THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

HORTICULTURAL PACKING SHEDS

FOR

THE CLYDE VALLEY

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INTRODUCTION

In recent years production on horticultural holdings in the West of Scotland has been increasing. The Clyde Valley was one of the earliest areas in Scotland to embark on horticultural enterprises and some of the original packing sheds are no longer large enough or are now out of date. In this report, the requirements of a modern packing shed are considered, bearing in mind the need for ease of working and for the minimum use of labour. Suggestions are made for layout plans of typical sheds to suit three different sizes of business. The report is based on studies of tomato grading and flower packing made in recent years.

Tomatoes are the principal crop grown in the area and they are often associated with the production of flowers in the winter and spring - usually bulb crops or chrysanthemums. The different sizes of business are measured by the output of one day's tomato grading at the peak period. These outputs are shown in Table I together with the approximate area of glass from which they might be produced.

Table I

Plan	No. of Boxes a Day	Approximate area of Glass
I	100	$\frac{1}{3}$ acre
II	300	1 acre
III	750	$2\frac{1}{2}$ acres

The layout of a shed for grading the required quantity of tomatoes was first designed and the size of shed determined. Then a lay-out was planned for bunching and packing flowers within this shed, and the number of flowers which could be processed was calculated. These calculations were based on the production of bulb flowers, but it is probable that larger quantities of chrysanthemums could be packed.

SOME GENERAL REQUIREMENTS OF PACKING SHEDS

On some nurseries the packing of produce is carried out in any shed which happens to be available, but it may not necessarily be well adapted to the purpose. With the ever-rising cost of labour and the difficulty, in some areas, of obtaining suitable workers, growers must seize every opportunity of reducing the amount of work needed to complete essential tasks. In a well designed and well laid out packing shed, work can be saved so that the day's output can be packed in less time or with fewer workers.

There are certain basic requirements for a good packing shed and these are as follows:

1. The packing shed should be near the glasshouses, preferably in a central position so that transport to and from it is at a minimum.

2. Care must be taken that it is sufficiently far away from the glasshouses not to cast a shadow upon them.

3. There should be easy access for lorries by a hard road.

4. There should be ample space for the lorries to turn. A wide yard in front of the shed would be suitable, or it might be more convenient to make a roadway round it.

5. The packing shed should be large enough to accommodate the maximum quantity of produce to be packed in a day, as well as to store a season's supply of packing materials. Where large quantities of materials are required, it may be that only part of the year's supply is stored at a time, but as there is an increasing tendency for a rebate on large consignments, it is advisable to design the shed large enough for a full season's supply.

6. There is an advantage in having the packing materials stored in the packing shed rather than in another shed some distance away, as transport is saved.

7. It is desirable to build the shed a little larger than required, to allow for possible expansion of the business, but if there is too much surplus space, there is a danger that it will be used for storage of all sorts of goods, leading to untidiness and a general lowering of efficiency.

8. The places where the operators are working should be well lit, and this is particularly true of points where grading is being done. For grading, the best form of lighting is daylight. While adequate lighting is essential, too large an area of glass may result in the shed becoming too hot. To prevent this, windows and roof-lights would normally face north, thus avoiding direct rays from the sun. Artificial light may be needed for packing during the winter time.

9. For flower packing in the winter, heaters will be required at the working areas, but it is usually desirable that the areas where the flowers are being kept should be cool. The use of infra-red electric radiators at the working points should be considered as they direct the heat to the areas where it is required and only a little diffuses to the rest of the shed.

PACKING SHED PLANS

Data from which the plans have been built up are given in Appendices 1 to 4. Appendix 1 gives details of the dimensions and space occupied by the various items of packing equipment and materials. Appendices 2, 3 and 4 show the specifications and stores required for each size of business.

In designing the layout for tomatoes it was decided to standardise on boxes for despatch to market rather than baskets. It was considered that the amount of fruit marketed in boxes was likely to increase while the use of baskets would probably decrease. Nevertheless, the extra space that would be required if baskets were used is mentioned under each plan.

