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Environment, Health, and Safety

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Dining Services Ergonomic Design Guidelines

For New Construction and Existing Buildings

Basic Design Principles

1. *Modular and Flexibility*: Provide flexible and modular design for relatively easy re-design as the needs change.

    - Kitchen equipment (ranges, refrigerators, carts, racks, etc.) and service components should be modular to allow for changing conditions such as different methods of services, new menu items, or a new preparation method
    - Using quick-connect utility lines is another example of flexible, modular design
    - Plan for various serving styles and recognize future renovations, additions, and expansions of the facility are likely

2. *Flow of Materials and Personnel*: The relationship among the various storage, preparation, cooking, serving, and cleaning functions must be carefully studied to provide maximum flow and efficiency.

    - Travel distances should be kept short and there should be minimal crossover of circulation paths
    - Open sight lines should be maintained as much as possible
    - The movement of food through the facility should follow a logical sequence beginning with receiving and ending with waste disposal. Flow considerations include:
        - Movement of employees from one area of the facility to another
        - Flow of dishes, pans, and utensils through the dishwashing area and back to the service area
        - Flow of customers from the entrance through the service area, to the dish drop-off area
        - Flow of raw foods through the main traffic aisles of the kitchen to the prep area
        - Flow of materials from the loading dock to storage areas

3. *Ease of sanitation:* Sanitation considerations should be addressed in the design phase to significantly reduce time spent cleaning and thus reduce the ergonomic risk for the employees. Examples of these sanitation considerations include:
    - *Building finishes:* durable and easy to clean, including structural glazed ceramic tile on the walls and quarry tile on the floors
    - *Utilization of wall-hung equipment:* equipment attached to the wall eliminates the use of legs, pedestals and other supports which makes it easier to clean the floors
    - *Equipment racks:* provide minimum number of legs for ease of cleaning
    - *Shelf storage design:* portable shelving systems and open shelving under tables can easily be cleaned
    - *Transitions between flooring types:* eliminate thresholds (at carpet/tile transitions) for easy of moving heavy furniture

4. *Maintenance:* Provide easy access to all kitchen equipment, facility mechanisms, and systems for regular maintenance.

Human Engineering

A work space that is designed with the safety and comfort of the employee in mind can positively impact productivity, efficiency, and reduce injuries.

Sufficient work space- The amount of space necessary for individual workers can vary based on the tasked performed. The following should be considered when determining work space:

- The number of people working in the space
- The amount and type of equipment
- Equipment door clearance
- The number and types of meals prepared and served
- Necessary storage space (and its proximity to the work space)
- Aisle space

Space Requirements

Storage needs will increase over time and this growth should be considered during the design phase. Having sufficient storage space allows employees to more easily access product. This can reduce the risk of injury by reducing awkward posture, extended reaches, and handling distances. Sufficient space for the use of material handling equipment use should also be considered. (See appendix for specific space requirements)

Work Surfaces

Height adjustable work surfaces (such as pedal assist) improve productivity and comfort. Install these in strategic locations to accommodate employee height differences and to make heavy tasks (i.e. using meat slicers and cheese graters) and light work (i.e. slicing, peeling, and cleaning foods) easier to perform. Such work surfaces should have a range of at least 28-44 inches in height.

Equipment Storage

The facility design should include storage space for material handling equipment, such as:

- Carts
- Hand trucks
- Skate wheel conveyors
- Forklifts

The storage location should provide easy accessibility to the equipment as well as power to charge the equipment.

Temperature and Humidity

Temperature and humidity levels can impact the risk of musculoskeletal injuries. For this reason, HVAC systems in the dishwashing and potwashing areas should be designed to provide a sufficient amount of air supply and exhaust to maintain the moisture level as low as possible and the temperature within the comfort zone. Considerations should also be given to areas with higher temperatures such as a bakery or rotisserie.

Noise Levels

It has been demonstrated that high levels of noise in a work setting can cause fatigue, accidents, and low productivity. Some design techniques to reduce noise levels include:

- Sound-reducing materials placed onto the underside of tables and counters.
- Separation of areas in the food facility, especially warewashing
- Designing conveyors to create a sound barrier between dish drop-off points and warewashing
- Acoustic ceilings which are grease- and moisture-resistant
- Carpeting in dining seating areas
- Carpeting on walls of dining areas
- Remote refrigerator compressors

If necessary, partner with Environmental Health and Safety specialists to determine safe and acceptable noise levels.

