DESIGN AND OPERATION OF CARCASS CHILLERS

By

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The proper design and operation of carcass chillers are important aspects in the economic processing of meat for human consumption. The key elements are refrigeration and hygiene.

REGULATIONS

Carcass chillers are the first stage in the refrigeration process designed to preserve meat from bacteriological spoilage and degradation. The regulating authorities stipulate certain temperature/time conditions which must be met depending upon the type of boning (hot or cold). These conditions must be achieved for each carcass hanging in the chillers - not only a few. Chillers must be designed to facilitate cleaning and prevent harbouring of bacteria. Chillers must be thoroughly cleaned before loading with carcasses. Proper cleaning procedures must be followed and adequate time allowed for this operation.

CHILLER DESIGN:

Refrigeration:

Heat is removed from the carcasses by movement of air across the surface of the meat. The air carries the heat to the 'evaporator' or'FDC Unit' where the heat is passed to the refrigerant which evaporates and takes the heat back to the engine room to be rejected to the atmosphere through condensers and cooling towers. In this 'cold chain' the two crucial points in chiller design are: adequate air movement and sufficient evaporator surface area.

The air at the correct temperature must pass across the surface of all carcasses in the chiller extracting heat from each body at the required rate and then pass this heat onto evaporators which should transfer the heat to the refrigerant also at the required rate. If these two points of design are correct then the chiller performamce will not be far off the specification.

STRUCTURAL:

Chillers constructed of bricks or mass concrete with cork or buzzer chips insulation, and lined with timber have largely been replaced by modern materials which weigh less, have better insulating values and are easier to clean. Chiller surfaces can now be built with hardwearing surfaces relatively free of crevices. The wider use of structural stainless steel and aluminium plus a whole range of polymers for surface

protection of walls, floors and ceilings has enabled the construction of more hygienic chillers with less maintenance. Unfortunately the construction methods do not always produce the best job and in correcting, or living with these problems, maintenance costs can be higher than otherwise necessary.

CONDENSATION:

This ever present and persistent problem is caused by cold chiller surfaces and warm moist air. Theoretically the problem can be overcome by keeping all surfaces (except the evaporator) above the dew point of the moisture ladened air but this is not achievable in practice. Condensation caused by washing down can be reduced by running the refrigeration during the washing period. Preferably, chillers should not be pre-chilled before loading with carcasses as moist air drawn from the hot beef passage and from the wet bodies will condense on entering the chillers. To help overcome this problem the hot beef passage should be refrigerated sufficiently to dry the air entering the chillers. An air-curtain between the kill floor and hot beef passage is also advisable. Many works pre-cool chillers down to 5-7° but in my opinion this should be avoided if at all possible.

By using modern materials chillers can now be built with the minimum thickness of lining material and thus avoid the 'cold-sink' associated with thick wall construction - a source of everlasting cold surfaces.

Important also is the proper design and sequencing of the evaporator defrost to avoid carryover of moisture into the airstream.

GENERAL DESIGN:

Floor drains should be designed and constructed to DPI standards. This not only makes it easier to wash down the floor but helps reduce damage to floors by excessive hosing.

Lighting fittings should be kept to a minimum but be powerful enough and strategically placed to give the required lighting level. The lighting level can quickly fall away with too many light fittings badly positioned or affected by condensation rust and dirt.

CHILLER OPERATION:

Chillers should be cleaned as soon as they are emptied and the following procedrue is recommended:

Dryclean floor

Coldwater wash floor, walls, doors.

Detergent wash " " "

Scrub stains on floor, walls, doors,

Hot water wash " " '

Sanitise atmosphere with fans running

Sanitise Drains

Carcasses should be loaded into chillers as fast as possible. Preferably without precooling the chillers. When the chiller is loaded and the doors shut, the lights should be turned off and the refrigeration turned 'ON FULL'. Chilling procedures vary from one works to the next and depend upon the typre of boning being done. In essence good chilling practice requires rapid pull down of temperature to immobilise bacteria and guarantee good quality meat and also 'crust' the surface of the carcass and prevent moisture pickup with loss of weight. When the meat temperature has been reduced sufficiently to achieve the required temperature/time condition then the air circulating fans can be reduced in speed. This helps to reduce weight loss and save energy. Carcasses should be unloaded as fast as practicable into a refrigerated room and the chiller cleaning procedure commenced immediately.

