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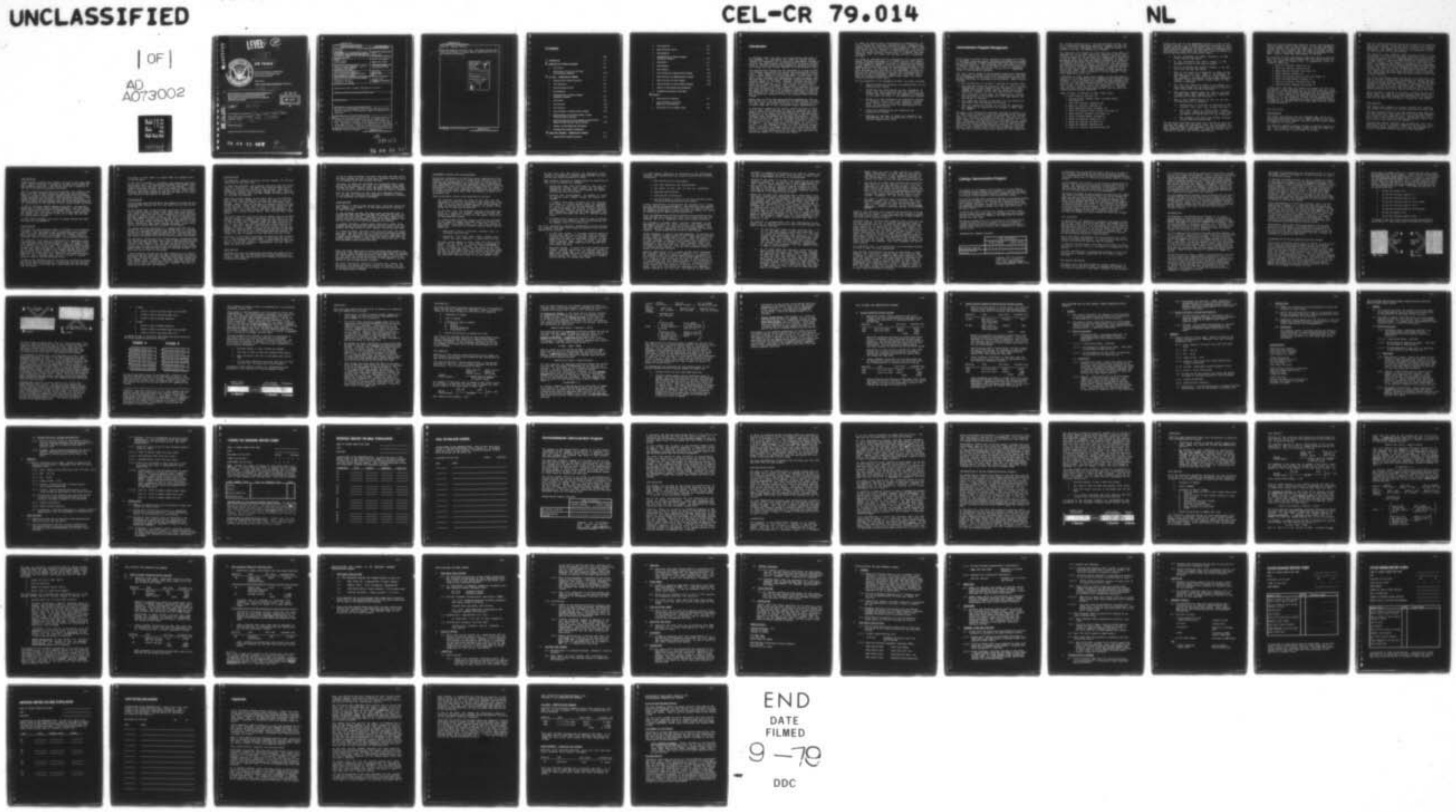

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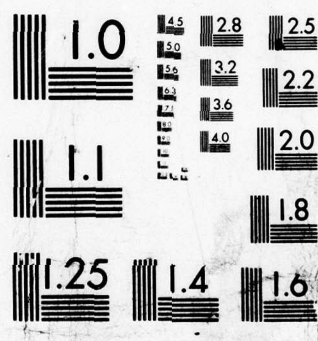

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CIVIL ENGINEERING LABORATORY
Naval Construction Battalion Center
Port Hueneme, California

Sponsored by

NAVAL FACILITIES ENGINEERING COMMAND

Final rept.,

DEVELOPMENT OF A DEMONSTRATION PROGRAM TO EVALUATE REHABILITATION CONCEPTS FOR REDUCTION OF VANDALISM OF NAVY BACHELOR ENLISTED QUARTERS

April 1979

75 p.

An Investigation Conducted by
SPACE FOR SOCIAL SYSTEMS
Alexandria, Virginia

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Study, develops concepts and design for field demonstration experiment for reducing vandalism and cost of damage repair to Naval BEQ sleeping room doors, door hardware and hallway ceilings. Experiment is designed to be conducted at specific BEQs at two Naval Stations. Data will be collected over a long term period and statistically analyzed for design effectiveness on

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Block 20. Abstract (Cont'd)

reducing vandalsim, and repair cost. The design concepts combine the philosophy of occupant behavior modification with target hardening techniques.

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Contents

Introduction

In September 1978, the Naval Civil Engineering Laboratory in Port Hueneme, CA, contracted with Space for Social Systems (SPACE4) of Alexandria, VA, to design an experimental program to evaluate the effectiveness and practicality of design concepts aimed at reducing vandalism-type damage to sleeping room doors and hallway ceilings of Navy Bachelor Enlisted Quarters (BEQs).

The Demonstration Program was the outgrowth of a study by BOSTI (The Buffalo Organization for Social and Technological Innovation). BOSTI issued its four-volume report on "Reducing Vandalism in Naval Bachelor Enlisted Quarters" in April 1978. The BOSTI study developed from observation by Navy personnel that the Navy had a continuing and seemingly expensive problem with property damage in its BEQs. However, although the Navy was aware of the problem, it did not have any hard information quantifying these incidents, their causes or their costs. Thus, the object of the BOSTI research was to describe the scope and costs of vandalism in Naval BEQs, to identify environmental and other factors causing or preventing vandalism, to describe environmental and other changes which could reduce vandalism and to describe a program to test and evaluate these proposed changes.

BOSTI drew its data from questionnaires completed by 105 commanding officers, 262 BEQ managers and 34 public works officers. This data base represented 83 percent of all stateside berthing in Naval BEQs and is thus considered highly representative.

In addition to analyzing the nature, extent and costs of vandalism in BEQs, BOSTI analyzed the data to determine the most damaged and most costly building elements and found that almost 60 percent of the damage (by cost) occurred in two BEQ spaces: Sleeping rooms (38 percent) and hallways (20 percent). Further, the BOSTI study found that the estimated 1976 cost and percentage of total cost of vandalism (in terms of material, labor and overhead only) was: Doors in sleeping rooms, $1.5 million, 21 percent; and space enclosures in hallways, $1 million, 14 percent. As the Statement of Work for this follow-on project notes, "The repair of damage resulting from vandalism of Navy-owned multiple-occupant BEQ quarters and their furnishings results in large expenditures of the Navy's BEQ operation and maintenance budget in a non-productive manner."

In hopes of curbing these "non-productive" expenditures, the Civil Engineering Laboratory determined that a Demonstration Program should deal with the building elements the BOSTI study found to be the most expensive to repair/replace. The contract with SPACE4 thus was limited to identifying and constructing tests for design concepts involved only in sleeping room doors (hardware, door and frame) and hallway ceilings (suspended ceilings).

The study of each BEQ facility selected for this experimental design involved development of a rehabilitation plan (demonstration program) designed to permit a statistical evaluation of the degree of change in the cost of vandalism-type damage between the retrofitted areas and unrehabilitated areas of the same facility. As prescribed in the Statement of Work, to avoid destroying the validity of the experiment, the development of the rehabilitation plans gave full consideration to minimizing the psychological impact the experiment might have on residents occupying rehabilitated space and others occupying unrehabilitated space.

As also suggested in the Statement of Work, the study included:

- Identification and selection of candidate BEQs for the Demonstration Program
- Scheduling and interviewing of base commanders at those sites where candidate BEQs are located to determine the willingness of the command to cooperate in and share the costs of the Demonstration Program
- Design of a data collection and analytical program to quantify statistically the vandalism incident rate, repair costs and other pertinent factors prior to, during and after the Demonstration Program evaluation period
- A plan for implementating and scheduling the Demonstration Program
- Analysis of the cost of labor and materials for implementing the BEQ retrofitting at each of the selected demonstration sites

Demonstration Program Background

SPACE4 began its work on this contract by reviewing all volumes of the BOSTI study and report, including the Summary and volumes on a "Demonstration Program & Design Guidelines" and on "Project Methods and Results." The contractor also considered the issue of "theft," which was part of the BOSTI study, to determine if there were sufficient correlation to use it as a modifying factor in testing design concepts.

Once this initial review of the preceding project was completed, the contractor developed criteria for the selection of the bases to be recommended to the Naval Civil Engineering Laboratory for possible inclusion in the Demonstration Program. These criteria included:

- the availability of "as-built" drawings of candidate BEQs
- that the base should be "typical," that is, with no extreme fluctuations in the number of BEQ residents, no major changes anticipated in BEQ staff or policy and no major renovation planned during the Demonstration Program
- that buildings altered under the Demonstration Program and buildings not so altered be of the same general age and design, if possible
- that some base funding be available for the renovations associated with the Demonstration Program
- that the commanding officer of the base be cooperative and receptive to undertaking the changes in BEQs under his command

The Naval Civil Engineering Laboratory provided an initial list of likely bases at which to institute the Demonstration Program; that list consisted of two bases at Norfolk, VA; four at San Diego, CA; and bases at Whidbey Island, WA; Moffett Field, CA; Pearl Harbor, HI; Philadelphia, PA; and Kingsville, TX. Those bases, selected before the contract was let, were chosen because they had the Welton Beckett-type BEQ, which at that time was envisioned as a standard BEQ design for the Navy in the future. However, after NAVFAC (Naval Facilities) personnel reported that the Navy's planned construction design for the future did not include continued use of the Welton-Beckett design, the Civil Engineering Laboratory approved a request for the contractor to choose from among "all high vandalism bases" for possible sites for the Demonstration Program.