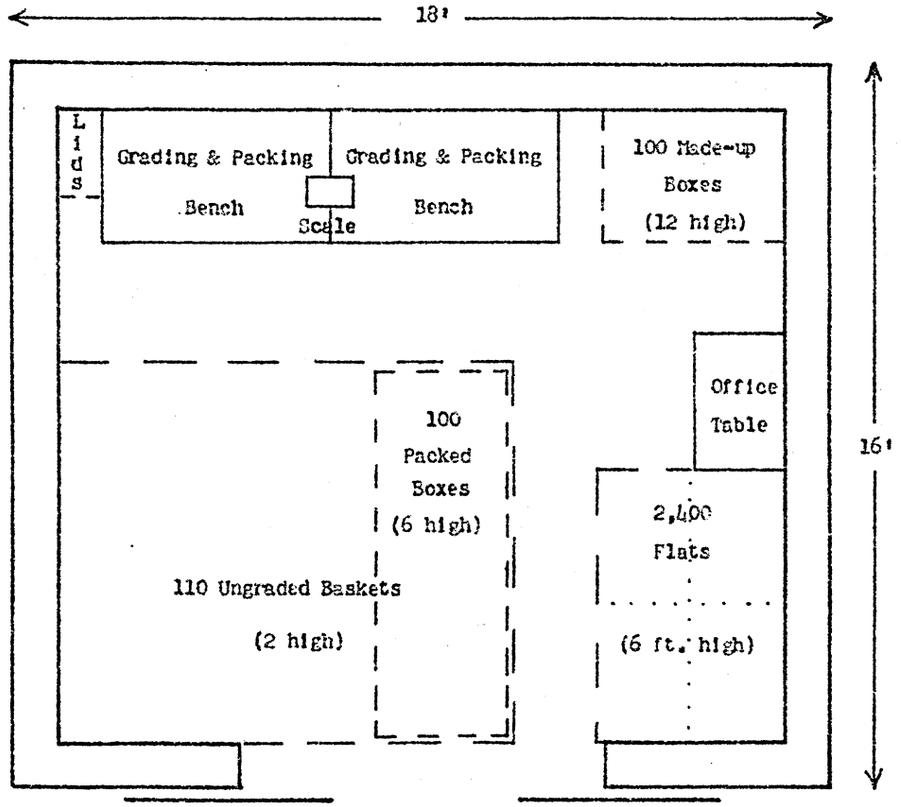
The plans are intended to give an example of a good layout which would enable all the necessary work to be carried on without waste of time or effort. Each represents the smallest size of shed in which the given quantity of tomatoes could be packed conveniently and efficiently. As stated previously, they are designed initially for tomato grading, but where the space required for grading the flower crop is greater than that needed for tomatoes, the design of the shed must be based on flower grading, and the tomato grading layout fitted into it.

PACKING SHED

PLAN I TOMATOES

Scale $\frac{1}{4}$" = 1 ft.

PRODUCTION: 100 boxes per day



Plan I Tomatoes. Output: 100 boxes a day

The layout is suitable for operation by a grower with about $\frac{1}{3}$ acre of glass. The time required for grading 100 boxes by hand would be 3 to $3\frac{1}{2}$ hours, depending on the quality of the crop. One grading table is sufficient, but two are shown in case it is necessary to have two persons to complete the job more quickly.

The layout is planned for the ungraded baskets to be stacked on the shed floor two high. The baskets must not be filled too full, as otherwise the fruit would be bruised. Some growers prefer to fill the baskets full - up to 18 lb. weight - so that fewer baskets have to be carried from the tomato house and in this case, they must be placed in a single layer on the floor. In order to make room for this arrangement, the space required for ungraded baskets would have to be at least half as large again as at present, and the length of the shed would therefore have to be increased by 4 ft.

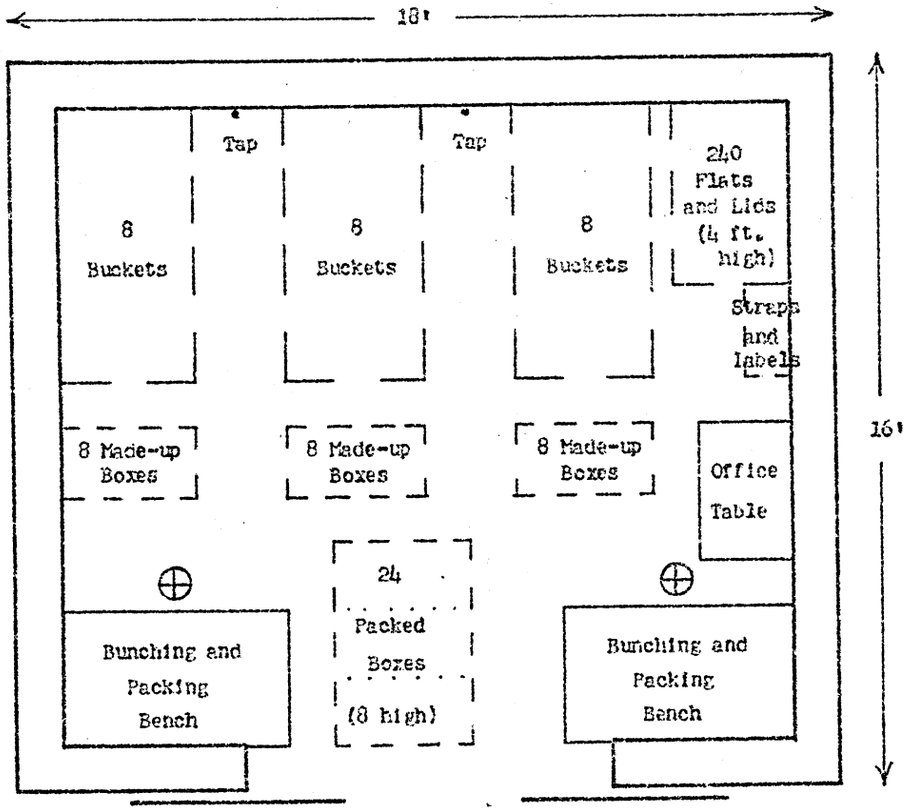
If it is intended to pack the fruit in baskets instead of boxes, the space for made up boxes would not be required, but more room would be needed for storing baskets, lining paper and lids, and the length of the packing shed would have to be increased 3 ft.