Lighting

Proper lighting levels are essential for the safety and well-being of foodservice employees. Below are the recommended lighting levels for foodservice facilities.

Space	Recommended Lighting (Foot Candles)
Receiving	25-45
Storage	15-20
Pre-preparation	20-30
Preparation and Production	30-50
Warewashing	70-100
POS/ Cashier	35-50
Intimate Dining	5-15
Casual Dining	10-20
Quick Service Dining	40-50

Floor Finishes

When selecting floor finishes, employee safety (slip and fall prevention) as well as ease of sanitation should be considered

Furniture Selection

Purchase durable light-weight tables and chairs for the dining facility that can easily be moved for daily cleaning

Agency Approval

All design and construction projects must have the proper approval from local agencies and/or campus Environmental Health and Safety

Task-Specific Design Guidelines

(Addressing the University of California's top at-risk tasks)

Food Preparation

1. Create dedicated corridor(s) for major traffic patterns to minimize cross traffic within cook and food-prep areas
2. Install 'hands free' automatic door openers from kitchen and food-prep areas to service areas
3. Design communication systems (computerized screens, wireless headsets, intercom systems, etc.) between frontline, backline, kitchen, and order desk to reduce foot traffic and increase efficiencies
4. Plan for use of smaller, height-adjustable tables in food-prep areas to accommodate different height users and make it easier to adjust and work with taller equipment. Table top surfaces must be approved by your campus Environmental Health and Safety sanitarian or other specialist.
5. Provide sufficient dry and refrigerated storage for food preparation demands in specialized food-stations in the front of the house
6. Place refrigerated storage in close proximity to food preparation areas to reduce trips to main cooler(s) to get product.
7. Select refrigerated salad bars to eliminate transport and clean-up of ice
8. Locate ice dispensers adjacent to areas of frequent use (i.e. beverage dispensers or smoothie stations)
9. Place sinks in locations providing easy access to users while minimizing cross traffic
10. Design self-serve food stations when possible. When not possible, pass-through areas (cooks to food-prep, or food-prep to customer) should not exceed a reach distance of 16 inches.
11. Install safety mirrors on blind corners to prevent collisions

Dishroom

1. Provide the appropriate ware washing machine to the specific dining commons. Flight type machines are used where there are more than 600 people served per meal.[1]
2. If using a single belt return, the height of the belt should be 36 inches and collection of dirty ware can occur from both sides of the belt.
3. If using a tray accumulator, design so the forward reach from edge of break down area to the tray or dishes does not exceed 16 inches and the overhead reach to the top carriage does not exceed 58 inches[2, 3]
4. Provide removable racks on the tray accumulator to make it easier to clean
5. When using a tray accumulator, provide a conveyor belt to transport dirty ware and racks to the ware washing machine and design so the other end of the belt is located close to and at the same height as the ware washing machine to reduce lifting and reaching.
6. The length of the overhead hose should allow for the nozzle not to exceed 40 inches from the floor to reduce awkward reaching motions. The nozzle should provide a locking mechanism for the trigger to reduce repetitive and sustained squeezing.
7. For user satisfaction, nozzle design should allow water flow rate of at least 1 gpm and to save water no more than 1.6 gpm
8. Use high temperature hoses which provide 80-150 psi to clean the dirty ware
9. Recess the under counter hose holder to prevent it from protruding when the hose is being used
10. Provide adequate drainage in the floor for the daily amount of water and manual cleaning

Pot/Pan Washing

1. Provide a separate pot/pan washing area from the dish room
2. Provide a turbo wash unit for the pot/pan area
3. Provide pot washing machines as needed
4. The length of the overhead hose should allow for the nozzle not to exceed 40 inches from the floor to reduce awkward reaching motions. The nozzle should provide a locking mechanism for the trigger to reduce repetitive and sustained squeezing.[4,5]
5. For user satisfaction, nozzle design should allow water flow rate of at least1 gpm and to save water no more than 1.6 gpm[6]
6. Use high temperature hoses which provide 80-150 psi to clean the dirty ware
7. Install 1-lb wall-mounted liquid soap and sanitizer dispensers near the end of counter

Loading Docks

1. Provide adjacencies between the loading dock, stockroom, preparation, cooking, and serving functions to limit the number and distance of material handling transfers required to transport products
2. Design modular loading dock (bays, vehicular access, waste bins, materials handling equipment) to adapt to work process changes
3. Match dock loading platform heights with the type of truck(s) servicing the facility. Typical docks are 55 inches above grade level to accommodate most trucks. Equip at least one loading berth with a dock leveler to accommodate varying truck platform heights.
4. Provide automated lift system to transport goods from dock surface to ground level
5. Install edge guards and dock bumpers in each loading berth
6. Provide steps with rails in each loading berth to promote safe employee access
7. Provide ramp to connect dock with truck parking area to facilitate use of hand trucks/carts from small trucks and vans. Ramp should have maximum slope of 1:12 and comply with ADA guidelines.
8. Provide canopy extending 48 inches beyond edge of dock platform. Canopy height must accommodate trucks servicing the facility.