The contractor then tapped the large data base which BOSTI had compiled for its earlier reports on vandalism in Naval BEQs, carefully examining the questionnaire summary sheets pertaining to the 98 bases for which there was information in order to determine which bases had the highest incidence of vandalism to sleeping room doors and hallway ceilings, and the costs associated with those incidents. Analysis of this information, and the data provided by commanding officers and BEQ managers who filled out the BOSTI questionnaires, yielded a list of eleven Navy bases with a high incidence of door damage and five bases with a high incidence of ceiling damage. Three bases appeared on both lists.

Elimination of those bases which seemed to have too small a population to be appropriate for a Demonstration Program finally yielded a list of 12 bases with apparently good prospects for inclusion in the Demonstration Program (including three which were on both the door and ceiling lists) and a 13th base, Cecil Field in Florida, which had switched to a "keyless" lock and thus might provide some insight into at least one viable solution to door vandalism.

Those 12 bases, in addition to Cecil Field, were:

- Naval Station, Norfolk, VA
- Service School Command, Naval Training Center, San Diego, CA
- Naval Air Station, Lakehurst, NJ
- Naval Air Station, Lemoore, CA
- Naval Amphibious Base, Coronado, CA
- Naval Air Station, North Island, San Diego, CA
- Naval Station, Miramar, San Diego, CA
- Naval Training Center, Orlando, FL
- Naval Air Station, Kingsville, TX
- Naval Air Station, Key West, FL
- Naval Air Station, Meridian, MS
- Naval Air Station, Patuxent River, MD

Letters were sent to the commanding officers of each of the 13 bases, posing a set of seven preliminary questions for which answers would be sought during several days of telephone interviews with those commanders, or their designated representatives. The questions, which would then provide a basis on which to select some Navy bases for site visits, were:

1. Do you anticipate any major renovation to BEQs within the next two years?

2. Do you anticipate any major changes in BEQ management policy in the next two years?

3. Do you anticipate any unusual changes in the BEQ staff over the next two years?

4. What is the extent of fluctuation in number of BEQ residents at your base? What is the turnover of BEQ residents? In your opinion, is the extent of the turnover or fluctuation in the number extreme or unusual? Would you expect present rates of fluctuation to continue?

5. Are there any renovation funds in your budget or is your base slated for any MILCON (military construction) funds within the next two years?

6. What physical changes would you like to see made in BEQs under your command to reduce vandalism specifically to doors and ceilings?

7. Who in your command should we talk to for the following specific information:

   a. Verification of incidents of vandalism to BEQ sleeping room doors and hallway ceilings?

   b. Any action taken to reduce these incidents since your command participated in a 1976 study (by BOSTI) for which this is the follow-up?

   c. How sleeping room doors and hallway ceilings in your BEQs are constructed?

The telephone interviews were made over a period of seven consecutive work days and involved at least two individuals at each base, although in some instances, as many as three or four base personnel were interviewed in order to complete the information sought on the initial questionnaire.

After the initial interview, which was usually with an administrative, public works or BEQ officer, if not the commanding officer himself, the contractor spoke with individuals, identified by the first contact, who were able to provide greater detail about the present extent of vandalism problems in the BEQs. Usually, these were BEQ managers or officers.

On the basis of this information, eight Navy bases on the East, West and Gulf Coasts were selected for site visits during the first two weeks of January 1979. In alphabetical order by location, these are:

- Naval Air Station, Kingsville, TX
- Naval Air Station, Lakehurst, NJ
- Naval Station, Miramar, San Diego, CA
- Naval Station, Norfolk, VA
- Naval Air Station, North Island, San Diego, CA
- Naval Training Center, Orlando, FL
- Naval Air Station, Patuxent River, MD
- Service School Command, San Diego, CA

A ninth base, the Naval Air Station at Lemoore, CA, was also considered a likely candidate for a site visit and was a "back up" for a visit in the event that one or more of the other bases proved for some reason to be unsuitable for the experimental program. This ninth base was kept in reserve to provide some flexibility in the selection of BEQs for the Demonstration Program, but it was unnecessary to visit the Naval Air Station at Lemoore, CA, because the first eight bases provided enough suitable candidates.

THE SITE VISITS

Site Visit #1

This Naval installation has one "problem" BEQ, which has a totally-student population from a tenant command at the base. According to the host command, that BEQ had "the highest amount of vandalism on the base."

The BEQ has a maximum capacity of 500, an average capacity of 300. The students, who number between 4,000 and 5,000 per year, stay an average of seven weeks in the BEQ.

The most visible damage here may be less a function of vandalism than of poor design. There are entire hallways in the building which have virtually no ceiling tiles. This is not a recent phenomenon. The command says much of the damage has existed for the six-year life of the building.

The reason for these virtually "nude" sections of hall is that the hallways are five feet wide and a two-foot-by-five-foot-wide acoustical ceiling tile is suspended across the entire width. The mere weight of the tile, even without any interference from resident sailors, often causes it to fall to the floor and break. In addition, the ceiling is designed so that the acoustical tiles--when in place--provide part of the air-conditioning system. The return air moves through that space and when tiles are missing, the flow of air is incorrectly channeled. And since there are also pipes above the tiles, there is condensation, which makes the tiles damp and heavy and also causes them to buckle and fall.

The initial poor design stems from the use of an odd-sized tile--with a five-foot width--which is expensive to replace and has too wide a span to be well supported. However, in some hallways, fluorescent lights had been installed in the center of the hall parallel to the walls; the foot-wide light fixtures left a two-foot section on either side, and that can be filled with common two-by-two-foot tiles, which are more readily available.

Doors were less a problem at this BEQ. Although the doors are hollow metal and seem to withstand damage rather well, the locks, which are keyed through the knob (there is no deadbolt), wear out and parts are not kept in supply for easy repair.

Site Visit #2

Poor design again seemed to be more culpable than vandalism with regard to problems with sleeping room doors at this base.

The major problems were in five new buildings--three decks each with 22 sailors per deck--where the doors have been changed to solid-core with a deadbolt lock. Because the doors are so thin, only 1-1/4 inches, installing the deadbolt causes the door to split above and below the deadbolt.

Although the command personnel who escorted the site visit team said there is a problem of damage to ceiling tiles, which are mineral fiber acoustical tiles, not much damage was visible, apparently because repairs are made promptly.

Site Visit #3

Vandalism-type problems were largely confined to two large BEQs here: BEQ A, which has a population of about 400 students and 400 permanent personnel; and BEQ B, which has a capacity of 600 and is occupied by permanent personnel.

Both acoustical-tile ceilings in the hallways and sleeping room doors and door hardware evidenced damage in both buildings. However, in BEQ A, the greatest damage seemed to be the mineral fiber acoustical ceiling tiles, which had holes and burns. Door damage included holes punched in the solid-core wood doors. A few doors which had been damaged near the locks had been repaired and strengthened by the addition of metal plates around the knobs.

In BEQ B, the major damage seemed to be doors. On one deck, among about a dozen rooms clustered together, there were three rooms which had missing doors or damaged locks. In one instance, the occupant had installed a padlock to provide some security, but another door had neither a lock nor a knob and the room was simply open to anyone.

In both these buildings, the locks are keyed through the knob, and there are no deadbolts.

Site Visit #4

This base has three distinct types of buildings in two separate locations. The two newest sets of buildings house students and the oldest buildings house permanent command personnel. Doors and door hardware are damaged in all three types of buildings and are a continuing repair and maintenance problem.

Door hardware in one type of student BEQ here apparently takes a beating just from prolonged, general use. The knobs loosen from repeated lifting in an attempt to make the deadbolt line up with the slot in the frame. This reportedly occurs because "hinges are always pulling out," thus causing the doors to get out of line, but it probably also happens because settling of the building causes cracks at the joints and interface of materials, e.g. the metal door frames and the gypsum wallboard. (This is less a problem where the walls are of a sturdier material, such as concrete masonry units.)

Instead of the deadbolts used in the previous building described, the second type of building has a heavy-duty knob and latchset with a key lock in the knob and a push-button to lock the door from the inside.

The doors in both types of student BEQs are gypsum-filled solid-core wood.

In the third increment of buildings, the sleeping rooms have hollow-core doors, surface-mounted deadbolts and wooden frames. These doors also have vent grilles at the bottoms; in the several buildings visited, there were almost no doors without dents or bent metal pieces in the vent grilles. Other doors had been reinforced around the knob by the addition of a metal plate bolted to the exterior of the door.

Site Visit #5

Two buildings were identified by the command as having the most vandalism-type damage, and this was borne out by touring the buildings.

On the second deck of one building, which had a long hallway with sleeping rooms on either side, there were holes poked in some doors, door vent grilles were dented and holes had been punched in hallway ceiling tiles. These doors are hollow-core, but once damage has been inflicted, the door is toughened by the addition of a 3/8" piece of plywood on the exterior of the door. The door frames are metal, but the latchset is a light-weight residential type keyed through the knob. Almost every door on this second deck had a plywood reinforcement.

The second building identified as a damage-prone BEQ had no hallway ceiling problems because the piping runs in a bulkhead inside the individual sleeping rooms and the ceilings thus did not have to be lowered with acoustical tile. The ceilings here were gypsum wallboard which was too high to sustain much damage.

But the doors, hollow-core with a light-weight, residential-type lock keyed through the knob, had in many instances been repaired with the same plywood face. One door on the first deck had cracked on the interior side and been reinforced with a metal plate around the knob on the inside, and plywood on the outside. Another door on that deck had a hole in the wood surface. All doors had vent grilles at the bottom.

A third building visited had not been singled out as a heavily-vandalized BEQ but there were hallway ceiling tiles with holes, and doors, hollow-core with a heavy-duty knob keyed through that knob, showed signs of damage. Some doors had been reinforced with plywood faces, others were splitting above and below the latch and a third had apparently been "jimmied" and had pry marks on the edge near the latchset.

Site Visit #6

Two identical, adjacent buildings housing students are the most vandalized at this Navy base.

In these two buildings, the sleeping room doors open off either side of a long hall. The doors are solid-core wood (with a gypsum fill) with vent grilles at the bottom; they have a residential latchset and are keyed through the knob. The walls are concrete masonry unit, the door frames are hollow metal and the ceilings are concrete.

Among the visible damage on the third deck of one building were "jimmy" marks around the latchset and dents in the vent grilles. On one door where the lock had previously been damaged, repair crews had replaced a triangular section of door around the knob. Other doors had metal plates around the knob on the exterior of the door to reinforce the latchset. On another door, the striker plate had been strengthened by the addition of a second striker plate; this held the door closed better.

The escort took the site visit team to another type of building used by students. Sleeping rooms open off one side of a long hallway in these buildings, and lounge and head facilities are in the building core. Deadbolt locks had been installed on many of the doors and were scheduled for installation on all doors. When this change, from residential-type latchset to deadbolt is made, a metal plate is put on the face of the door around the lock and a pull is added to the exterior of the door. These doors with pulls are only latched when the deadbolt is locked; no key is needed to lock the door from the inside.

