

dictates the need for a high-quality space station stabilization system to minimize periodic and transient motions and angular rates.

Gravity

In discussions between the requirements committee and the design teams, it became evident that the most difficult problem to resolve is the matter of artificial gravity. If artificial gravity is made a firm requirement its implementation can have a very large impact on space station design. Zero gravity is a mandatory requirement for major portions of the experiment programs. There is however, apprehension in some quarters that personnel will not be able to carry out certain tasks satisfactorily in a zero-g environment. On the other hand, provision of artificial gravity by rotating the station complicates the experiment and station design tremendously and introduces other apprehensions about the capability of people to carry out tasks in a rotating station. The following comments on these problems are therefore offered.

Rotation of the space station cabin presents a serious problem in the execution of most experiments in all the areas studied. In astronomy, the need for accurate pointing of telescopes without disturbance from the station obviously calls for a support system that is as motionless as can be obtained. Photography and accurate pointing of sensors needed in meteorology and earth resources can be accomplished simpler and more reliably from a stationary platform than from a rotating one. Most orbital operations could be accomplished only with difficulty from a rotating station and all advanced technology experiments not directed toward the study of the effect of gravity are generally best accomplished in a nonrotating situation. Similarly, in long-term flight, most of the program is best suited to nonrotation and that portion of the program which requires a centrifuge is directed toward the effects of gravity (primarily biomedical effects). Plant biology is constrained to a gravity level less than 10^{-5} gravity units.

Even though the experiments and their apparatus are most suited to zero gravity, there still remains the question whether man can, in zero gravity, accomplish the experimental program conveniently. This problem is more than a question of man's health. It relates to his awkwardness in doing tasks that are quite simple in a normal earth environment but are complicated by the lack of a gravity force to keep things in proper place. Experience in the Gemini program tends to be a little discouraging in this respect. It must be realized, however, that we are still in the early stages of developing competence in operations at zero gravity and, furthermore, the Gemini cabin is so small that it provides a relatively cramped space for two people. With the development of suitable aids and provision of more commodious cabins, the difficulties in working in a zero-gravity field could certainly be alleviated. An argument has been advanced by some groups concerned with the operational feasibility of a space station that artificial gravity should be provided in any event for crew convenience. The validity of this argument can probably be determined from experiments in space addressed to this issue. In any event, whether this convenience is furnished or not, the space station crew must learn to operate in a zero-gravity environment in order to carry out most of the crew tasks associated with the research and development programs.

If the artificial gravity were obtained by rotation of the space station cabin with the rotating radius very large so that the angular velocity would be very low then the experimental program might be less severely affected. A radius of rotation of thousands of feet would be needed to get the greatest advantage of this approach and, of course, the practicality of providing it remains to be established.

More conventional schemes for rotating the cabin usually have a radius of rotation of the order of 50 to 100 feet. They offer the capability of living continuously in an artificial gravity field, but Coriolis effects and gravity gradients are expected to be problems for personnel in this type of environment. Naturally, the programs that cannot tolerate station rotation would have to be carried out in a nonrotating part of the station or in a nonrotating module separated from the station unless rotation of the station were stopped for the duration of such experiments.

Mission requirements

Orbit attitude and inclination and mission duration are the key factors considered as space station mission requirements. Table III shows a summary of the altitude and inclination requirements.