9. Ensure the trucks servicing facility have access to loading dock via driveways or service roads with minimal pedestrian or bicycle traffic.
10. Provide manually adjustable lighting in each loading berth to illuminate the interior of trailers
11. Provide automatic doors with sufficient width to accommodate loaded pallet jacks
12. Keep loading dock, storeroom and food preparation areas on same level. If not possible, locate storerooms adjacent to freight elevators in multi-level environments
13. Position dumpsters below dock level and provide sufficient, dedicated space to accommodate the use of automated lifting equipment
14. Avoid grades at dock to avoid rolling of vehicles and containers away from dock. Use chocks, wheel stops, dock locks, or hooks on axles to prevent rolling
15. Provide staging area inside building adjacent to the loading dock to inventory and organize received goods
16. Provide durable, slip-resistant, level concrete dock surfaces that are easy to clean and maintain. Avoid thresholds, lips, and uneven drains
17. Include a wet room/wet area with hose connections and drainage to sanitation system to clean equipment such as trash containers, carts and floor mats
18. Provide electrical and utility hookups for equipment used on the loading dock. Consider the size and voltage of electrical hook-ups, the size and coupling of utility hook-ups, the number of hookups to meet demands, and the placement of hookups to limit cords, hoses and cables in walkways and high traffic areas.

Storerooms

1. Provide separate functional storage areas (i.e. dry storage, freezer, produce and dairy coolers, meat and meat thawing coolers, and prep area) that are large enough to promote organization and efficient access to products
2. Provide sturdy, adjustable stockroom equipment (shelving, racks, etc.) that support the weight of items stored on them.
3. Provide mobile equipment (i.e. wheeled shelving) to accommodate re-design and cleaning needs
4. Keep loading dock, storeroom and food preparation areas on same level. If not possible, locate storerooms adjacent to freight elevators in multi-level environments.
5. Design storage areas and circulation paths to accommodate size and type of lifting/moving equipment used (i.e. forklifts, carts, pallet jacks/lifts)
6. Use doors with windows and domed mirrors in corners to avoid collisions and improve sight lines
7. Install double doors that accommodate pallets and pallet jacks at each end of storeroom to promote movement through the area and limit crossover traffic
8. Provide automatic door openers to facilitate movement through the storeroom.
9. Provide durable, slip-resistant and easy to clean quarry tile or concrete on storeroom floors. Floors should be continuous and level with no ramps, thresholds, lips or uneven drains.
10. Install glazed, ceramic tile on storeroom walls for cleaning purposes
11. Use wall-hung and ceiling mounted equipment and track systems to eliminate the legs, pedestals and other supports mounted on floor for ease of cleaning and movement
19. Provide electrical and utility hookups for equipment used in the storeroom. Consider the size and voltage of electrical hook-ups, the size and coupling of utility hook-ups, the number of hookups to meet demands, and the placement of hookups to limit cords, hoses and cables in walkways and high traffic areas.
12. Use sliding rather than swinging doors to optimize space and avoid collisions

Transporting Food

1. Catering kitchen should be in close proximity with and on the same level as the loading dock
2. For locations with multiple levels:

a. Install adequate freight elevators and/or dumbwaiters for catering to minimize traffic
b. The distance from the service elevator to the catering kitchen and prep areas shall be a maximum distance of 50 feet with no impediments (stairs, textured surfaces, bumps, drains, slopes greater than 2% incline)

3. Design and install hydraulic lifts onto loading dock for ease of transfer and transport. If docks are not equipped with hydraulic lift, allow sufficient space to accommodate either mobile or stationary lifts or an ADA compliant ramp.
4. Provide sufficient dedicated storage space for transits and carts. Location of storage should be in close proximity so as to avoid unnecessary transporting of equipment.

Material Handling

1. Provide refrigerated salad bars which provide access from all sides. Installation of electrical, plumbing, and drainage systems (floor troughs with suspended, non-skid grating) must accommodate placement of salad bar.