The doors in this type of building are solid-core with a gypsum fill. One problem with these doors is that when the door is cut for the latchset, there is only a quarter-inch of wood into which to screw the latchset; consequently, the door splits above and below the latch.

Site Visit #7

Although this base has apparently diminished the number of incidents of door and ceiling vandalism through administrative actions, there were two buildings with frequent turnovers which evidenced some damage.

In one of those buildings, one door from which the vent grille had been knocked out had a large hole, obviously made by force, in the plywood which had replaced the vent.

The doors in these two buildings are solid-core with a vent grille at the bottom; the lock is a residential type keyed through the knob. Several doors had metal plates on the interior and exterior wrapping around the knob and latch (a channel).

None of the buildings at this base has suspended ceilings. All ceilings were concrete with sprayed-on acoustical treatment, or the buildings had exterior walkways.

Site Visit #8

According to a public works officer here, the major reason for door damage in the BEQs is to the vent grilles in the doors of some buildings.

In one building visited, the doors were hollow-core with a residential-type lock keyed through the knob and had both vent grilles and kick plates. Some doors also had a metal plate around the knob and latchset, which the building manager said was done after the lock had been damaged and replaced.

In another building, several doors shown had a metal plate wrapped around the knob and latchset on both sides of the door because the wood had split after someone forced the door open.

In a third building, the doors were solid-core wood, the frames were metal and the locks were a residential type keyed through the knob. The doors did not have vent grilles. Some doors had a metal piece attached to the frame near the striker plate to prevent anyone's using a credit card to violate the lock. Some also had metal plates around the knob.

After the eight bases were visited, the bases were ranked as to population size, the severity of vandalism-type damage to sleeping room doors and/or hallway ceilings in their BEQs, the availability of base funds for retrofitting some buildings as part of the Demonstration Program and the interest of the command in participating in such an experimental program.

The Civil Engineering Laboratory reviewed this ranking and designated two bases--the Naval Station at Norfolk, VA, and the Service School Command at San Diego, CA--for participation in the Demonstration Program.

PERFORMANCE CRITERIA FOR CEILINGS/DOORS

During the preparation for the site visits, during the visits themselves and while the Civil Engineering Laboratory was considering the recommendations for two bases to participate in this experimental program, the contractor and a subcontractor were developing data collection and analysis materials, defining performance criteria for the design elements to be tested (ceilings and doors/door hardware) and identifying manufacturers of products which would meet these performance criteria at a reasonable cost.

These performance criteria were described as follows:

> The ceilings presently in place at the test site are suspended ceilings with 2x4 mineral fiber acoustical tiles. These tiles are easily damaged by holes being punched in them, by burning with butane lighters, by pieces' being broken out of them and by moisture.
>
> At the test site, the suspended ceiling system does not serve as a return air plenum; therefore, it does not require an impervious surface for the proper functioning of the mechanical system.
>
> Two identifiably-different products which are resistant to the types of damage described above and which still meet normal fire-safety codes, e.g. NFPA 101, should be identified. Some possible products meeting these requirements are:
>
> - o metal-face tile--a perforated aluminum face on a mineral board backing.
> - o wood-fiber tile--long wood fibers bonded with cement and then subjected to compression and heat.
>
> The most severe damage to doors stems from their being kicked, but the damage is almost totally unrelated to theft. Instead, it is largely the result of sailors' losing or misplacing their keys and resorting to force to get into their own rooms. The impact of kicking causes the face of the door to splinter and pull away and causes the lock mechanism to come loose from the gypsum core. The door/lock interface seems to be the weakest point.

At the test site, the locksets are apparently quite "cheap"--a residential latchset keyed through the knob--and are thus quite vulnerable to force.

Door products resistant to damage should be identified for each of the following four elements:

- o Gypsum-core door with solid wood at least one and one-quarter inches thick around the perimeter (edges) of the door and solid around the handle and lockset area of the door.
- o Exterior door reinforcement. An example is using an applied steel channel around the handle and lockset.
- o A deadbolt lock whose cylinder core can withstand five blows of 74-foot pounds force, as suggested for class III Security by the National Institute of Law Enforcement and Criminal Justice (NILECJ) standards for physical security of door assemblies and components. Applying the same standards, the bolt should withstand two blows of 118-foot pounds force.
- o A lockset which would not require a key to operate, eliminating the problem of the lost/misplaced key. An example of this is a cipher lock.

The Civil Engineering Laboratory recommended possible products for sleeping room doors which might be tested as part of the Demonstration Program:

- o A steel door system: 1) 14-gauge standard industrial hollow metal door with steel door jamb and without louvered ventilator; 2) passage latchset without keyed lock in knob (to hold door closed); 3) door lockset--tubular type, single cylinder, removable core, dead bolt with thumb turn for opening door from inside the room.
- o Wood door system: 1) solid core (stave type) wood door without louvered ventilator; 2) passage latchset--same as for metal door; 3) door lockset--same as for metal door except the door is reinforced with metal channel around the lock; 4) high-security deadbolt lock strike set in a wooden door jamb.

For each product identified as conforming to the performance criteria, the subcontractor was asked to provide the following information:

- o the availability of the product
- o unit cost (materials and installation)
- o any gross or bulk cost to the U.S. government
- o detailed specifications
- o installation instructions
- o any difference in prices on the East and West Coasts, including shipping and delivery charges.

A major consideration in designating the products to be tested was, of course, cost-effectiveness. Not only would the commands be unable to participate if the cost were too high but even if the products tested out as highly resistant to damage, the expense of retrofitting all BEQs could be prohibitive.

Since the Demonstration Program involved only existing construction and thus was limited to retrofit and rehabilitation, the products had to be compatible with the existing buildings.

The contractor reviewed several possible "responses" to the performance criteria for their potential cost effectiveness and their potential for resisting or deterring damage. This involved two basic approaches to design concepts for building elements: target hardening and behavior modification.

Target hardening is just as the name suggests: it involves the use of a harder or tougher material which might better withstand certain types of damage known to occur. Thus, the design for ceilings includes a type of ceiling tile which is expected to be more resistant to damage from punching with objects or hands/fists, and the design for doors includes a door reinforcement to make the door more resistant--less vulnerable--to kicking, which appears to be the most prevalent source of damage to doors/door hardware.

Behavior modification uses a design concept which encourages the potential vandal to alter his behavior in a situation. For ceiling tiles, this behavior-modification approach is to paint bands of bright color on the existing type of ceiling tile to beautify the environment and make it more pleasant; it is hypothesized that such beautification of the ceiling will serve as a deterrent to acts of vandalism. A behavior-modification design for door hardware is the use of a "keyless" or cipher lock which eliminates the expensive and seemingly-endless problem of the lost key. The behavior of the room's occupant is changed by elimination of his need to "break" into his own room because he cannot find his key; it thus alters the way he approaches access to his sleeping room.

Because of the number of ceiling tiles available for the Demonstration Program, it was possible to select <u>two</u> designs to test: both a harder material and a more attractive tile. But since the cost of replacing enough locksets to permit testing of two design concepts would be prohibitive, only one type of lock--the "keyless" or cipher deadbolt lock--is being tested in the Demonstration Program.

Among the ceiling tiles considered were a metal-faced tile, but even a manufacturer discouraged the use of a metal-faced tile because it dents and becomes as unsightly and damaged as the existing type of mineral fiber acoustical tile--and is considerably more expensive to replace. The choice was a mineral fiber acoustical tile with a "tough" face specifically designed for use in so-called "high-activity areas." This is hypothesized to be more resistant to damage than is the existing type of mineral fiber acoustical tile. The decision to paint some of the existing ceiling tiles in bands of bright color, as previously discussed, is part of an attempt to test behavior modification through use of a more-attractive tile which is no harder or more damage resistant than what is presently in use.

The decision to systematically test the effectiveness of the cipher lock in reducing vandalism to doors and door hardware was based on several premises:

- o The one Navy base known to have installed such locks in all its BEQs reports unofficially that the locks are virtually maintenance free, that it is very easy to change the combination when occupants of a room change, that the incidents of door vandalism, previously high, have dropped to almost "zero" and that the locks have more than paid for themselves. (Of course, there is no systematic documentation of any of these statements, but the command thinks it made a wise decision.)

- o At all bases where the contractor talked with command and BEQ personnel, the astronomical problems of replacing lost keys were cited. These problems include the cost, the frequency, the time it takes to have new keys made (at even some fairly-large bases there is only one locksmith) and the difficulty in rekeying locks when occupants of rooms change. A security problem is also created by the fact that occupants fail to turn in their keys when they move or they pretend to have lost keys so they can pass them on to friends.

- Keyed locks are seen in some quarters as headed toward obsolescence, in which case it would be far-sighted of the Navy to have documented evidence of the effectiveness of cipher locks in reducing incidents and cost of door and door-hardware vandalism.

- The use of the cipher lock involves the possibility that behavior can be modified so that it is not necessary for the Navy to look toward a future of ever tougher and harder materials until one day the BEQ is a virtual prison--an unacceptable alternative if it wants to attract skilled and qualified individuals who expect something better than an institutional atmosphere in the all-volunteer Navy.

- The door is generally most vulnerable--when it is attacked--around the lockset, and with the cipher lock a tougher material (the reinforced door instead of a "tougher" lockset) can be tested at the same time a behavior-modifying concept is also being tested.

However, the contractor also examined the possibility of using other designs to respond to the door and door hardware criteria, including a metal door, a wood-stave door and a keyed deadbolt lock used with a passage latchset.

The metal door is initially more expensive than a wood door and presents problems for use in existing construction (such as the retrofitting which is involved in this Demonstration Program) because it is impossible to "field trim" a metal (16-gauge steel) door to fit an existing frames. In addition, the subcontractor found that the metal doors made by three different manufacturers do not fit each other's frames. Since there are already hollow-metal frames at the Demonstration Program site, and there is no plan to change those to another hollow-metal frame, the easy availability of the proper-sized metal door would be limited. Also the metal door is heavy, and unless hallways are carpeted, their use increases the noise level greatly.

The wood-stave door, a solid-wood door, was eliminated because it fails to meet fire-code regulations.

Very serious consideration was given to specifying a keyed deadbolt lock used with a passage latch, but since this type of design is increasingly common in BEQs which continue to have vandalism problems, it was felt that testing a different concept--the cipher deadbolt lock which seems to have some inherently-positive features--would provide the Navy valuable information (and documentation) to help it decide if what it wants and needs in the future is merely a "tougher" lockset or if a lock which changes the behavior of the BEQ residents is in fact a more cost-effective solution.