Chillers should not be overloaded with carcass as this will restrict air movement across the carcasses and reduce the heat extraction as well as putting more heat into the chiller (through more bodies) which also has to be taken out. This results in higher meat temperatures.

Chillers should not be operated partly empty as the air will take the least line of resistance and by-pass the carcasses. This also results in higher meat temperatures.

Chiller thermometers should be read at intervals to make sure the chilling cycle is proceeding to schedule. Thermometers should be regularly checked by the maintenance department.

OPERATING COST:

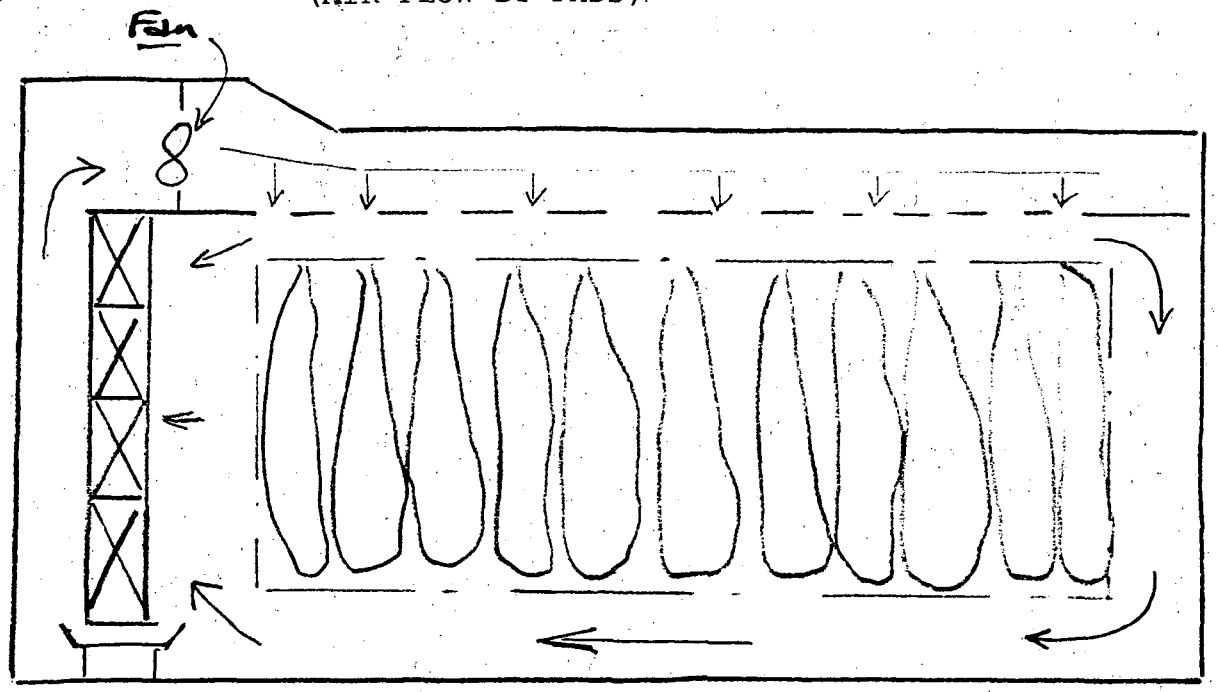
Economic operation is achieved through tight control of the chilling cycle and taking care in the use of services - modern micro electronic controls are making cycle-control far easier and less expensive than in the past. This enables better chilling performance in terms of temperature/time, air circulation and weight loss as well as giving more precise control in the realm of energy management.