2. Provide storage space under salad bar with slide out shelves if the design allows.

3. Include design and space for a total Fat Oil Grease (FOG) management system (including equipment) that automatically dispenses, contains, monitors, extracts, transports and filters cooking oil for immediate on-premise recycling and use

4. Provide adequate space around fryers for FOG machines to be used for removal (either by staff or by outside vendor)

5. Provide storage space/area (recessed, if necessary) for the FOG machine near the largest fryers; include electric outlet for recharging

6. Provide adequate space adjacent to milk, soda, and frozen yogurt dispensers for equipment maintenance, loading/unloading products, including space for storing a step stool or safety ladder. Install soda dispensers in close proximity to storeroom to limit distance supplies must be transported.

7. Specify adjustable or variable height and depth counters to accommodate varying sizes and designs of these dispensing machines so they can be accessed easily when loading and cleaning them.

8. Design for installation of gravity-assisted ice dispensing machines with integrated portable totes and carts (see product recommendations for product details)

9. Installation of electrical, plumbing, and drainage systems (floor troughs with suspended, non-skid grating) must accommodate placement of ice machines

10. Locate ice machines close to where ice is used most frequently .

11. Provide adequate aisle space in bakery to accommodate the movement of automatic bowl lifters

12. Provide door width and height in bakery to accommodate an automatic bowl lifter (see product recommendations for product details).

13. Design equipment storage in dining areas under self-serve counters with slide out shelves (for waffle irons, toasters, etc).

14. Designate one (or more) cooler or walk-in specifically for transits and carts that hold prepared food (before final preparation and serving). Cooler should be shallow with no shelving to accommodate one row of transits.

15. Include sufficient storage for pots and pans to prevent congestion and stacking pots and pans to unsafe heights. Shelf height with equipment stored should not exceed 70”

16. Allow for a minimum of 24-inch by 43-inch space next to large tilt kettles, skillets, etc. to accommodate material handling devices and carts

17. Counter space next to steamers, convection, and combi ovens should be at least 22-inches by 13-inches to provide sufficient space for unloading full-sized pans

18. Floor troughs with suspended, non-skid grating should be integrated into the design at all ice machines, tilting skillets, kettles, vertical cutter and mixers, and dish/pot washing areas to minimize slip hazards from water on the floor

Material Handling

1. Provide refrigerated salad bars which provide access from all sides. Installation of electrical, plumbing, and drainage systems (floor troughs with suspended, non-skid grating) must accommodate placement of salad bar.
2. Provide storage space under salad bar with slide out shelves if design apermits
3. Include design and space for a total Fat Oil Grease (FOG) management system (including equipment) that automatically dispenses, contains, monitors, extracts, transports and filters cooking oil for immediate on-premise recycling and use
4. Provide adequate space around fryers for FOG machines to be used for removal (either by staff or by outside vendor)
5. Provide storage space (recessed, if necessary) for the FOG machine near the largest fryers; include electric outlet for recharging
6. Provide adequate space adjacent to milk, soda, and frozen yogurt dispensers for equipment maintenance, loading/unloading products, including space for a step stool or safety ladder. Install soda dispensers in close proximity to the storeroom to minimize the distance that supplies must be transported.
7. Specify adjustable or variable height and depth counters to accommodate varying sizes and designs of soda, milk, and frozen yogurt dispensing machines so they can be accessed easily during loading and cleaning
8. Design for the installation of gravity-assisted ice dispensing machines with portable totes (**see product recommendation sheet for product details**)
9. Installation of electrical, plumbing, and drainage systems (floor troughs with suspended, non-skid grating) must accommodate placement of ice machines
10. Locate ice machines close to where ice is used most frequently
11. Provide adequate aisle and door clearance in bakery to accommodate the movement of automatic bowl lifters
12. Design equipment storage in dining areas under self-serve counters with slide out shelves (for waffle irons, toasters, etc.).
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References

Birchfield, John C. and Sparrowe, Raymond T. (2007). *Design and Layout of Foodservice Facilities, 3rd Edition*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Eastman Kodak Company. (2004). *Kodak's Ergonomic Design for People at Work, 2nd Edition*. Hoboken, New Jersey: John Wiley & Sons, Inc.