Ceilings: Demonstration Program

The purpose of the Demonstration Program is to test whether recommended design changes are effective in reducing incidents and cost of vandalism which results in damage to ceiling tiles in hallways of Navy Bachelor Enlisted Quarters (BEQs).

The ceiling changes which are being tested in this Demonstration Program will be made in hallways of two adjacent BEQs at the Naval Station, Norfolk, VA: Carter Hall, which has transient and permanent personnel, grades E4-6; and Groshong Hall, which has permanent personnel, grades E1-6 (and some Chief Petty Officers, E7-8).

Incidents and cost of ceiling-tile damage in hallways where design changes have been made will be compared with incidents and cost of ceiling-tile damage in hallways where no design changes have been made.

The design changes which will be tested in the Demonstration Program involve the use of a harder ceiling-tile material (target hardening) and the painting of the existing type of mineral fiber acoustical ceiling tile (appearance or behavior modification).

DEMONSTRATION PROGRAM STRUCTURE

	TIME (IN MONTHS)												
	Before Change							After Change					
	1	2	3	4	5	6		1	2	3	4	5	6
New Design Location	0	0	0	0	0	0	X	0	0	0	0	0	0
Existing Design Location	0	0	0	0	0	0		0	0	0	0	0	0

(Adapted from Fitz-Gibbons, Carol Taylor and Morris, Lynn Lyons, How to Design a Program Evaluation, 1978, p.55)

X represents the ceiling design changes which will be made in the locations designated for testing of the design concepts. O is documentation of incidents of ceiling-tile damage in both locations, where there is new design and where there is existing design.

To test whether the incidents of ceiling-tile damage would be more or less than normally expected, a comparison location is needed. The important considerations for selection of the two locations include the similarity of the resident populations, building design and building management.

The first six months of data collection on ceiling-tile damage and repair--the data collected before the design changes are made--is used to examine the two locations to see if they do have similar types and numbers of ceiling-tile-damage incidents as was assumed when they were selected; and to compare in the two locations the change in the frequency and types of ceiling-tile damage that occurs in each--to check the effects of the ceiling-tile design changes. Six months is believed sufficient time to collect enough incidents and types of ceiling-tile damage to provide a reliable picture of ceiling-tile damage that occurs before and after the changes.

SITE SELECTION

In Carter Hall, the changes will be made on two wings of each of the four floors, and in Groshong Hall, the changes will be made on four floors of each of two towers; this will comprise the new design location. The existing design location will be the other two wings of each of the four floors of Carter Hall and the other two floors of each tower in Groshong Hall. The existing design location was selected because it is similar to the new design location in each building.

One of the three considerations for site selection was similarity of resident populations. In each building, the two locations are similar by type and rank of resident.

In terms of building design, all wings on all floors of Carter are similar, and all floors of the towers of Groshong Hall are similar.

The last consideration in matching the locations is that each building has a manager responsible for all floors of that building.

DATA-COLLECTION PERIOD

The data to test the effectiveness of design changes will be collected over a period of time. As pointed out by BOSTI in its study on vandalism in Navy BEQs, "threats" to the validity of an evaluation of the design change can be minimized through the use of a "time series" design. This is done by instituting routine measurement of vandalism incidents and repair for a specified period of time, then installing the design concept aimed at reducing vandalism, and finally continuing measurement of the vandalism and repairs. Then the trends over time both before and after the changes are compared. Since there is also a control group (no changes in ceiling tiles will be made in certain areas), all incidents before the changes can be compared with all incidents after the changes both within each location and between the two locations.

For this Demonstration Program, data collection will be over a 12-month period (six months before and six months after the changes are made), plus the time it takes to make the ceiling design changes. This figure is based on estimated incidents of ceiling-tile damage in Carter and Groshong Halls, which are deemed frequent enough that the two six-month data-collection periods should be sufficient to provide statistically-reliable results.

RECORDKEEPING

The backbone of the Demonstration Program is, of course, recordkeeping, or data collection. Whether or not BEQ management personnel are currently documenting incidents of vandalism, *they must do so for this Demonstration Program.* While the documentation is mandatory, however, it is designed to be the least disruptive to normal BEQ activities. The data must be collected by wing or floor, depending on how the design changes are allocated within a building.

For this Demonstration Program, both BEQ resident managers, or their assistants, and persons who make repairs will be required to keep records on ceiling-tile damage. The BEQ personnel should make weekly inventories of damage--always on the same day of the week. This avoids the possibility that one period (of a week) might include two weekends, which could be periods of high vandalism-type damage, while another "week" might be only five or six days long. However, this Demonstration Program does not prescribe when or how frequently repairs should be made. Repairs should be made in keeping with usual procedure.

The data-collection forms, samples of which appear at the end of this section, are somewhat self-explanatory. Yet it is important that before data collection begins, the persons who will be filling out these forms be given an orientation to establish ground rules about what constitutes major types of damage and how and when the forms should be filled out, as well as to provide them with an opportunity to ask questions. The purpose is to make the data collection as complete and uniform as possible.

The sample forms demonstrate the information which is vital to meaningful analysis of damage to ceiling tiles and the impact of the design changes.

In addition to keeping records of types of damage and numbers of ceilings tiles damaged, the BEQ management personnel need to keep monthly records showing the number of residents on each wing or floor, as well as whether they were transient or permanent personnel. A sample form for this data collection is included at the end of this section. The same individuals should also keep a "log" of events in the BEQ which might affect incidents of vandalism, e.g. a fire in one of the buildings. This "log," which is included at the end of this section, should indicate the date and the event so that these events can be taken into consideration during analysis of the incidents of ceiling-tile damage.

Since recordkeeping in itself may influence repair and even observation of damage, it is important that the system for keeping these records be in place long enough before changes are made so that keeping the records becomes routine. As the BOSTI study pointed out, "the measuring instrument should not produce more or less repair than would ordinarily occur" and "a routinized recording instrument should be in place on the chosen site before the treatment is instituted and should create less reactivity" (reaction to recordkeeping). This necessity that recordkeeping be routine is associated with the required pre-change data-collection period.

Additionally, before data collection begins, the ceilings should be in good order. This should not be a problem at Norfolk since the Demonstration Program is scheduled to begin shortly after some refurbishing/renovation in Carter and Groshong Halls has been completed and that work includes replacement of damaged ceiling tiles.

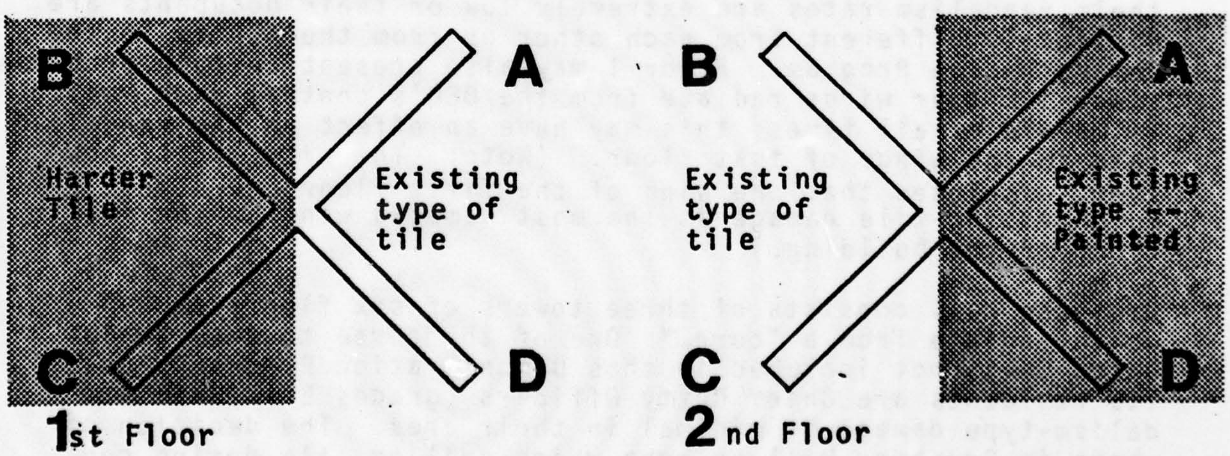
IMPLEMENTATION OF DESIGN CHANGES/EVALUATION SCHEDULE

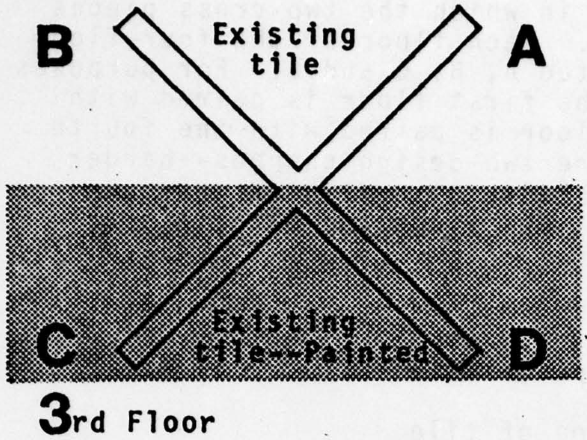
Initial data collection should begin at Norfolk as soon as possible after the refurbishing/renovation work is completed. This is presently estimated as early spring 1980, so the schedule calls for the data collection to begin in April 1980. After the six-month mandatory period for collecting base-line data, the changes in tiles would be made in the designated wings and on the designated floors. Then the second six-month period of data collection would begin. Data would be collected while the changes are being made, but this data will be considered separately or will not be considered. It is very important that there be a six-month data-collection period before the changes are made and another six-month data-collection period after the changes are made.