Method of Operation Tomatoes are brought in to the shed and set down in the area marked "Unagraded baskets". The area shown as "packed boxes" is cleared first so that the boxes can be stacked there after grading. This area is sited near the door for ease of loading on a lorry for despatch. The made up boxes are set down as near the grading and packing bench as convenient.

PACKING SHED

PLAN I FLOWERS

Scale $\frac{1}{4}$" = 1 ft. ⊕ = Worker PRODUCTION: 24 boxes per day



Plan I Layout for Flowers

The layout is designed primarily for bulb flowers and provides for them to be debulbed if necessary, bunched and packed in the shed. Where a different crop, such as chrysanthemums, is being packed some modification to the details may be required, but the basic principles of layout remain the same.

In order to provide easy access, the buckets are set out in double rows with two-foot passageways between. The part of the floor on which the buckets stand will have a slight slope towards a drain so that buckets can be emptied in situ and replaced. They would be filled with water from a hose. The direction of the slope and the siting of the drains are not shown as they will depend on the situation and slope of the land and the position of the main drains.

It would be possible to have the rows of buckets double-decked by putting a second tier on shelving above the first. In this way the number of buckets which could be accommodated would be doubled. If this were done, the storage of flats would present a problem because doubling the output would necessitate storing the flats up to 8 ft. high, which is too high for convenient working. It may be that some 120 flats could be stored in another place, or alternatively, it might be better to have only half the bucket area double-decked.

Another way of increasing the number of buckets at a peak period would be to set 8 buckets out in each of the passageways as the flowers are put in. They would have to be taken up and nested as flowers are removed, in order to gain access to the other buckets. This method is suitable for an emergency but as it takes extra time, it is not recommended for general use.

Where there is any danger of the floor being damp near the bucket area, it would be advisable to store the flats on a low wooden platform or stillage (4" to 6" high) to ensure that they were kept dry. The stacks of made up boxes might also have to be set on a stillage. Water taps are shown in the most convenient position for attaching the hose to fill buckets.

Method of Operation Flowers are brought from the growing houses to the two bunching and packing tables, debulbed if necessary, bunched and then taken to the buckets. Boxes are made up when convenient and set in the positions shown. When packing, the flowers are removed from the buckets and carried to the bunching and packing tables, where they are packed and the packed boxes stored near the door.