The essentials for good cost control are the minimum use of:

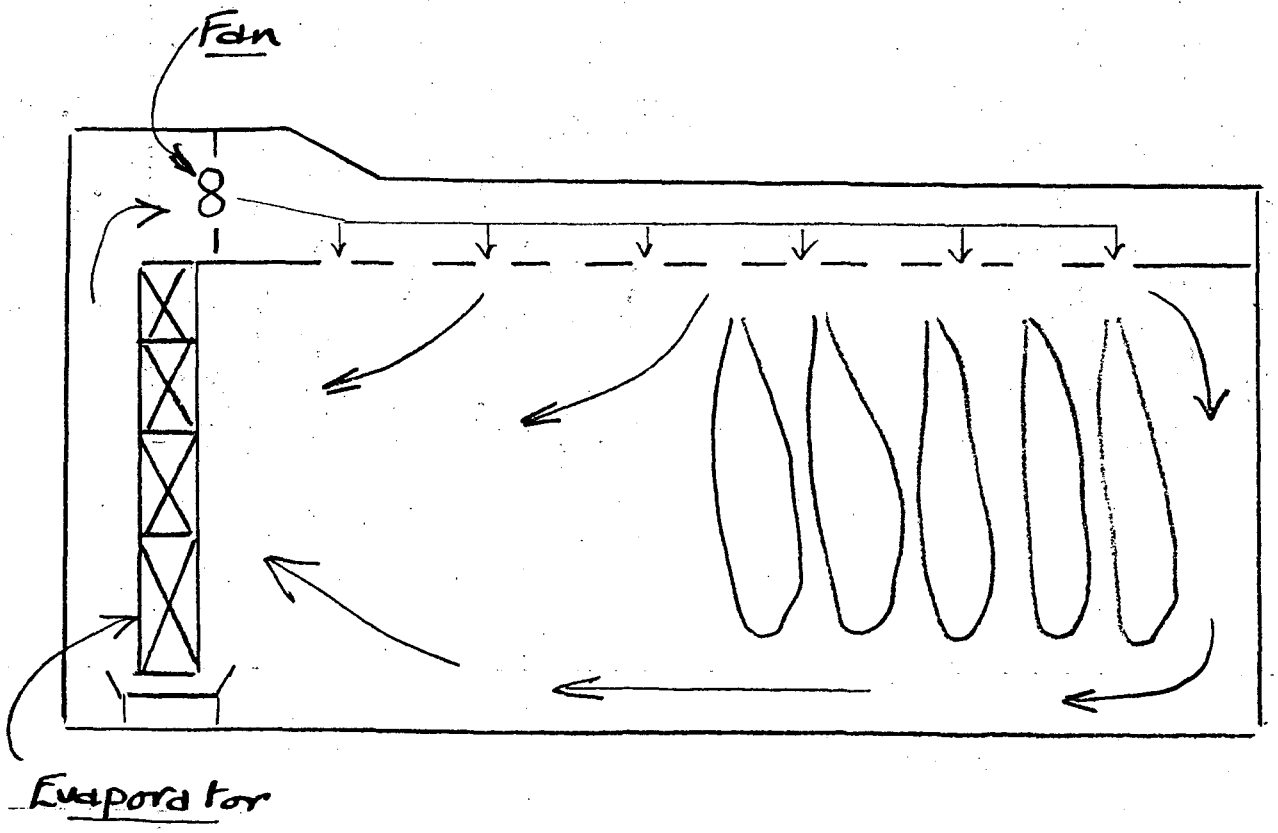
Refrigeration Power
Fan Power
Lighting
Water
Steam
Cleaning materials.

The following diagrams illustrate some aspects of chiller operation and design discussed in the text.

DIAGRAM 1: CHILLER LOADING
(AIR FLOW BY-PASS).