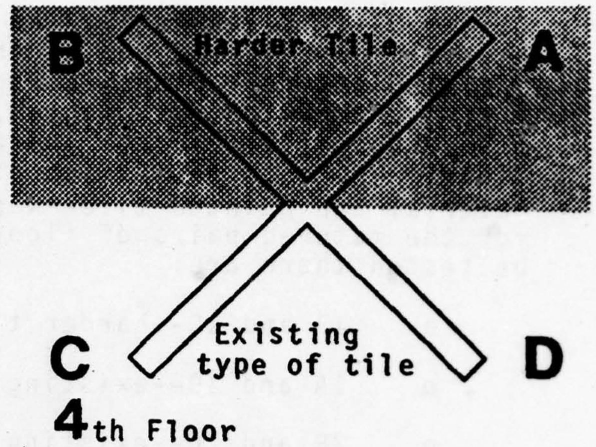
Carter Hall is shaped like an "X in which the two cross pieces are perpendicular to one another. Each floor of the four-floor building has four wings, designated A, B, C and D. For purposes of this Demonstration Program, the first floor is paired with the second floor and the third floor is paired with the fourth floor. Where to test which of the two design changes--harder material and painted tile--was decided by a flip of the coin for the matched pairs of floors. The wings and materials to be tested there are:

- o 1B and 1C--harder tile
- o 1A and 1D--existing type of t e
- o 2B and 2C--existing type of tile
- o 2A and 2D--existing type of tile painted
- o 3B and 3A--existing type of tile
- o 3C and 3D--existing type of tile painted
- o 4B and 4A--harder tile
- o 4C and 4D--existing type of tile

A diagram of the four floors, how the wings are paired and which wings will have which type of ceiling tile follows:







Of the 16 wings in Carter Hall, four will have the harder tile, four will have the existing type of tile painted and the other eight will have the existing type of tile. There are 135 ceiling tiles per wing in Carter Hall; thus there would be 540 harder tiles, 540 existing type tiles painted and 1,080 existing type ceiling tiles in the Demonstration Program.

The occupants of Carter Hall are transients on floors 3 and 4, permanent personnel on floor 1 and some transients and some permanent personnel on floor 2. It is possible that after the initial period of data collection (the six months preceding the changes), floors 1 and 2 will be dropped from the study if their vandalism rates are extremely low or their occupants are distinctly different from each other or from the others in the Demonstration Program. Floor 1 may also present certain problems since its four wings radiate from the BEQ's central desk, which is manned at all times; this may have an effect on the vandalism rate in the wings of that floor. (Note: The site visit, however, disclosed that one wing of the first floor had almost as much ceiling-tile damage as the most damaged wing on the fourth floor of the building.)

Groshong Hall consists of three towers of six floors each which radiate from a "core." One of the three towers--designated C--is not included in this Demonstration Program because its residents are Chief Petty Officers (grades E7-8) and vandalism-type damage is minimal in their area. The decision of where in Groshong Hall to test which ceiling tile design concept was decided by enumerating the possibilities for each of the two remaining towers--A and B--and then randomly selecting from those possibilities. The floors and the materials to be tested there are:

- o A Tower
  - o Floors 1 and 2--existing type tile painted
  - o Floors 3 and 4--existing type tile
  - o Floors 5 and 6--harder material
- o B Tower
  - o Floors 1 and 2--harder material
  - o Floors 3 and 4--existing type tile painted
  - o Floors 5 and 6--existing type tile

A diagram of the six floors of each tower and which materials are to be tested on each floor follows:

TOWER A

6	TOUGHER-FACED TILE
5	TOUGHER-FACED TILE
4	EXISTING TYPE TILE
3	EXISTING TYPE TILE
2	EXISTING TYPE PAINTED
1	EXISTING TYPE PAINTED

TOWER B

6	EXISTING TYPE TILE
5	EXISTING TYPE TILE
4	EXISTING TYPE PAINTED
3	EXISTING TYPE PAINTED
2	TOUGHER-FACED TILE
1	TOUGHER-FACED TILE

Of the 12 available floors in Groshong Hall, there will be four each having the harder tile, the existing type of tile and the existing type of tile painted. There are 248 ceiling tiles per floor in each tower of Groshong Hall; thus there will be 992 ceiling tiles of each type in this Demonstration Program.

Footnote: When this report was in its final stages, the contractor learned that some population changes had occured in both Carter and Groshong Halls. It is obvious that space needs dictate the populations of these BEQs. It is therefore recommended that these population distributions be updated just before the Demonstration Program is to begin so that alterations can be made in matching of floors/wings and assignment of design changes.

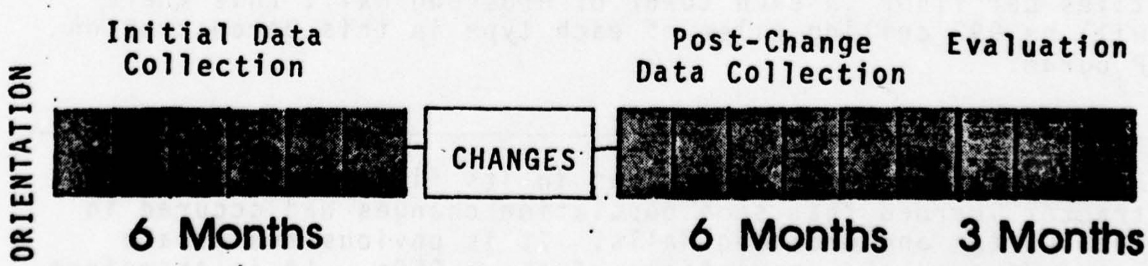
The occupants of Towers A and B in Groshong Hall are permanent personnel, grades E1-6.

Three types of ceiling material will be tested in Carter and Groshong Halls: the existing type of mineral fiber acoustical tile, that existing type painted so that there are bands of color in a hallway, and a harder-faced material. The two experimental designs reflect two different approaches to reducing vandalism: target hardening, that is, using a material which is believed to be more resistant to the types of damage inflicted on ceiling tiles; and appearance, that is, beautifying the existing type of ceiling tiles because that might be a deterrent to damage (this also involves behavior modification of the BEQ residents since it is the use of a design to decrease their inclination to damage ceiling tiles).

The time schedule also includes a period for orientation of individuals who will collect the data and a three-month evaluation period once all the data has been collected. The time period for making the changes in ceiling tiles should be as short as possible, and it should be well documented for the following information:

- How many people it took to make the changes
- How long it took to make the changes (with dates)
- What the hourly rate was of the people who did the work
- If a private contractor was used, what was the total contract fee, including profit and overhead

A diagram of the proposed schedule for implementation and evaluation of the ceiling tile design changes follows:



CONSTRAINTS

There are some constraints which must be observed in connection with the Demonstration Program:

- Construction related to design changes cannot begin until after the specified initial data-collection period (here, it is six months).

- The initial data collection cannot begin until the impending refurbishing/renovation of Carter and Groshong Halls is completed. Unfortunately, at the time this Demonstration Program report was being written, command personnel at Norfolk did not know a firm date for construction to begin or end on those projects. However, the best estimate--which is used for the schedule which accompanies this Demonstration Program--is that the work will be completed in early spring 1980. Firmer information may be available in late May 1979.

- No changes--no major renovation or construction--may be made at the test sites during the data-collection periods. Although data will be collected while the ceiling-tile design changes are being made, that data will not be considered or will be examined separately. It may also be necessary to "throw out" or examine separately the data collected for a period immediately after the changes--particularly if vandalism rises dramatically--and to extend the data-collection period by that much more time.

- When changes involving color are made, as are proposed at Norfolk, they should be couched to residents as being an improvement in the environment: the place looked "drab" and needed "sprucing up." This is reasonable even though these design changes are planned after some major refurbishing of Carter and Groshong Halls, that is, they might just be "late" additions to that project. Otherwise, there is a danger the residents will perceive the painting of the ceiling tiles as a "test" which they might find it interesting and amusing to interfere with. When the painted ceiling tiles are replaced, it must be with a tile of the same color.

DATA ANALYSIS

By using statistical procedures appropriate for the evaluation plan, one can tell whether any meaningful results occured as a result of the design changes by describing and comparing:

1. Frequency of damage

2. Type of damage

3. Frequency by type of damage
   a. Hole(s)
   b. Burn(s)
   c. Writing (Marking)
   d. Broken/Missing

4. Trends and patterns of damage over time

The statistical analyses applied to these measurements would show, using conventional statistical significance levels, whether differences found were due to chance, variation or reliable differences in the frequency and types of ceiling-tile damage, which would point to the effectiveness of the design changes.

COST ANALYSIS

Analysis of cost requires establishing the effectiveness of the remedial design tested and projecting the cost-effectiveness of using the design.

The simplest measure of design effectiveness is the percent reduction in the total cost of damage sustained during the test period. This is calculated as follows:

$$\text{Design Effectiveness} = \frac{\text{Total cost of damage in control group} - \text{Total cost of damage in test group}}{\text{Total cost of damage in control group}}$$

For example, if the total cost of damage in the control group of ceilings is \$1,000 and the total cost of damage for that design element in the test group is \$250, then

$$\text{Design Effectiveness} = \left(\frac{\$1{,}000 - \$250}{\$1{,}000}\right) 100 = 75\%$$

Thus, Design Effectiveness = 75%.

Once the effectiveness of the remedial designs has been calculated, their cost-effectiveness is determined by calculating a benefit-cost margin and a benefit-cost ratio for each.

The measure of benefit is the annual dollar savings realized by preventing, or reducing the cost of, a particular group of damage incidents. The measure of cost is the total cost of installing the remedial design over the entire area at risk. Using these measures of benefit and cost, the benefit-cost margin and the benefit-cost ratio are defined, calculated and interpreted as shown below.

Benefit-Cost Margin = Benefits - Costs

The margin measures the absolute difference between the savings realized when the damage is prevented and the costs of the solution. It thus tells whether the remedial design is actually affordable. A positive margin means that it is cheaper to solve the damage problem than to let it continue. For example, if damage costing $1,000 is prevented by a design costing $500, then the benefit-cost margin is

$1,000 - $500 = $500.

That is, there is a net savings of $500. A margin of zero means that the costs of the problem and the solution are equal. A negative margin means that the cost of solving the problem (with a particular design) is greater than the cost of letting the problem continue.

Benefit-Cost Ratio = Benefits/Costs

The ratio measures the relative difference between the savings realized when the damage is prevented and the costs of the solution. It tells which of the alternative solutions to the problem is the best investment, in terms of dollar savings realized for every dollar invested. A ratio greater than one means that the benefits of solving the problem are greater than the costs of letting it continue. The larger the ratio, the better the investment. For the example given above, in which the $500 design saves $1,000 of damage, the ratio is

$1,000/$500 = 2.

In contrast, however, a $20 design which saves $100 of damage has a ratio of 5. Other things being equal, the second design would be preferable for its greater benefit-cost ratio. A benefit-cost ratio of one means that the costs of the problem and the solution are equal, and a ratio of less than one means that the solution is more costly than letting the problem continue.