PACKING SHED

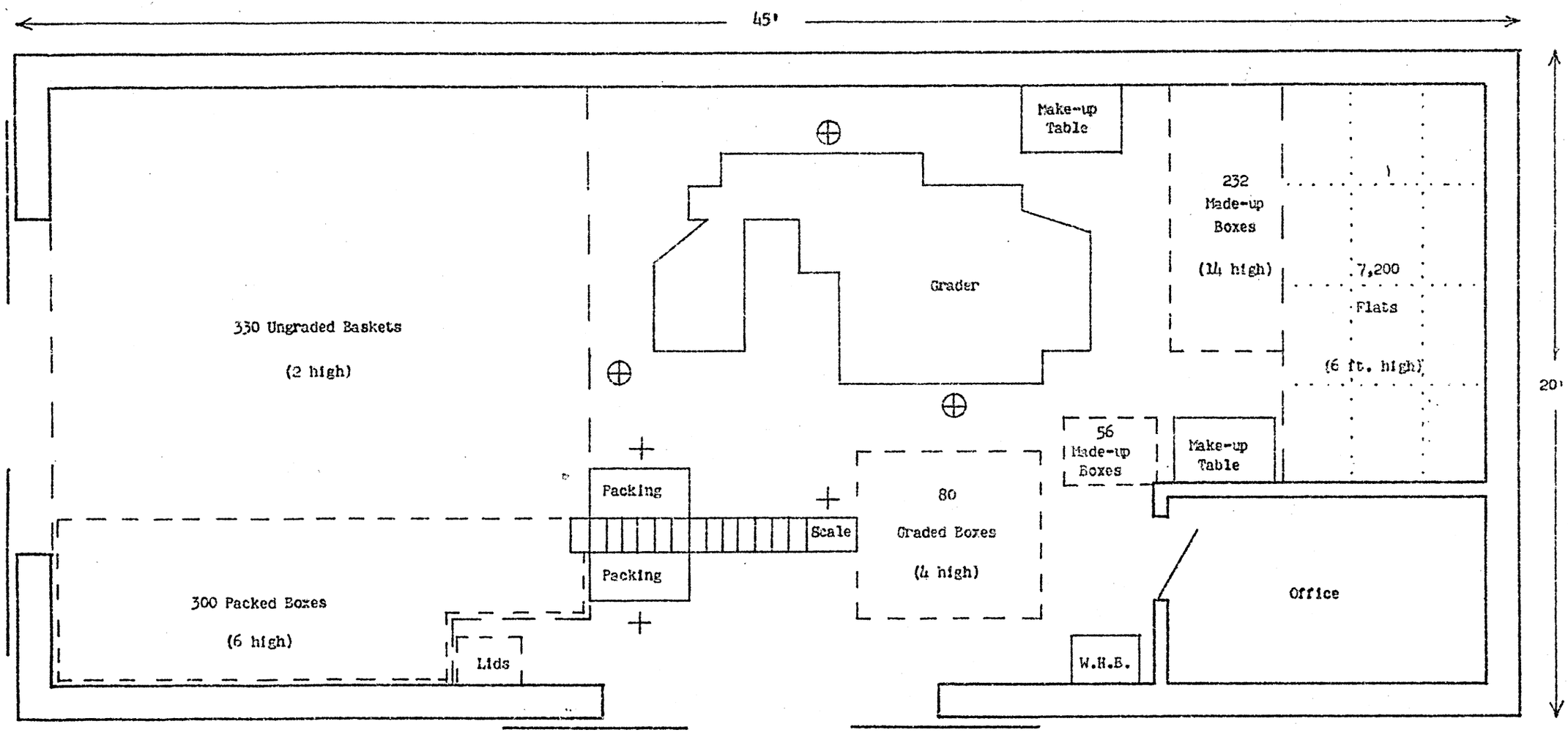
PLAN II TOMATOES

Scale ¼" = 1 ft.

⊕ = Worker 1st Stage

\+ = Worker 2nd Stage

PRODUCTION: 300 boxes per day



Plan II Tomatoes. Output: 300 boxes a day

This plan is designed primarily for use with a rotary grader where only three or four workers are available. The work is divided into two parts and carried out in batches. Tomatoes are graded and the graded boxes stacked beside the weighing machine. It might be an advantage to stack them on a low table or platform to save having to lift them off the ground. When a batch has been graded, the workers then proceed to the second stage. One worker weighs the boxes while two workers pack and stack the boxes. A portable conveyor might be used to move boxes from the packing tables to the stacking point. When a fourth worker is available, he or she would unload boxes from the conveyor and stack them.

Provision has been made for 80 graded boxes, on the assumption that the day's grading will be divided into four batches. On this system it would be possible for a team of three workers to make up boxes, grade and pack 300 baskets in $2\frac{1}{2}$ to 3 hours, depending on the quality of the fruit.

If 6 or 7 workers are available, grading and packing could be carried out simultaneously. The stack of graded boxes would not be needed and a short conveyor might be installed to run from the main taking off point at the grader to the weighing machine. If this number of workers were always available it would be better to have a layout similar to Plan III.

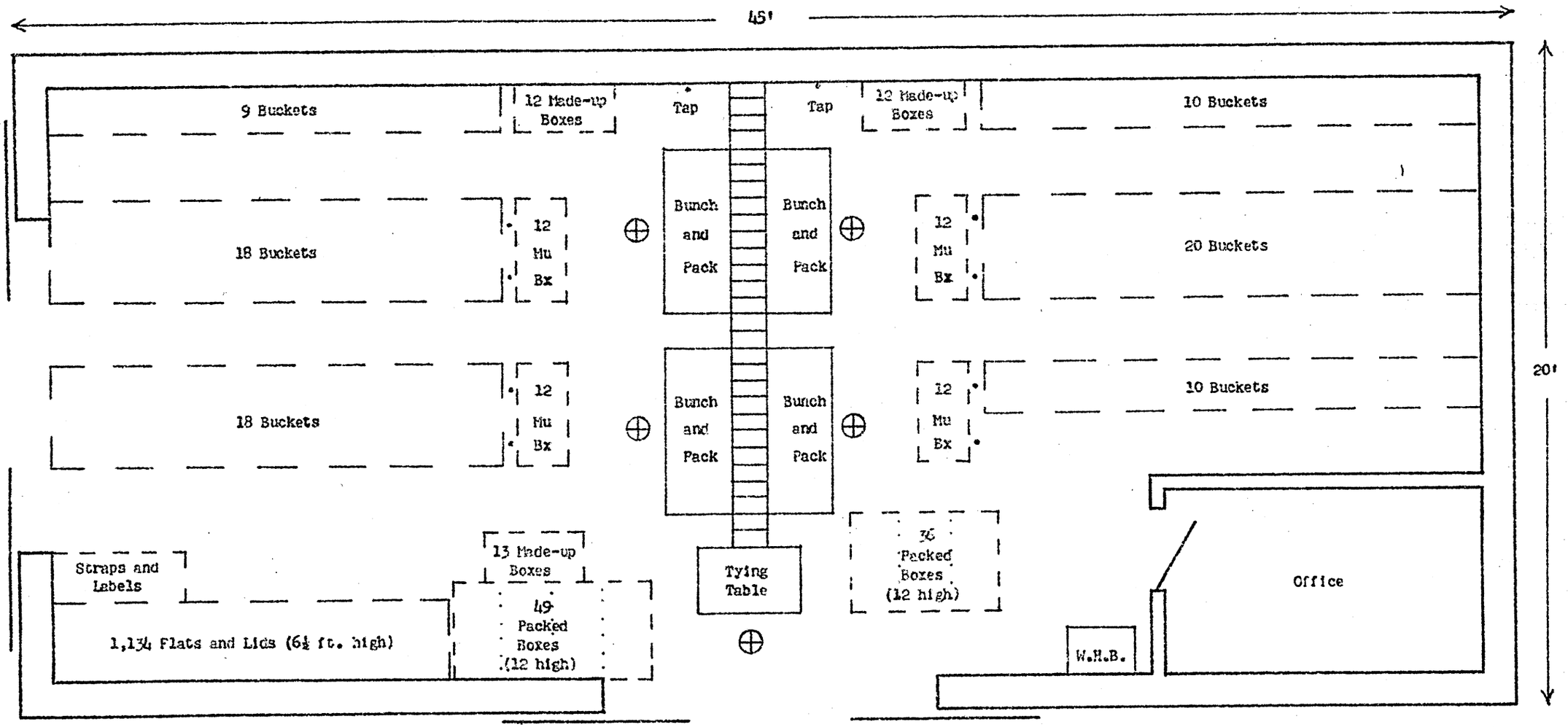
If the tomatoes are to be despatched in baskets, the shed would require to be 4 ft. longer to allow for the storage of baskets.

