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The formulae $\frac{\partial \rho \bar{U}_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho \bar{U}_i \bar{U}_j)=-\frac{\partial \bar{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu \frac{\partial \bar{U}_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ *for building* $\frac{\partial}{\partial x_j}(\rho \bar{U}_i \bar{U}_j)=-\frac{\partial \bar{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu \frac{\partial \bar{U}_i}{\partial x_j}-\rho \overline{u_i' u_j'}\right)+g_i(\rho-\rho_0)$ *state of the art* $\frac{\partial}{\partial x_i}(\rho \bar{U}_i \bar{H})=\frac{\partial}{\partial x_i}\left(\lambda \frac{\partial \bar{T}}{\partial x_i}-\rho \overline{u_i' h'}\right)$ *biomedical research facilities.*

Pre-Design & Questionnaire Part I

Form Follows Function– a phrase attributed to Louis Sullivan, who in turn attributed it to Vitruvius. These three simple words elucidate the essence of the design process.

The design process encompasses different sub-processes beginning with pre-design and culminating with occupancy. This article will focus on the pre-design phase.

The time span from project inception to occupancy can feel like a very long time. Too often, due to schedule pressure or at the direction of the client, the designer skips or rushes through the pre-design process and begins with Design Development (DD). However, perceived needs of the client do not translate into actual needs, and all too often progress of the DD process is later impeded by in-progress re-design and change orders, all of which impact the overall project schedule and could have been avoided with a thorough pre-design. The challenge here lies in recognizing and then convincing the client of the value of investing time and resources in pre-design effort.

Pre-Design

Pre-design is an evolving process that requires a detailed and meaningful dialogue with the client through structured Question & Answer (Q&A) sessions, with the aim of capturing the client's needs, goals, and vision. It involves asking the right questions and understanding the reasoning behind the answers. This means replacing the question 'what do you want' with 'what do you do' and 'how do you do it.'

For a complex laboratory, clinical, or aseptic facility project, this requires an experienced medical or laboratory planner who is knowledgeable of the processes and procedures the space will be used for and their impact on the facility's design.

Data Gathering and the Use of Questionnaires

The aim of this stage is to collect information pertaining to the functions before ever putting pencil to paper.

Questions that seek to define and extract information regarding the program and its functions, processes, etc. shall be posed to the client. These questions may be qualitative or quantitative in nature.

Quantitative questions seek to develop an understanding of the functions and processes that the project will support, its associated requirements such as required utilities and adjacencies, light and sound requirements or restrictions, cleaning and decontamination processes, work processes, etc. This info will aid the designer in determining the applicable functional and spatial requirements, standards, regulations, etc. based on research type.

Qualitative questions help the designer develop an understanding of the client's vision for the character of the spaces or facility. These questions seek to understand the client's aesthetic and the nature of work areas. Topics of discussion include the client's desire for access to daylight (for personnel working in that space) or lack thereof (due to research type), nature views, desired adjacencies, aesthetics, and ergonomics. These sessions also guide the client and designer in establishing the budget parameters of the project.

The DRM provides template questionnaires for the designer's convenience in Exhibits 2.1, 2.2, 2.3 and 13.1 which can be tailored to accommodate the project's and researcher's unique needs. These questionnaires are for the most common NIH facility types such as BSL-2 Laboratory, Animal Research, Biocontainment, or Aseptic Processing Facility (APF).

At the conclusion of the data gathering stage, the designer must have a thorough understanding of:

- the functions that need to be housed within the given space
- its associated requirements such as utilities, security, shielding, etc.
- program processes such as the flow of people (i.e. researcher vs. husbandry staff), materials, specimens, final products, waste, equipment, etc.
- the levels of interconnection and/or separation amongst functions and processes
- both current and future needs of the space

The collected data and information are used to generate the form-producing parameters, which are used in the next phase of design, bubble diagrams. This article will be continued in next month's News to Use with a review of bubble diagrams as well as design development.

See Chapter 2: Planning and Programming of the NIH Design Requirements Manual (DRM) for additional guidance.

'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 Chapters 2
https://www.orf.od.nih.gov/TechnicalResources/Pages/DesignRequirementsManual2016.aspx