Benefit = Design Efficiency X Cost per damage incident X No. of damage incidents per year

where,

Cost per damage incident = Labor Cost per incident + Material cost per incident + Administrative cost per incident + Overhead cost per incident

Costs = (Cost of one installation of the remedial design X Total number of installations required to cover area at risk) + (Material cost per usable unit replaced and not reused, and of unused inventory X Number of units replaced and in stock)

The sample form for collecting data on damage to ceiling tiles does not ask that the persons making repairs list material costs, time taken to make repairs or hourly rates of those making repairs. This is omitted to keep the form shorter and more manageable (both damage-inventory and ceiling-tile-repair information is sought on the same form), but there is no reason that those instituting the Demonstration Program could not, for their own ease, include on a form space for such information. In addition, it is felt that it would not be particularly difficult to compute repair costs after the fact since it could fairly easily be determined how long it takes to install "X" number of ceiling tiles.

The methodology for determing the cost-effectiveness of the designs tested should be flexible enough to account for:

- o Designs which are less than 100% effective.
- o Variable effectiveness against different types of damage, such as ceiling tiles which are 75% effective against punching, 90% effective against breakage and 20% effective against burns; or by area, such as 90% effective within sight of a BEQ desk, 65% effective in remote areas. The sample data-gathering instrument on ceiling tiles asks for specific information about the type of damage to provide greater flexibility in analysis of the data, that is, so that a possible determination can be made that a particular design element is significantly better at withstanding a particular kind of damage.

- Limitations on the utility of the design which are intrinsic to the design itself (e.g. the expected useful lifetime of a ceiling tile) or extrinsic to the design (e.g. the remaining lifetime of the building in which the design element is installed).

- Phased installation of the design, e.g. replacing ceiling tiles as they are damaged, as well as one-shot installation, e.g. renovating the entire floor while the occupants are on vacation. (This Demonstration Program will use a one-shot installation procedure when the design changes are made at the end of the first six-month data-collection period.)

Development of the complete methodology for establishing the cost-effectiveness of the remedial design over the expected remaining lifetime of the BEQ in which it is installed (or over the expected useful lifetime of the design itself) should be undertaken during the Demonstration Program in accordance with the principles and procedures of economic analysis (benefit-cost analysis) outlined in the ECONOMIC ANALYSIS HANDBOOK, NAVFAC P-442, Department of the Navy, Naval Facilities Engineering Command, June 1975.

COST ESTIMATE FOR DEMONSTRATION PROGRAM

A. Target Hardening Design Concept

1. Materials--mineral fiber acoustical tile with a "tough" face (see specifications); does not include suspended "T" grid which is existing and will not be replaced.

Quantity	Item	Unit Cost	Extended Cost
650	2x4 tile (8sf)	42¢/sf	$2184
1200	2x2 tile (4sf)	42¢/sf	2016
		TOTAL	$4200

Materials estimates are based on current East Coast prices, including freight, provided by three manufacturers. Prices are expected to increase eight to twelve per cent (8-12%) per year and vary with the distributor. Bulk prices will probably not be available because the quantities are not large enough.

Quantities of tiles include a twenty per cent (20%) average for inventory to provide for replacement during the six-month data-collection period after the change has been made.

2. Labor--although "self-help" or base work crews may be employed to execute the work, an estimated price for installation by a private contractor follows.

Quantity	Item	Unit Cost	Extended Cost
1080	2x4 tile (8sf)	25¢/sf	$2160
1980	2x2 tile (4sf)	25¢/sf	1980
		TOTAL	$4140

Labor estimates are based on current East Coast prices adjusted for Norfolk, Virginia. Quantities are double the number of tiles to be installed, to account for removal and salvage of existing tile.

B. Beautification (Behavior Modification) Design Concept

1. Materials--latex paint, in three colors, for painting mineral fiber acoustical tile of the existing type from existing stock at the base (see specifications).

Quantity	Item	Unit Cost	Extended Cost
18 gal.	650 tiles x 2x4 tiles (8sf) (300 sf/gallon)	$12/gal.	$216
18 gal.	1200 tiles x 2x2 tiles (4sf) (300 sf/gallon)	$12/gal.	216
		TOTAL	$432

Materials estimates are based on current East Coast prices provided by three manufacturers. Prices are expected to increase eight to twelve per cent (8-12%) per year and vary with the distributor. Bulk prices will probably not be available because the quantities are not large enough.

Quantities of paint in three colors include a twenty per cent (20%) overage for inventory to provide for replacement during the six-month data-collection period after the change has been made.

2. Labor--although "self-help" or base work crews may be employed to execute the work, an estimated price for a private contractor follows.

Quantity	Item	Unit Cost	Extended Cost
1080	2x4 tile (8sf)	25¢/sf	$2160
1980	2x2 tile (4sf)	25¢/sf	1980
		TOTAL	$4140

Labor estimates are based on current East Cost prices adjusted for Norfolk, Virginia, and include overhead and profit. Quantities of tiles for estimating installation labor are double the number of tiles to be installed to account for removal and salvage of existing tile.

SPECIFICATIONS FOR CEILING CHANGES (TARGET HARDENING DESIGN CONCEPT)

1. GENERAL

1.1 This section describes the removal of existing panels in existing exposed tee grid system and installation of new materials as described in this section.

1.2 The types of panels specified herein are square-edged, nominal 2x4 and 2x2, with special sizes to accomodate existing system. All panels shall have damage-resistant characteristics as specified hereinafter.

1.3 Quality Assurance

1.3.1 Performance Data: Acoustical Materials and Insulating Association (AIMA) Bulletin, "Performance Data Architectural Acoustical Materials."

1.3.1.1 Flame-Spread Range: ASTM E84.

1.3.1.2 Noise-Reduction Coefficient (NRC): ASTM C423, as published in AIMA Bulletin.

1.3.1.3 Sound-Transmission Class (STC), as published in AIMA Bulletin for Mounting, No. 7.

1.4 Submittals

1.4.1 Manufacturer's Data: Submit two copies of manufacturer's specifications and installation instructions for acoustic panel required, including certified laboratory test reports and other data as required, including certified laboratory test reports and other data as required to show compliance with these Specifications.

1.4.2 Samples: Submit three sets of 12-inch-square samples for acoustic panel required. Each sample shall show the full range of exposed color and texture to be expected in the completed work. Sample submittal and Contracting Officer's review shall be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

1.4.3 Maintenance Instructions: Submit manufacturer's recommendations for cleaning and refinishing panels, including precautions against materials and methods which may be detrimental to finishes and acoustic efficiency.

1.5 Product Delivery, Storage and Handling

1.5.1 Deliver acoustic panels to the Project site in original unopened packages, bearing manufacturer's name and labelled to identify each type of acoustic unit.

1.5.2 Storage: Advise Contracting Officer of acoustic material manufacturer's recommendations for storage of acoustic panels to be used in the work.

2. PRODUCTS

2.1 Mineral material overlay type: Design is based on the product of Armstrong Co. "Armatuff" with the following characteristics:

2.1.1 Size: Nominal 2'x4'x5/8" thick and 2'x2'x5/8" thick.

2.1.2 NRC: .55-.65.

2.1.3 STC: 35-39.

2.1.4 Flame spread: 0-25.

2.1.5 Pattern: Non-directional rough texture with random perforations.

2.1.6 Surface: High-impact mineral bonded to tile.

2.1.7 Finish: Vinyl latex paint.

2.2 Provide one of the products upon which the design is based, or the equal products of the following:

2.2.1 Conwed Corporation.

2.2.2 Owens-Corning Fiberglas.

2.3 Accessories: Provide manufacturer's standard flexible deceleration clips for attachment to existing grid.

3. <u>INSTALLATION</u>

3.1 Remove all existing tile from designated hallways and salvage for Owner (Navy).

3.2. Verify that existing grid system is in acceptable condition to receive new tile. Notify Contracting Officer of any conditions to the contrary.

3.3 Acoustical lay-in panels shall be installed in the completed grid system according to manufacturer's installation instructions and recommendations.

3.4 <u>Acceptance</u>

All chipped, nicked, scratched, soiled and otherwise defective panels, or panels damaged during or after installation and prior to final acceptance shall be removed and replaced at no additional cost to the Government.

<u>MANUFACTURERS:</u>

Armstrong Cork Company
Gables One Tower Building
1320 South Dixie Highway
Coral Gables, FL 33146

Conwed Corporation
Ceiling Products Division
332 Minnesota Street
P.O. Box 43237
Saint Paul, MN 55164

Owens-Corning Fiberglas Corporation
Interiors Marketing Division
Fiberglas Tower
Toledo, OH 43659

Capaul Ceilings
Division of Acoustiflex Corporation
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SPECIFICATIONS FOR CEILING CHANGES--BEAUTIFICATION (BEHAVIOR MODIFICATION) DESIGN CONCEPT

1. GENERAL

1.1 This section describes the removal of existing panels in existing exposed tee grid system and installation of new materials as described in this section.

1.2 The types of panels specified herein are square-edged, nominal 2x4 and 2x2, with special sizes to accomodate existing system. All panels shall have damage-resistant characteristics as specified hereinafter.

1.3 Quality Assurance

1.3.1 Performance Data: Acoustical Materials and Insulating Association (AIMA) Bulletin, "Performance Data Architectural Acoustical Materials."

1.3.1.1 Flame-Spread Range: ASTM E84.

1.3.1.2 Noise-Reduction Coefficient (NRC): ASTM C423, as published in AIMA Bulletin.

1.3.1.3 Sound-Transmission Class (STC), as published in AIMA Bulletin for Mounting, No. 7.

1.4 Submittals

1.4.1 Manufacturer's Data: Submit two copies of manufacturer's specifications and installation instructions for acoustic panel required, including certified laboratory test reports and other data as required, including certified laboratory test reports and other data as required to show compliance with these Specifications.

1.4.2 Samples: Submit three sets of 12-inch-square samples for acoustic panel required. Each sample shall show the full range of exposed color and texture to be expected in the completed work. Sample submittal and Contracting Officer's review shall be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

1.4.3 Maintenance Instructions: Submit manufacturer's recommendations for cleaning and refinishing panels, including precautions against materials and methods which may be detrimental to finishes and acoustic efficiency.

1.5 Product Delivery, Storage and Handling

1.5.1 Deliver acoustic panels to the Project site in original unopened packages, bearing manufacturer's name and labelled to identify each type of acoustic unit.

1.5.2 Storage: Advise Contracting Officer of acoustic material manufacturer's recommendations for storage of acoustic panels to be used in the work.