In order to comply with building regulations, wash hand basins and water closets must be provided for the workers. In the design, a wash hand basin has been located beside the office and it is suggested that water closets should be provided outwith the building.

PACKING SHED

PLAN II FLOWERS

Scale ¼" = 1 ft. ⊕ = Worker PRODUCTION: 85 boxes per day



Plan II Layout for Flowers

Again the plan is designed primarily for bulb flowers and with the layout shown, the possible output would be 85 boxes a day. With 4 workers it would take about 7 hours to bunch, put in water and pack this quantity. In an emergency, an additional 40 buckets could be put in the passageways. If buckets were double-banked, it would be possible to deal with 140 boxes a day by reducing the number of bucket points to 70 (i.e. 140, double-banked) and using the space released for two additional packing tables and storage for extra flats.

The stack of made up boxes behind the packing tables will be 6 ft. high and it might be worth while to arrange for two rigid rods to fit into sockets in the floor to steady them. If the boxes are fastened with string at both ends, it may be an advantage to have a turntable built into the tying table to enable the boxes to be rotated. If it is not the practice to tie the boxes, the tying table will not be required.

Method of Operation Boxes of flowers are brought to the shed, placed on the roller conveyor and moved up towards the far end. Flowers are then available on the conveyor for each buncher to take as required. From time to time the bunchers collect bunches of flowers, carry them to the buckets and place them in water.

When packing, the packers collect the flowers, pack them on the bunching and packing tables, and pass the boxes down the conveyor to the tying table. From there they are taken to the stack of packed boxes awaiting transport. Empty boxes are made up on the bunching and packing tables as convenient.

