing of this booklet has been somewhat delayed, but as soon as it is received from our printers we will be pleased to send you a copy of it.

In the meantime, we are sending you herewith a copy of the September, 1951 edition of our "Indiana's Golden Zone" book, which we believe will be of interest to you.

Yours very truly,

FORT WAYNE NEWSPAPERS, Inc.,

Manager, General Advertising

P H Knapp'R