2. PRODUCTS

2.1 Mineral acoustical lay-in type: Design is based on the product of Armstrong Co. "Minaboard" with the following characteristics:

2.1.1 Size: Nominal 2'x4'x5/8" thick and 2'x2'x5/8" thick.

2.1.2 NRC: .50-.60.

2.1.3 STC: 35-39.

2.1.4 Flame spread: 0-25.

2.1.5 Pattern: Non-directional fissured texture with random perforations.

2.1.6 Finish: Factory-applied latex paint, to be field painted as described in this specification.

2.2 Provide one of the products upon which the design is based, or equal new products from existing stock, or the equal products of the following:

2.2.1 Conwed Corporation.

2.2.2 Owens Corning Fiberglas.

2.3 Accessories: Provide manufacturer's standard flexible deceleration clips for attachment to existing grid.

3. SHOP PAINTING

3.1 Remove any loose dirt or particles from manufacturing from the face of the new panels.

3.2 Paint by spraying or by roll coating, according to the manufacturer's instructions, being careful not to close or clog the perforations or fissures in the material.

3.3 Products: Paint as recommended by acoustic-panel manufacturer. The following is based upon product recommendations by Armstrong Cork Co. and paint manufacturers.

3.3.1 Latex wall paint by one of the following manufacturers or equal:

3.3.1.a Pratt & Lambert Vapex flat wall paint.

3.3.1.b PPG Wallhide latex flat wall paint.

3.3.1.c Benjamin Moore latex flat wall paint.

3.3.2 Colors will be bright or deep tone and limited to no more than three in approximately equal quantitites.

3.3.2.a Provide paint in the following colors or equal. Color selection is based on Pratt & Lambert colors. If another manufacturer's product is selected, submit three sets of 3"x5" card samples showing colors to match those listed below. Sample submittal and Contracting Officer's review will be for color and texture only. Compliance with all other manufacturer's requirements is the exclusive responsibility of the Contractor.

3.3.2.b Color A: Pratt & Lambert #3564 Sunday Green.

Color B: Pratt & Lambert #5097 Blue Storm.

Color C: Pratt & Lambert #8044 Violite.

4. INSTALLATION

4.1. Remove all existing tile from designated hallways and salvage for Owner (Navy).

4.2 Verify that existing grid system is in acceptable condition to receive new tile. Notify Contracting Officer of any conditions to the contrary.

4.3 Acoustical lay-in panels shall be installed in the completed grid system according to manufacturer's installation instructions and recommendations and according to color and location as shown on the accompanying drawings.

4.3.4 Acceptance: All chipped, nicked, scratched, soiled or otherwise defective panels, or panels damaged during or after installation and prior to final acceptance shall be removed and replaced at no additional cost to the Government.

CEILING TILE DAMAGE REPORT FORM

NAME OF PERSON SUBMITTING FORM ____________________

DATE ____/____/________

BUILDING (Circle One) Carter Groshong

FLOOR (Circle One) 1 2 3 4 5 6

WING/TOWER (Circle One) A B C D

NOTE: Record only types of damage to tiles which need to be replaced. The discriminating factor is whether the tile should be replaced. If so, then that is major damage--such as a large scorch mark, a broken and/or missing tile or graffiti (writing)--but not small scratches or marks made from moving furniture. Tiles which need to be replaced because of maintenance problems, such as water damage from leaking pipes, should not be counted.

MAJOR DAMAGE TYPES	TALLY OF DAMAGED TILES	TOTAL
Hole(s)		
Burn(s)		
Writing (Marking)		
Broken/Missing		

INSTRUCTIONS TO THOSE MAKING REGULAR INSPECTIONS: As you walk down each hallway, note on the form above the type of damage you observe on the ceiling tiles. You may make tally marks (𝍸) in the second column for each time in that hallway you observe any one of the above types of damage as the major damage to the tile. Then, in the third column, total the damaged tiles for each category. Be sure to note the date, building and location (by floor and wing or tower).

INSTRUCTIONS TO THOSE REPLACING TILES: Please note how many tiles you replace and for what reason (holes, burns, writing, broken or missing) on the above form. Also note the date, building and location (by floor and wing or tower).

MONTHLY REPORT ON BEQ POPULATION

NAME OF PERSON SUBMITTING FORM ____________________

DATE _____/_____/_________

BUILDING ____________________

INSTRUCTIONS TO BEQ MANAGERS/STAFF: On the first day of each month, write in the space below the number of residents assigned to each wing of each floor at the end of the previous day (the last day of the previous month). Also indicate how many of them are transients, students and permanent personnel.

FLOOR/WING	TOTAL	STUDENT	PERMANENT	TRANSIENT
1A				
1B				
1C				
1D				
2A				
2B				
2C				
2D				
3A				
3B				
3C				
3D				
4A				
4B				
4C				
4D				

LOG OF MAJOR EVENTS

INSTRUCTIONS TO BEQ MANAGER/STAFF: Note on this form major events in the BEQ which might affect vandalism. An example would be a fire in the building. Please be careful to note which building the log refers to.

BUILDING (Circle One) Carter Groshong

DATE	EVENT

Doors/Hardware: Demonstration Program

The Purpose of the Demonstration Program is to test whether recommended design changes are effective in reducing incidents and cost of vandalism which results in damage to doors and door hardware of sleeping room doors of Navy Bachelor Enlisted Quarters (BEQs).

The door/door hardware changes will be made in one of two adjacent similar BEQs at the Naval Training Center, San Diego, CA: changes will be made on the A and B Wings of two floors of Building 90 and each of those floors will be compared with the same floors in Building 91. Incidents and cost of door/hardware damage on floors where changes have been made will be compared with incidents and cost of door/hardware damage on floors where no changes have been made.

The design changes which will be tested in the Demonstration Program involve both target hardening and behavior modification. Target hardening is the use of material which is believed to be more resistant to damage (here, a solid-core wood door reinforced around the lockset, the door area which seems to suffer the most abuse). The behavior-modification concept involves the use of a "keyless" or cipher lock which eliminates the problem/cost of lost keys and thus alters the way an individual approaches entry to his sleeping room.

DEMONSTRATION PROGRAM STRUCTURE

	TIME (in months)		
	Before Change 1 2 3 4 5 6 7 8 9		After Change 1 2 3 4 5 6 7 8 9
New Design Location	0 0 0 0 0 0 0 0 0	X	0 0 0 0 0 0 0 0 0
Existing Design Location	0 0 0 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0

(Adapted from Fitz-Gibbons, Carol Taylor and Morris, Lynn Lyons, How to Design a Program Evaluation, 1978, p. 55)

X represents the door/hardware changes which will be made in the locations designated for testing the design concepts. O is documentation of incidents of door/hardware damage in both locations, where there is new design and where there is existing design.

To test whether the incidents of door/hardware damage would be more or less than normally expected, a comparison location is needed. The important consideration for selection of the two locations includes the similarity of resident populations, the building design and the building management.

The first nine months of data collection on door/hardware damage and repair--data collected before the design changes are made--is used to examine the two locations to see if they do have similar types and numbers of door/hardware damage incidents as was assumed when they were selected and to compare in the two locations the change in the frequency and types of door/hardware damage that occurs in each--to check the effects of the door/door hardware design changes. Nine months is believed sufficient time to collect enough incidents and types of door/hardware damage to provide a reliable picture of the door/hardware damage that occurs both before and after the changes.

SITE SELECTION

The changes will be made on the second and fourth floors (A and B Wings) of Building 90, which will comprise the new design location. The existing design location will be those same floors of Building 91, which has a very similar population. The existing design location was selected because it is similar to the new design location.

One of the three considerations for site selection was similarity of resident populations. These two locations--the fourth floors and the second floors of both buildings--have the same type and rank of student. The populations of these floors are very similar--students, grades E1-6.

Typically, there are virtually no vandalism problems in BEQ areas housing CPOs or Waves, so Wing C of Building 91 has been eliminated from this experimental program since late in the design of this Demonstration Program, the contractor learned that a billeting change had been made in the two BEQs planned for this program. Because of an overflow of Chief Petty Officers and Waves, one wing (C) of Building 91 was turned over to them: CPOS are on the top two floors and Waves on the bottom two floors of this wing. Although this situation is reportedly temporary and may not exist by the time the Demonstration Program is implemented, it was deemed prudent to modify the design to accomodate this situation.

In terms of building design, Buildings 90/91 are described as having three wings--A, B and C--although A and B are the two ends of a continuous hall. The C Wing is physically isolated from A and B, that is, it is not necessary for anyone entering C to pass through A or B, nor is it necessary for anyone entering A or B to pass through C. This is important because of the possible influence Chief Petty Officers, the Navy's highest-ranking enlisted men, might exert over lower-ranking sailors, which would make Building 91 quite dissimilar to Building 90. However, because C is physically isolated, it can be assumed its occupants will have minimal effect on the occupants of Wings A and B of Building 91, thus not destroying its similarity to Building 90's A and B Wings.

The last consideration in matching the buildings was that both buildings have the same manager.

DATA-COLLECTION PERIOD

The data to test the effectiveness of design changes will be collected over a period of time. As pointed out by BOSTI in its study on vandalism in Navy BEQs, "threats" to the validity of an evaluation of the design change can be minimized through the use of a "time series" design. This is done by instituting routine measurements of vandalism incidents and repair for a specified period of time, then installing the design concept aimed at reducing vandalism, and finally continuing measurement of the vandalism and repairs. Then the trends over time both before and after the changes are compared. Since there is also a control group (no changes in the type of doors and door hardware will be made in these areas), all incidents before the changes can be compared with all incidents after the changes both within each location and between the two locations.

For this Demonstration Program, data collection will be over an 18-month period (nine months before and nine months after the changes are made), plus the time it takes to make the door/door hardware changes. This figure is based on estimated incidents of door/door hardware damage in Buildings 90/91. Nine months for each data-collection period is believed sufficient time to collect enough incidents of damage to provide statistically-reliable results.

RECORDKEEPING

The backbone of the Demonstration Program is, of course, recordkeeping, or data collection. Whether or not BEQ management personnel are currently documenting vandalism and repair, they must do so for this Demonstration Program. While the documentation is mandatory, however, it is designed to be the least disruptive to normal BEQ activities. The data must be collected weekly by floor and building.

For this Demonstration Program, both BEQ resident managers, or their assistants, and persons who make repairs will be required to keep records on door/door hardware damage for the test sites. The BEQ personnel should make weekly inventories of damage--always on the same day of the week. This avoids the possibility that one period (of a week) might include two weekends, which could be high periods of vandalism-type damage, while another "week" might be only five or six days long. However, this Demonstration Program does not prescribe when or how frequently repairs should be made. Repairs should be made in keeping with usual procedure.

The data-collection forms, samples of which appear at the end of this section, are somewhat self-explanatory. Yet it is important that before data collection begins, the persons who will be filling out these forms be given an orientation to establish ground rules about what types of damage to doors and door hardware will be monitored and recorded and how and when the forms should be filled out, as well as to provide them with an opportunity to ask questions. The purpose is to make the data collection as complete and uniform as possible.