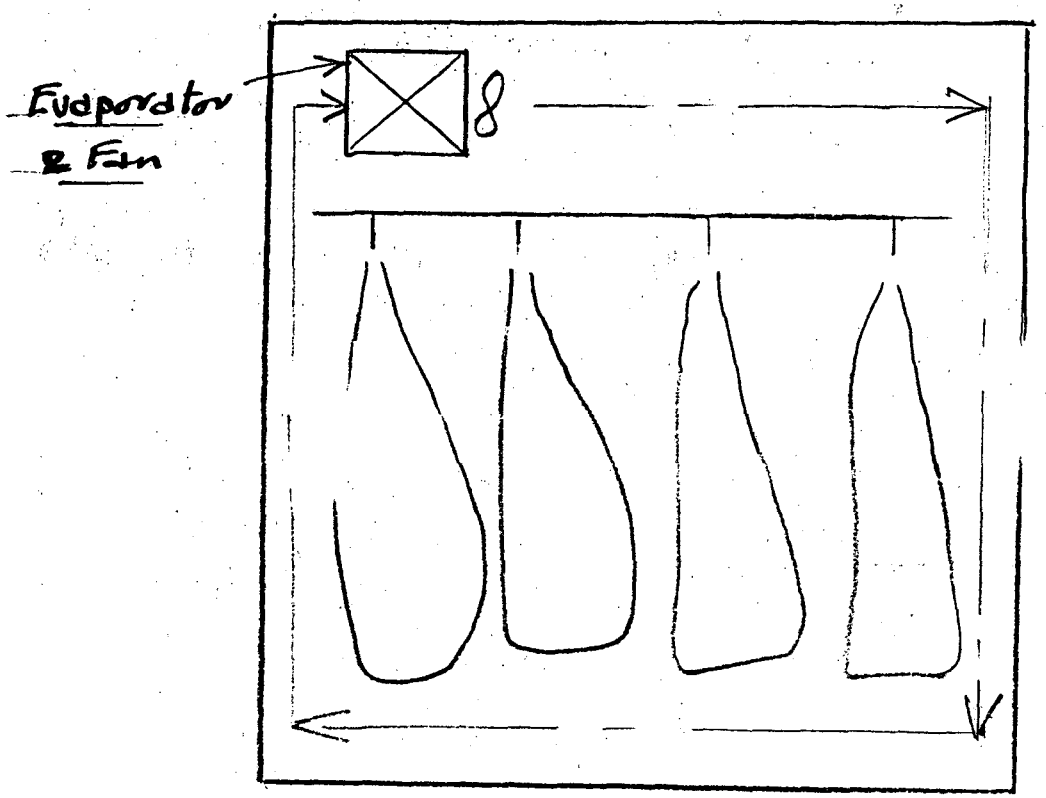


OVERLOADED

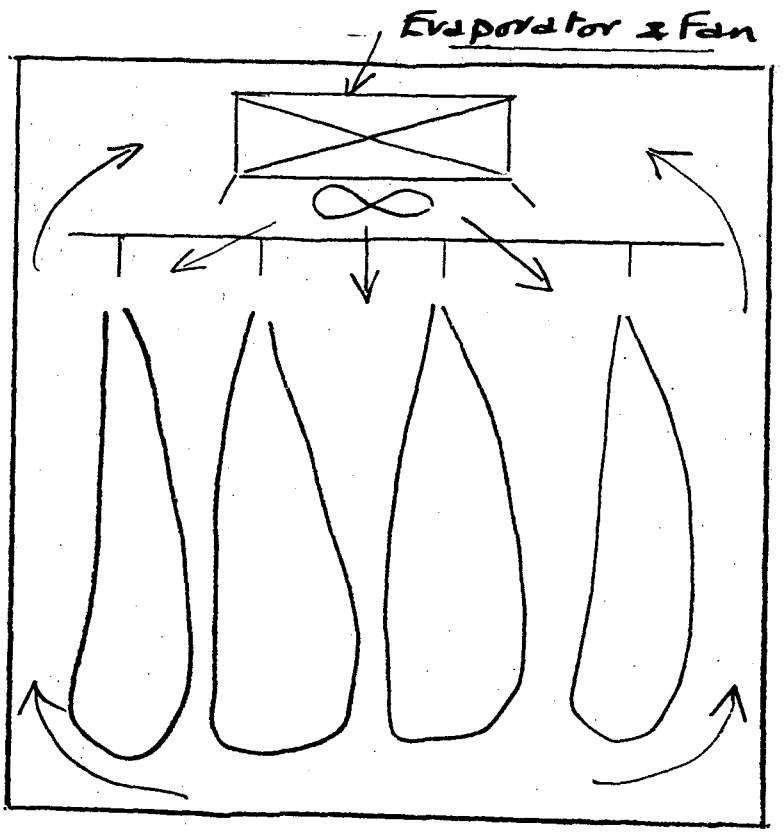


PARTLY LOADED

DIAGRAM 2: AIR FLOW
(CROSS SECTION)

