

The formulae $\frac{\partial \rho U_i}{\partial t} + \frac{\partial}{\partial x_j} (\rho U_j U_i) = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\mu \frac{\partial U_i}{\partial x_j} \right) + g_i (\rho - \rho_s)$ for building $\frac{\partial}{\partial x_j} (\rho U_j \bar{U}_i) = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\mu \frac{\partial \bar{U}_i}{\partial x_j} - \rho \bar{u}_i' u_j' \right) + g_i (\rho - \rho_s)$ state of the art $\frac{\partial}{\partial x_i} (\rho U_i \bar{H}) = \frac{\partial}{\partial x_i} \left(\lambda \frac{\partial \bar{H}}{\partial x_i} - \rho \bar{u}_i' h' \right)$ biomedical research facilities.

Planning for Oversized Equipment

When designing for oversized equipment, such as Magnetic Resonance Imaging machines (MRIs) and Nuclear Magnetic Resonance spectrometers (NMRs), designers often overlook factors such as the route equipment will travel, height of existing ceilings, width of doors, and size and type of elevators along the route. This can cause problems, because while facilities last decades, equipment does not, and must sometimes be replaced. The significant size and weight of MRIs and NMRs require planning for both immediate considerations and future accommodations.

Path of Travel

The design team should review travel paths for equipment and study how it is brought into and removed from the building.

Section 4.6.1.5 of the DRM, Transportation Route, states:

Delivery pathway through the building, both horizontal and vertical, must be verified during the design phase to ensure an adequate route is available for equipment components or pallets. Doors, elevators, corridors, areaways, parking areas, loading docks, entrances, and all other components of the route shall be of adequate size and load-bearing capacity to accommodate the installation or replacement of large equipment. Assessment shall include turning radii, clearance for rigging, and notation of any actions that will be required (i.e., removing doors from frames, removing light fixtures). Rationale: Costly, disruptive modifications to the building should not be necessary to deliver or remove large equipment in or out of the building.

Factors to consider along the route of travel include:

Ceiling Heights. Corridor heights, including bulkheads, may be insufficient for the movement of large equipment.

Door Widths. NMR and MRI magnets are often wider than typical doors and may therefore require larger openings.

Floors. The load-bearing capacity of floors along travel paths must be evaluated. Temporary floor protection may be necessary to prevent damage to existing finishes, and temporary shoring may be required to ensure against overloading.

Elevators. Large equipment may exceed the capacity of freight elevators, and cab height may be insufficient for the components.

Building Access. Section 5.1.5 of the DRM, Equipment Access, states that designers should “plan and provide access to service existing and replace obsolete equipment.” The rationale for this is to provide “foresight into how instruments/equipment can be moved from and into the building horizontally and vertically, including set-up of equipment needed for the move, which will be critical to minimizing any building damage that may occur from equipment transport.” To avoid expensive changes to buildings, spaces which house this type of equipment should be designed with the consideration for knock out panels or roof hatches for ease of installation and removal.

Rigging Planning

The path for moving equipment in and out of the building, as well as for repair or replacement, should be determined during the conceptual design phase.



Magnet weighing 38,000 pounds lifts off from South Drive

The number and size of cranes to be used must be evaluated based on the equipment, the location of the area receiving the equipment, and site and operating constraints. Road closures, site planning, and other pre-approvals associated with bringing in cranes are required in advance of these activities to

provide adequate time for coordination.

Documentation Requirements

Section 4.6.1.4 of the DRM, Documentation Requirements, states that the “path of travel from point of delivery to final destination for oversized and overweight pieces of equipment ...shall be illustrated and included as a drawing sheet” (emphasis added). Working with the manufacturers from the beginning of the project is key to successful equipment installation. This section of the DRM also specifies the following:

- Location of service areas and clearances shall be identified on the construction drawings.
- Equipment plan and schedules shall state if vendor/ trade support is needed upon delivery.
- Equipment clearances shall be illustrated on the equipment plans accommodating the worst-case requirements. All specified manufacturers should be accommodated in design clearances and utility accommodation, not just the basis of design manufacturer.
- Equipment performance specifications for contractor-furnished equipment should clearly indicate responsibilities of the contractor, owner, and the NIH.
- During the construction phase, the designer, equipment user, and the Project Officer shall review all movable equipment to ensure that models that have changed during the design process can be accommodated at time of delivery.

Summary

At NIH, our clinicians eagerly await the latest breakthroughs in technology for new and innovative healthcare, and equipment is part of their success. It is important to ensure that facilities are properly designed to accommodate specialty equipment, including its installation, removal, repair, and servicing.

‘Design Requirements Manual (DRM) News to Use’ is a monthly ORF publication featuring salient technical information that should be applied to the design of NIH biomedical research laboratories and animal facilities. NIH Project Officers, A/E’s and other consultants to the NIH, who develop intramural, extramural and American Recovery and Reinvestment Act (ARRA) projects will benefit from ‘News to Use’. **Please address questions or comments to:** shawm@nih.gov

Further details on this month’s topic are available on the DRM website: Section 4.6 Furnishings and Equipment
<https://www.orf.od.nih.gov/PoliciesAndGuidelines/Pages/DesignRequirementsManual2016.aspx>