ErgoMatters® *Standing Workstation Guidelines*, Volume 1, Number 25. 19 December 2011 <http://www.statefundca.com/safety/ErgoMatters/StandingGuidelines.asp>

Foodservice Research International. *An Investigation of Ergonomic Design and Productivity Improvements in Foodservice Production Tables.* Blackwell Publishing, 2005

Greenbaum, Sophia. *Whole Building Design Guide – Loading Dock.* National Institute of Building Sciences.04-21-2011. <http:www.wbdg.org/design/loading dock.php>

Humantech, *The Handbook of Ergonomic Design Guidelines*, 2009

Kroemer, K.H.E. and Grandjean, E. (2005). *Fitting the Task to the Human, 5th Edition.* New York: Taylor & Francis.

Minnesota Department of Children, Families and Learning. *School Food Service Musculoskeletal Injury Prevention*

Evaluation Tool. (2008)

Occupational Health and Safety Agency for Healthcare in BC. *An Ergonomics Guide for Kitchens in Healthcare.* 2003

Sanders, Mark S. and Ernest J McCormick. (1993) *Human Factors in Engineering and Design, 7th Edition*. New York: McGraw-Hill.

US Department of Justice. (2010) *ADA 2010 Guidelines for Accessible Design 2010*. http://www.ada.gov/2010ADAstandards_index.htm

Handbook AS-70.1 (2005) *Updated with Postal Bulletin Revisions through November 9, 2006*. http://www.apwu.org/dept/ind-rel/usps_hbks/as-series/as-701%20material%20management%2011-06%20(3.81%20mb).pdf

Nation's New Restaurant. (2006) *Safety often overlooked in professional kitchen design.* http://findarticles.com/p/articles/mi_m3190/is_42_40/ai_n16788810/

Occupational Health and Safety Agency for Healthcare in BC. *An Ergonomics Guide for Kitchens in Healthcare.* 2003

EPA Water Sense. (2011) *Pre-Rinse Spray Valves Field Study Report.* http://www.epa.gov/WaterSense/docs/final_epa_prsv_study_report_033111v2_508.pdf

Roy Mech. (2011) *Human Sizes.* http://www.roymech.co.uk/Useful_Tables/Human/Human_sizes.html

Design Guidelines Appendix
Space Requirements

Aisle Space

Space Description	Aisle Width
Single aisle with limited equipment	3.0 feet
Double aisle with limited equipment	4.5 feet
Single aisle with protruding equipment	4.5 feet
Double aisle with protruding equipment	6.0 feet
Aisle with little traffic	4.0 feet
Aisle with major traffic	6.0 feet

Storage Space

Type of Food Operation	Dry Storage*	Paper/Cleaning Supplies	Refrigerated Storage
Fast Food	50-125 square feet	60-100 square feet	90-120 square feet
Small Restaurant	100-150 square feet	75-120 square feet	120-150 square feet
Medium Restaurant or Small Institution	200-300 square feet	120-175 square feet	180-240 square feet
Large Restaurant or Medium Institution	400-1000 square feet	175-250 square feet	240-400 square feet
Large Institution with simple menu	1000-2500 square feet	250-300 square feet	400-600 square feet
Large Institution with complex menu, catering facilities, snack bars	3000+ square feet	300+ square feet	600-900 square feet

*Additional space for staging product should also be considered.

Kitchen and Dining Room Size

Type of Food Operation	Meals per Day	Dining Room Size	Kitchen Size
Restaurant, table service, 100 seats	1000	1400 square feet	1300 square feet
Restaurant, table service, 175 seats	1800	2625 square feet	2000 square feet
Hospital, cafeteria, and 200-bed tray service	600	2250 square feet	2300 square feet
College cafeteria, 350 seats	1400	4200 square feet	1500 square feet
University cafeteria and catering	2400	5625 square feet	2530 square feet
Coffee shop, 100 seats	800	1225 square feet	850 square feet

Bakery Size

Number of Seats in the Facility	Limited Baking*	Extensive Baking**
Under 50	40 square feet	80 square feet
50-100	100 square feet	150 square feet
100-175	250 square feet	400 square feet
175-250	300 square feet	600 square feet
250-500	400 square feet	800 square feet
More than 500	600 square feet	1400 square feet

*Limited baking includes rolls, cobblers, sheet cakes, and a few specialty desserts
**Extensive baking includes a variety of baked goods such as pies, cakes, pastries, doughnuts, rolls, loaf bread, and extensive specialty products

Warewashing

Type of Dish System	Dishes Per Hour	Square Feet
Single-tank Dishwasher	1500	250
Single-tank Conveyor	4000	400
Two-tank Conveyor	6000	500
Flight-type Conveyor	12000	700