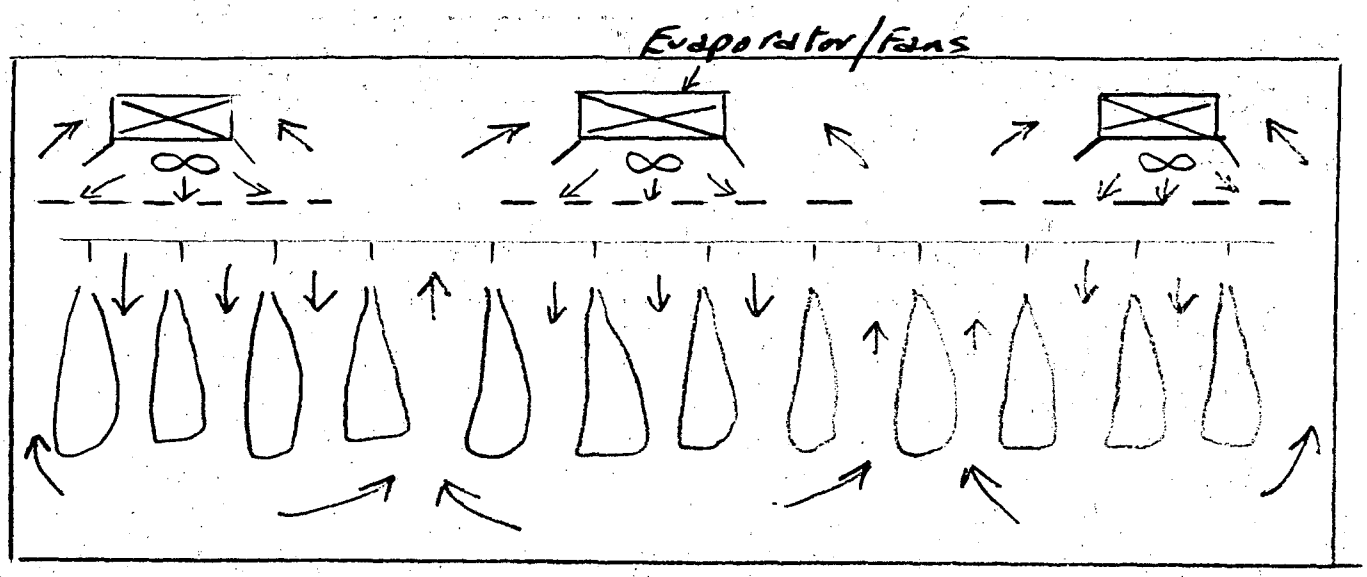


POOR

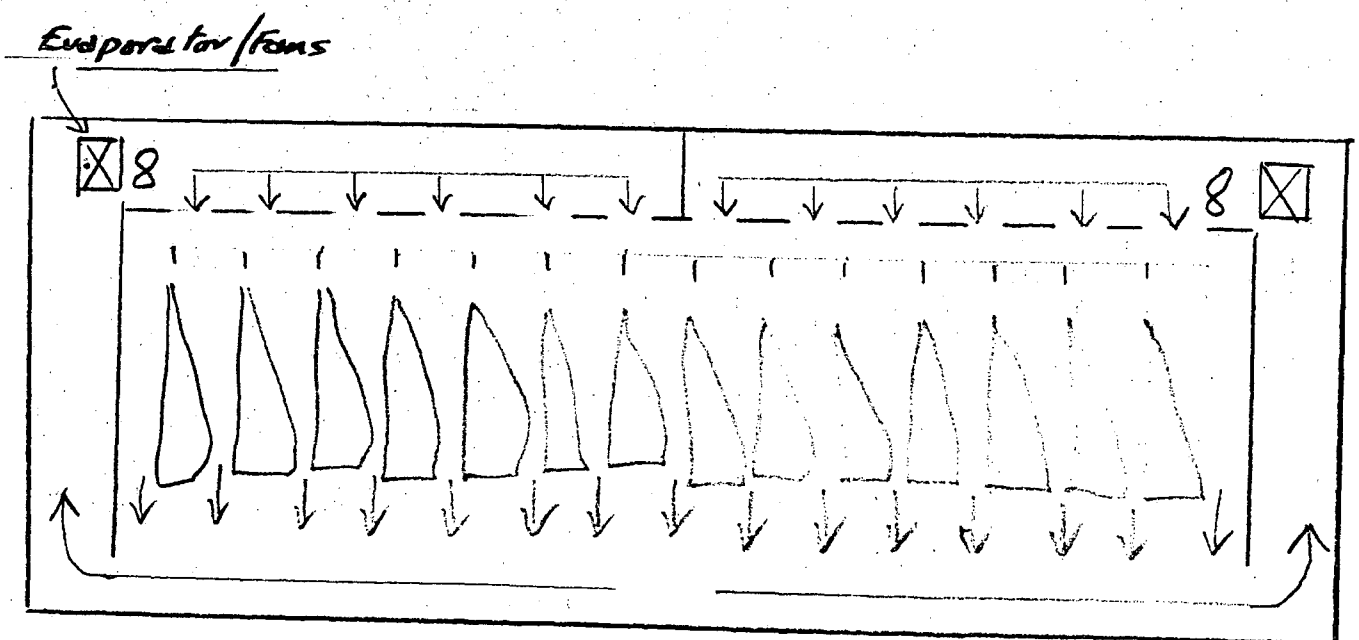


BETTER

DIAGRAM 3: AIR FLOW
(LONGITUDINAL SECTION)