PACKING SHED

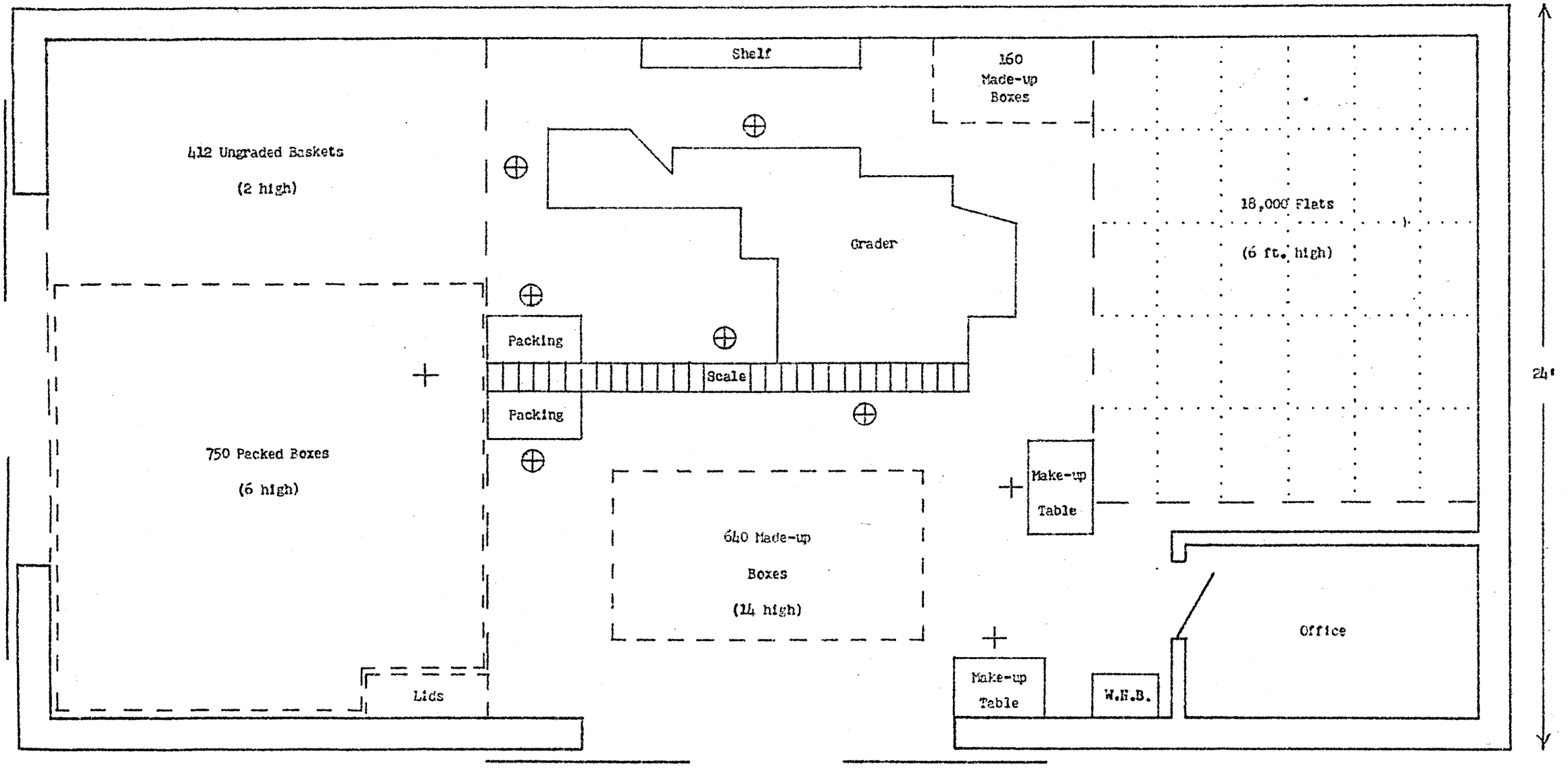
PLAN III TOMATOES

Scale ½" = 1 ft.

⊕ = Worker

\+ = Additional Worker

PRODUCTION: 750 boxes per day



Plan III Tomatoes. Output: 750 boxes a day

In the larger packing shed, a fundamental problem arises as to whether it should be a single or double storey building. The advantages of the two storey shed are that flats, baskets and other stores can be kept out of the way on the upper floor. The upper floor can also be used for making up boxes, which can be delivered by chute to the point at which they are required. In the shed shown on this plan, the floor area is 48 ft. by 24 ft. If it were built with a double storey the grading area and the area required for boxes or baskets of tomatoes would still have to be on the ground floor, so that it would be possible to deduct only 10 ft. from its length. Thus, a two-storey shed would take up more than half the area of a single storey one.

A two storey shed is considerably more expensive to build than a single storey one. The charge for extra height on the walls is not great, but the cost of supporting and constructing the upper storey is high. There are also other disadvantages. A hoist or elevator is needed to convey goods up to the store. The upper floor makes the ground floor dark, and natural lighting can only be in the form of windows in the walls which would not be suitable if the walls had a sunny aspect. Provision has to be made for a secure stairway leading to the upper storey. A single worker, making up boxes in the upper floor, may find the job monotonous and lonely, which can lead to discontent. For these reasons, therefore, it was decided to consider only a single storey building.

Provision has been made for storing the full season's supply of box flats and lids. If only 5000 flats were stored at a time, the shed could be made 2 ft. shorter, but since there is a reduction in price for large quantities of box flats, it is assumed that the full season's supply will be stored. Some of the flats will have been used before the peak of the grading season is reached, but the amount so used cannot easily be estimated, and any extra space that may be available will help to avoid overcrowding at a busy period.

It is assumed that picking will continue while grading is being done, so provision has been made for only half-a-day's supply of ungraded baskets.

A 7 ft. length of conveyor runs from the grader to the weighing point, and another 7 ft. length from the weighing point to the packing tables. After packing, the boxes are fed onto a moveable conveyor which takes them to the stacking point. As an alternative method, the boxes could be stacked on pallets and removed by pallet truck or fork lift truck to the storage point. If a fork lift were available it would be used for loading pallets on to a lorry for despatch. A pallet 36" x 48", packed 6 boxes high, would accommodate a load of 54 boxes.

If baskets were required for despatch, the packing shed would have to be 8 ft. longer to store a season's supply of baskets.

The minimum number of workers required to operate this continuous system is 6, but it is better to have more, and an effective manning is 9 workers. A team of 6 would be employed in the following tasks:-

1 filling grader
1 grading
1 taking off baskets
1 weighing
2 packing.

If 9 workers are available the additional three would carry out the following functions:-

1 bringing baskets to grader and stacking boxes
1 making up boxes
1 assisting in either of the above or at the grading belt.