GOOD



EXCELLENT

DIAGRAM 4: CONDENSATION

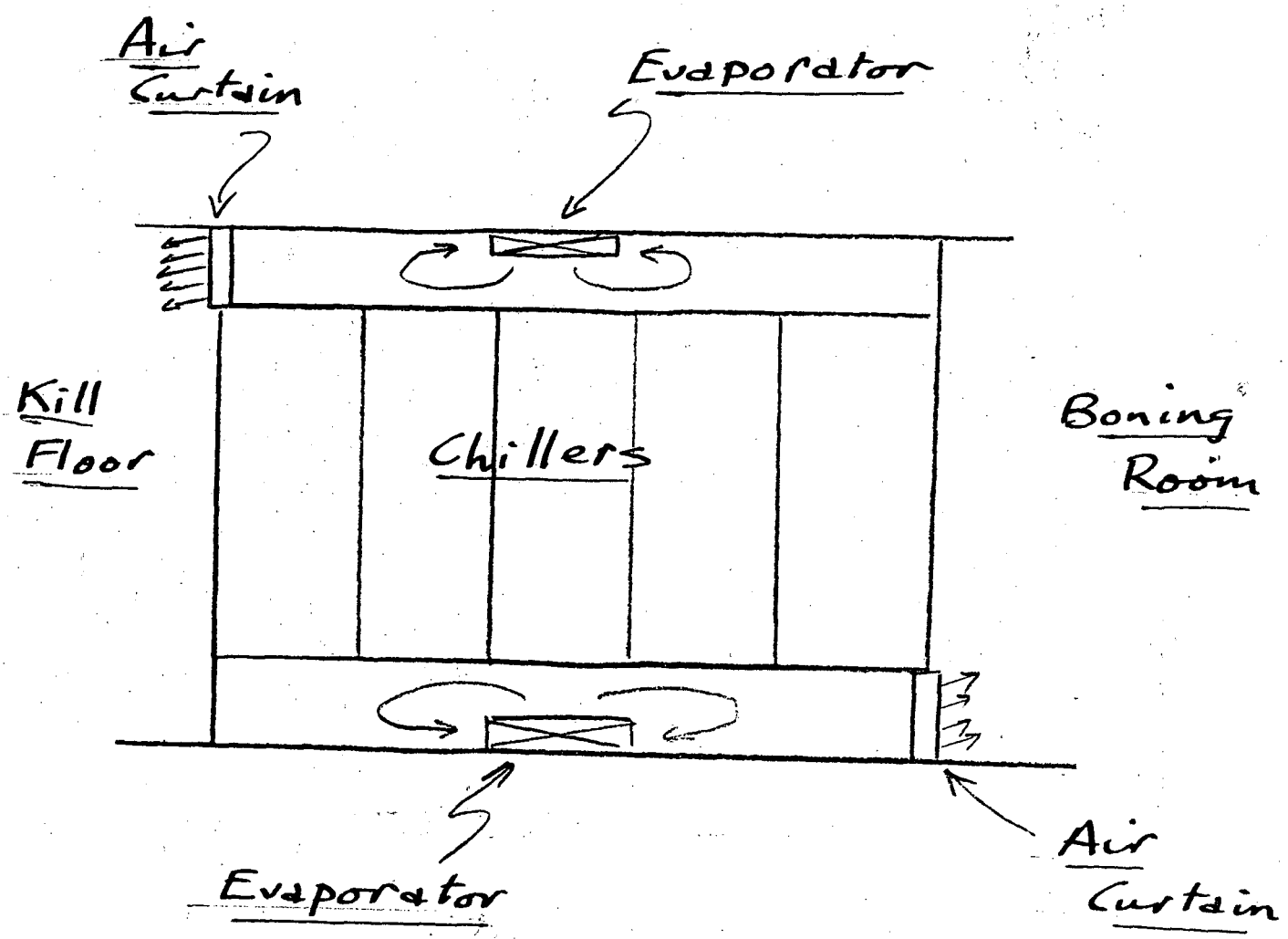
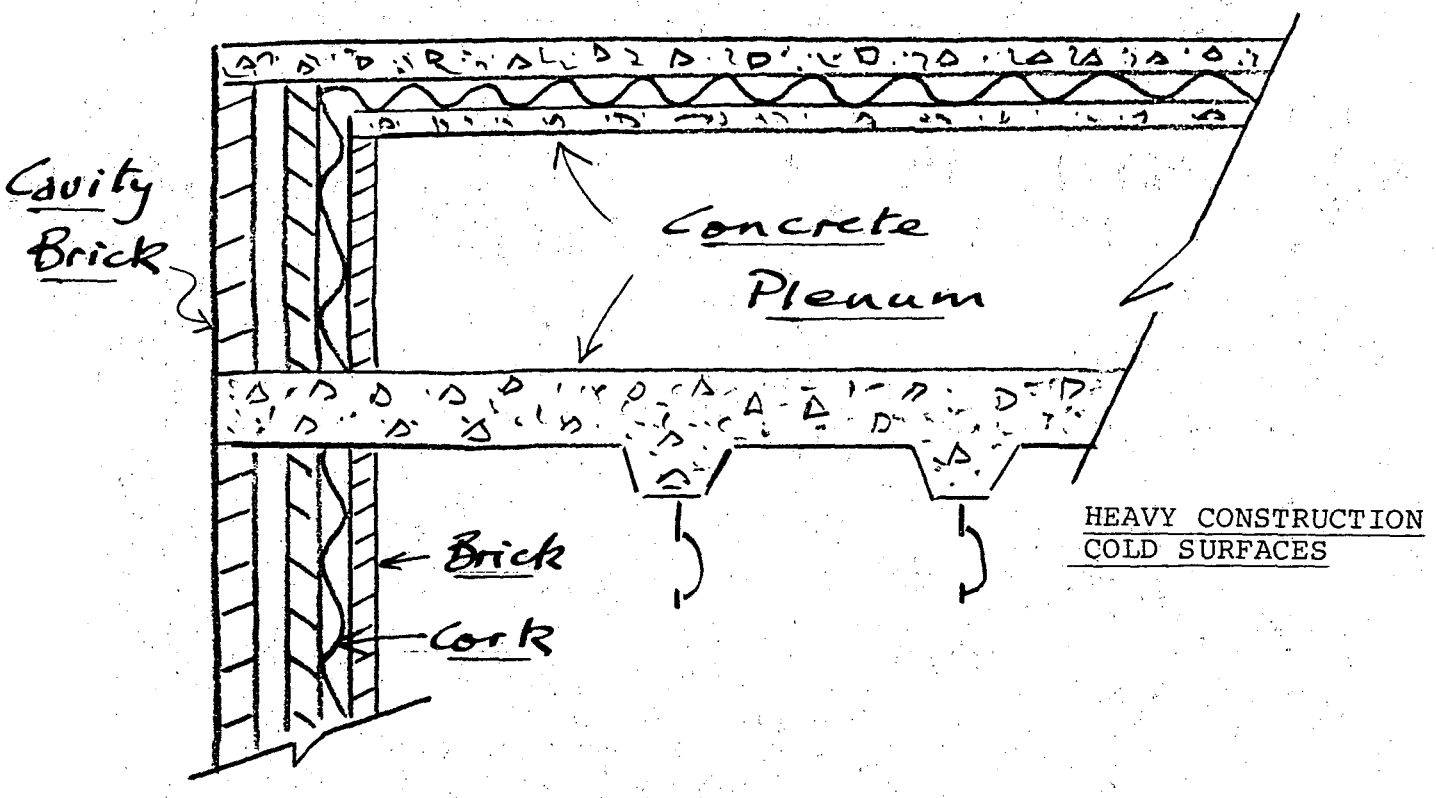
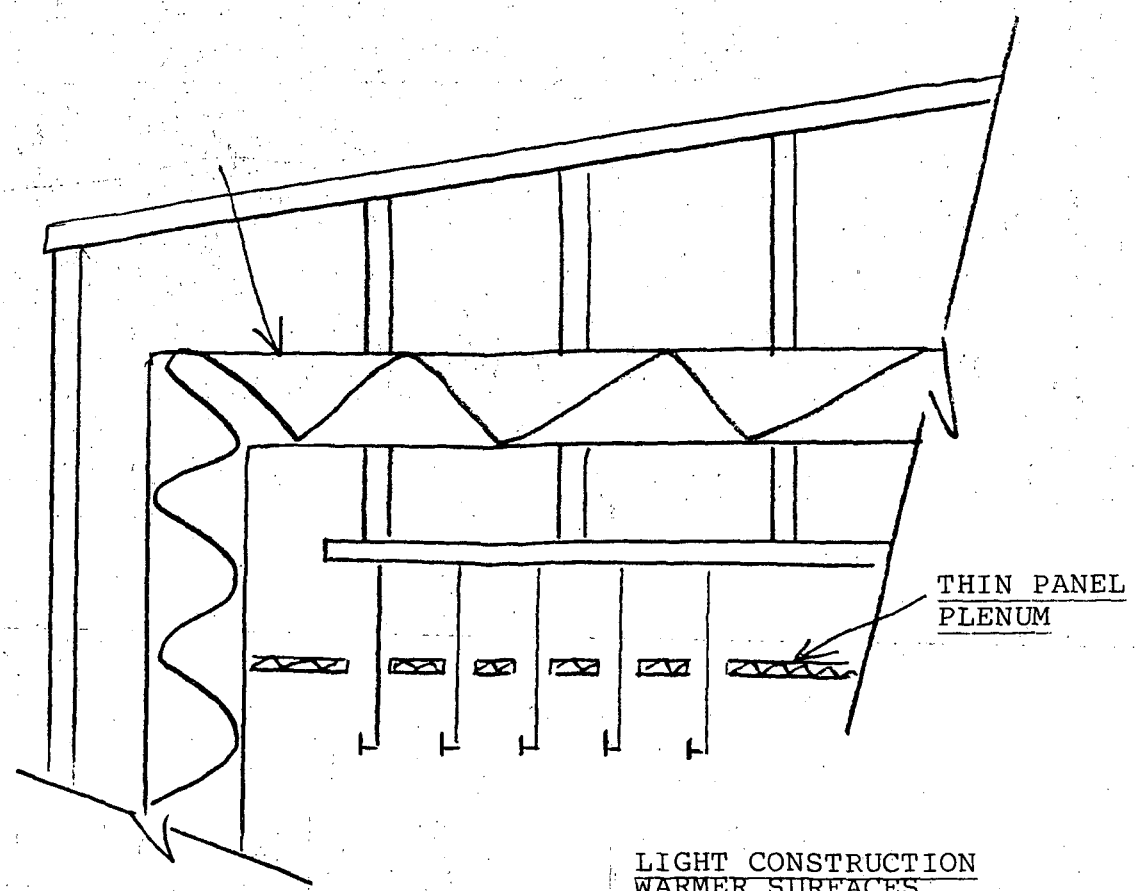


DIAGRAM 5: CONDENSATION
(THE 'COLD SINK')



PANEL WALLS
& CEILINGS



LIGHT CONSTRUCTION
WARMER SURFACES