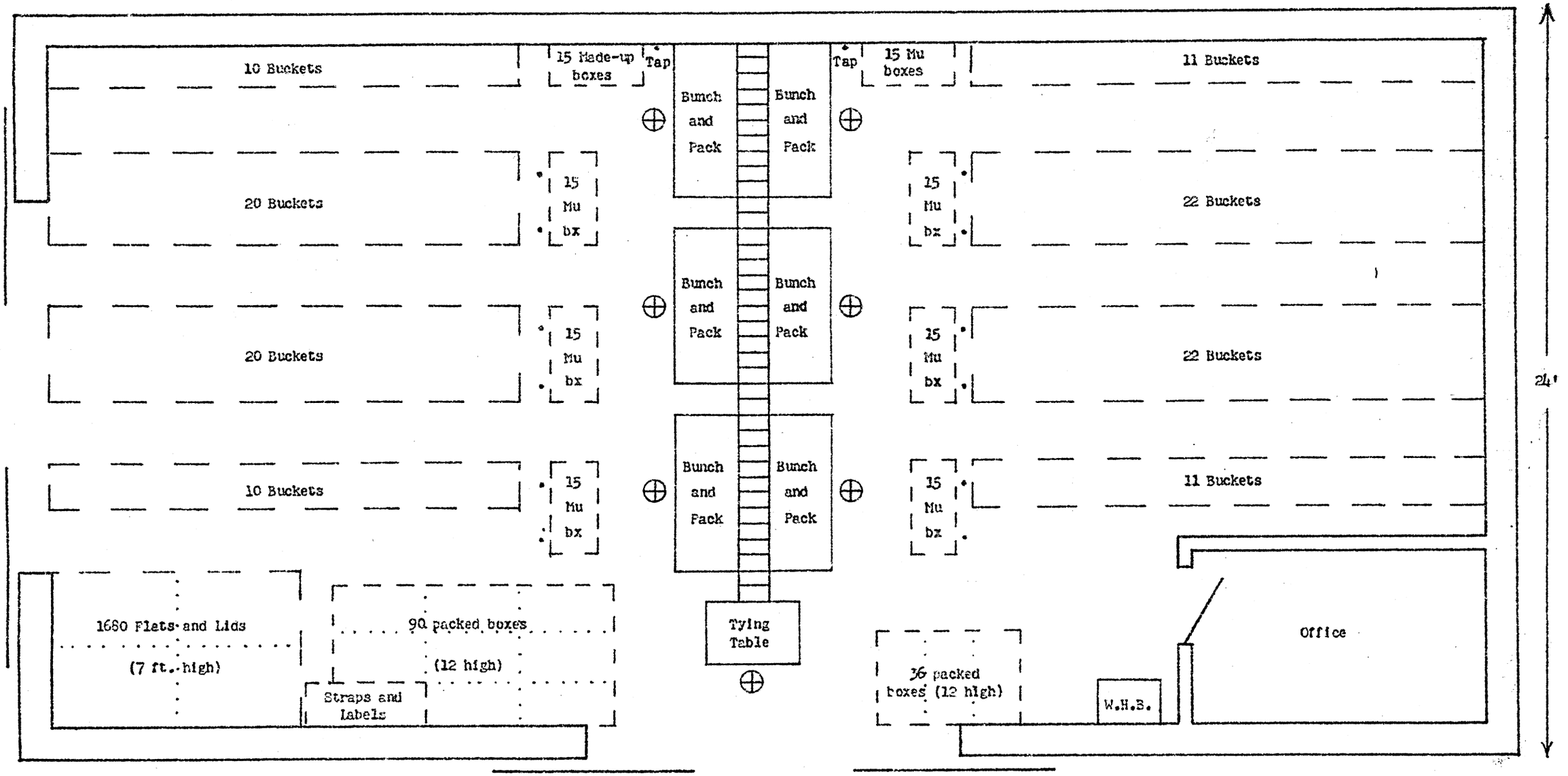
With a team of 9 workers it would take under 3 hours to grade and pack 750 boxes.

PACKING SHED

Scale ¼" = 1 ft. ⊕ = Worker

PLAN III FLOWERS

PRODUCTION: 126 boxes per day



Plan III Layout for Flowers

The layout of this shed is similar to that for plan II so that the same considerations apply. In a packing shed of this size many growers would wish to have a cold store. This could be built as a lean-to at the back of the shed. The entrance to the cold store should be at the end of the conveyor so that it can be used to convey produce to and from the store.

The method of operation in the shed is the same as in Plan II. If pallets are used for handling boxes of tomatoes, they can equally be of service in handling flowers.

GENERAL CONSIDERATIONS

The erection of a new packing shed, involving as it does, a considerable expenditure of capital, requires careful planning to ensure that the most productive use is made of the money spent. Time and care should therefore be spent at the planning stage, to ensure that the new shed is suitable for all foreseeable requirements, and that it enables the most effective use to be made of labour. This may well be repaid in lower production costs.

In tomato grading, the possible output of a rotary grader, with a full complement of workers, would be some 2500 12 lb. boxes in a normal working day. Few growers in the area with which this report is concerned have so large an output, so that the grader on an individual holding would seldom, if ever, be working at full capacity. A strong case can therefore be made out for two or more growers joining together to share a grader or develop some form of co-operative grading enterprise.

ACKNOWLEDGEMENTS

The gratitude of the authors is due to growers who made valuable criticisms of the plans and to the horticultural advisers at Lanark for their advice and assistance.

APPENDIX 1

PACKING SHEDS

Data and Specifications - General

Windows: Not shown in drawing as depend on orientation. Where convenient, side windows in N. wall and/or roof lights along N. side. Position of tomato grading points and flower bunching and packing benches should be well lit.

Tomatoes

Baskets:	12 lb. 16" x 10" x 6" each. Nested empty in bundles of 18 - 2' high. Filled baskets 2 high. Stacked in 4's 20" x 20".
Boxes:	Flats - 3' x 2' 1" x 6" high per bundle of 50. (or $2\frac{3}{4}$" per 24). Made up boxes 16" x 12" x 5" each. Packed boxes to 6 high - 3'.
Box Lids:	Packets of 250 lids - 16" x 11" x 4" high.
Elastic Bands:	1 lb. packets - about 850 per $7\frac{1}{4}$" x $3\frac{3}{4}$" x $3\frac{3}{4}$" packet.

Flowers

Buckets:	Spaced at 1' 6" centres. 1 bucket to 1 box of flowers.
Boxes (Trunks): (White lined)	Flats 4' x 2' 6" x 2" per bundle of 20 boxes ditto " " " box lids Made up boxes. 34" x 17" x 6" or say 3' x $1\frac{1}{2}$' x 6"
Straps	Say 17" long.

APPENDIX 2

PACKING SHEDS (Contd.)

Data and Specifications

PLAN I 100 boxes Tomatoes per Day

Building:

18 ft. x 16 ft. external
16 ft. x 14 ft. internal
Door 8 ft. wide

Tomatoes

Production:

Annual production 2400 boxes
Av. yield of 30 cwt./100 ft. comes from 860 ft. of glass, 16' wide.

Stores Required:

2400 box flats
2400 box lids
100 made-up boxes per grading day
2 grading benches 5' x 3' about 2' 9" high and scale
1 office table 3' x 2'
Labels etc.
110 baskets for ungraded tomatoes.

Flowers

Production:

Peak production 24 boxes per day twice weekly.
Average production = $\frac{1}{4}$ of peak.
For 20 week period = 240 boxes/annum.

Stores Required:

240 box flats.
240 box lid flats.
24 flower buckets.
24 made-up boxes per packing day.
2 benches for bunching, packing and tying 5' x 3' each.
1 office table 3' x 2'.
String and labels and straps.

APPENDIX 3

PACKING SHEDS (Contd.)

Data and Specifications

PLAN II 300 boxes Tomatoes per Day

Building:

45 ft. x 20 ft. external
43 ft. x 18 ft. internal
Office 10 ft. x 6 ft.
2 doors each 10 ft. wide

Tomatoes

Production:

Annual production 7200 boxes/annum
Av. yield of 30 cwt./100 ft. of glass comes from 2570 ft. of glass, 16' wide.

Stores Required:

7200 box flats
7200 box lids
300 made-up boxes per grading day
1 rotary type grader
330 baskets for ungraded tomatoes
1 weighing table 1½' x 1' and scale
7' roller conveyor
2 packing tables 3' x 1½' each
1 table for making-up boxes 3' x 2'
Labels etc.

Flowers

Production:

Peak production 85 boxes/day twice weekly.
Average production ⅓ of peak.
For 20 week period = 1134 boxes/annum.

Stores Required:

1134 box flats.
1134 lid flats.
85 flower buckets.
85 made-up boxes per packing day.
4 bunching and packing benches 5' x 2'.
1 tying bench (with turntable) 3' x 2'.
14' roller conveyor.
Straps, string and labels.
8 metal supports for stacks of made-up boxes.

APPENDIX 4

PACKING SHEDS (Contd.)

Data and Specifications

PLAN III 750 boxes Tomatoes per Day

Building:

48 ft. x 24 ft. external
46 ft. x 22 ft. internal
Office 10 ft. x 6 ft.
2 doors each 12 ft. wide

Tomatoes

Production:

Annual Production 18,000 boxes
Av. yield of 30 cwt./100 ft. of glass comes from 6430 ft. of glass, 16' wide.

Stores Required:

18000 box flats (4 times a year).
18000 box lids
750 made-up boxes
1 rotary type grader
412 baskets for ungraded tomatoes (half-days supply)
1 weighing table 1½' x 1' and scale
2 7' lengths of roller conveyor

Also 16' length roller conveyor fixed, from packing tables
16' length roller conveyor moveable, from filling point
or 1 fork lift truck and supply of pallets

2 packing tables 3' x 1½' each
2 tables for making-up boxes 3' x 2' each
Labels etc.

Flowers

Production:

Peak production 126 boxes/day, twice weekly.
Average production ⅓ of peak.
For 20 week period = 1680 boxes/annum.

Stores Required:

1680 box flats.
1680 lid flats.
126 flower buckets.
126 made-up boxes per packing day.
6 bunching and packing benches 5' x 2'.
1 tying bench with turntable 3' x 2'.
18' roller conveyor.
Straps, string and labels.
12 metal supports for stacks of made-up boxes.