The sample forms demonstrate the information which is vital to meaningful analysis of damage to doors/door hardware and the impact of the design changes, including a "possible or probable cause" of the damage, e.g. kicking, use of a blunt instrument, use of a "tool."

In addition to keeping records of types of damage and numbers of doors and their hardware damaged, the BEQ management personnel need to keep monthly records showing the number, type and grade of residents on each floor which is part of this Demonstration Program. A sample form for this data collection appears at the end of this section. The same individuals should also keep a "log" of events in the BEQ which might affect incidents of vandalism, e.g. graduation from school or a fire in one building. This "log," a sample of which is included at the end of this section, should indicate the date and the event so that these events can be taken into consideration during analysis of the incidents of door/door hardware damage.

Since recordkeeping in itself may influence repair and even observation of damage, it is important that the system for keeping these records be in place long enough before changes are made so that keeping the records becomes routine. As the BOSTI study pointed out, "the measuring instrument should not produce more or less repair than would normally occur" and "a routinized recording instrument should be in place on the chosen site before the treatment is instituted and should create less reactivity" (reaction to recordkeeping). This necessity that recordkeeping be routine is associated with the required pre-change data-collection period.

Additionally, before data collection begins, although the doors and hardware need not look "terrific," they must be in working order. Since the cost of starting the Demonstration Program with all new existing-type doors and hardware is prohibitive, it would be helpful for photographs to be taken of the condition of each door in the test at the time the data collection begins and again at the end of the second nine-month data collection period. In addition, records should be compiled showing when each of the doors now existing in the two buildings was newly installed. The photographs at the beginning and end of the data-collection period--plus the work repair data kept for the experimental program--should provide data analysts with additional useful information on the extent and type of damage found.

IMPLEMENTATION OF DESIGN CHANGES/EVALUATION SCHEDULE

The Demonstration Program could begin at any time here--and the sooner the better since current command personnel who would be involved in the program are quite enthusiastic about it. But it should not be started at an atypical time such as a holiday season. A time schedule for implementation and evaluation of door/door hardware design changes is proposed that would have data-collection for this Demonstration Program end at approximately the same time data collection for a similar Demonstration Program on design changes in hallway ceilings is being concluded at another base. Then the evaluations of the design changes of both buildings would be made at the same time. However, this is mainly for convenience and to keep the evaluation from running over too long a time. It is not a problem if the Demonstration Program at San Diego must begin earlier than this schedule. What is important is that there be a nine-month data-collection period before the changes are made and another nine-month data-collection period after the changes are made.

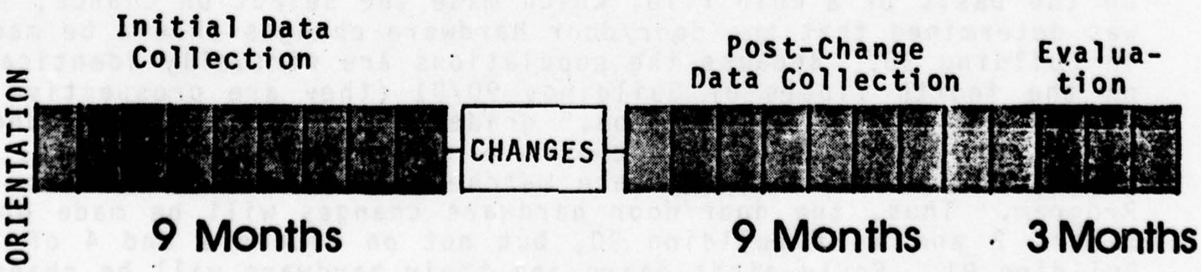
On the basis of a coin flip, which made the selection chance, it was determined that the door/door hardware changes should be made in Building 90. Because the populations are virtually identical on the fourth floors of Buildings 90/91 (they are prospective students "Awaiting Instruction," grades E1-3) and on the second floors of Buildings 90/91 (they are radio operator students, grades E1-3), those floors are matched for this Demonstration Program. Thus, the door/door hardware changes will be made on floors 2 and 4 of Building 90, but not on floors 2 and 4 of Building 91. Forty-eight doors and their hardware will be changed for this experimental program.

One new type of door/door hardware "system" will be tested at San Diego against the existing door/door hardware "system." Buildings 90/91 presently have solid-core wood doors with a fire-retardant gypsum fill and vent grilles at the bottom; they have a residential type latchset keyed through the knob. The doors which will be installed for this experimental program are also solid-core wood with a fire-retardant gypsum fill, but they will not have vent grilles and will be reinforced on the interior of the door around the lockset; the locking mechanism will be a "keyless" or cipher lock used with a "high-security" strike plate. This combination of a reinforced wood door and a cipher lock reflects two approaches to reducing vandalism: target hardening, which is the interior reinforcement of the wood door around the lockset to make the door more resistant to damage, and behavior modification of the residents by eliminating the lost or misplaced key which so often is the reason for a door and locking mechanism being broken. The use of the cipher lock is designed to decrease the need for damage to doors and their hardware.

The time schedule also includes a period for orientation of individuals who will collect the data and a three-month evaluation period once all data has been collected. The time for making the changes in doors and door hardware should be as short as possible. And it should be well documented for the following information:

- How many people it took to make the changes
- How long it took to make the changes (with dates)
- What the hourly rate was of the people who did the work
- If a private contractor was used, what was the total contract fee, including profit and overhead

A diagram of the proposed schedule for implementation and evaluation of the door/door hardware design changes follows:



CONSTRAINTS

There are some constraints which must be observed in connection with the Demonstration Program:

- o Construction related to design changes cannot begin until after the specified initial data-collection period.
- o No changes--no major renovation or construction--may be made during the data-collection periods. Although data will be collected while the design changes are being made, that data will not be considered or may be considered separately. It may also be necessary to "throw out" or examine separately the data collected for a period immediately after the changes--particularly if vandalism rises dramatically--and to extend the data-collection period by that much more time.

DATA ANALYSIS

By using statistical procedures appropriate for the evaluation plan, one can tell whether any meaningful results occured as a result of the design changes by describing and comparing:

1. Frequency of damage
2. Type of damage
3. Frequency by type of damage
   a. Hole or break in face of door (other than around lockset)
   b. Hole or break in door around lockset or knob
   c. Knob missing
   d. Lock broken
   e. Vent grille missing or broken
   f. Deadbolt lock broken
   g. Door split around lockset
   h. Hinge damaged or pulled away
   i. Other
4. Trends and patterns of damage over time

The statistical analyses applied to these measurements would show, using conventional statistical significance levels, whether differences found were due to chance, variation or were reliable differences in the frequency and types of door and door hardware damage, which would point to the effectiveness of the design changes.

COST ANALYSIS

Analysis of cost requires establishing the effectiveness of the remedial design tested and projecting the cost-effectiveness of using the design.

The simplest measure of design effectiveness is the percent reduction in the total cost of damage sustained during the test period. This is calculated as follows:

$$\text{Design Effectiveness} = \frac{\text{Total cost of damage in control group} - \text{Total cost of damage in test group}}{\text{Total cost of damage in control group}}$$

For example, if the total cost of damage in the control group of doors and door hardware is $1,000 and the total cost of damage for that design element in the test group is $250, then

$$\text{Design Effectiveness} = \left(\frac{\$1,000 - \$250}{\$1,000}\right) 100 = 75\%$$

Thus, Design Effectiveness = 75%.

Once the effectiveness of the remedial designs has been calculated, their cost-effectiveness is determined by calculating a benefit-cost margin and a benefit-cost ratio for each.

The measure of benefit is the annual dollar savings realized by preventing, or reducing the cost of, a particular group of damage incidents. The measure of cost is the total cost of installing the remedial design over the entire area at risk. Using these measures of benefit and cost, the benefit-cost margin and the benefit-cost ratio are defined, calculated and interpreted as shown below.

Benefit-Cost Margin = Benefits - Costs

The margin measures the absolute difference between the savings realized when the damage is prevented and the costs of the solution. It thus tells whether the remedial design is actually affordable. A positive margin means that it is cheaper to solve the damage problem than to let it continue.

For example, if damage costing $1,000 is prevented by a design costing $500, then the benefit-cost margin is

$1,000 - $500 = $500.

That is, there is a net savings of $500. A margin of zero means that the costs of the problem and the solution are equal. A negative margin means that the cost of solving the problem (with a particular design) is greater than the cost of letting the problem continue.

Benefit-Cost Ratio = Benefits/Costs

The ratio measures the relative difference between the savings realized when the damage is prevented and the costs of the solution. It tells which of the alternative solutions to the problem is the best investment, in terms of dollar savings realized for every dollar invested. A ratio greater than one means that the benefits of solving the problem are greater than the costs of letting it continue. The larger the ratio, the better the investment. For the example given above, in which the $500 design saves $1,000 of damage, the ratio is

$1,000/$500 = 2.

In contrast, however, a $20 design which saves $100 of damage has a ratio of 5. Other things being equal, the second design would be preferable for its greater benefit-cost ratio. A benefit-cost ratio of one means that the costs of the problem and the solution are equal, and a ratio of less than one means that the solution is more costly than letting the problem continue.

$$\text{Benefit} = \text{Design Efficiency} \times \text{Cost per damage incident} \times \text{No. of damage incidents per year}$$

where,

$$\text{Cost per damage incident} = \text{Labor cost per incident} + \text{Material cost per incident} + \text{Administrative cost per incident} + \text{Overhead cost per incident}$$

$$\text{Costs} = \left(\text{Cost of one installation of the remedial design} \times \text{Total number of installations required to cover area at risk} \right) + \left(\text{Material cost per usable unit replaced and not reused, and of unused inventory} \times \text{Number of units replaced and in stock} \right)$$

The data for determing cost-effectiveness of design changes involving doors and door hardware in Buildings 90/91 at San Diego, CA, will be taken from the "Door Repair Report Form," a sample of which appears at the end of this section. That form asks for the person submitting the form to note the following:

- o Length of time to make repairs
- o Cost of materials
- o Number of persons making repairs
- o Hourly rates of repair-crew members

The methodology for determing the cost-effectiveness of the designs tested should be flexible enough to account for:

- o Designs which are less than 100% effective.
- o Variable effectiveness against different types of damage, such as doors which are 75% effective against kicking, 90% effective against the use of a credit card to violate the lock and 20% effective against gum in the lock; or by area, such as 90% effective within sight of the BEQ desk, 65% effective in remote areas. The sample data-gathering instrument on doors asks for specific information about the type of damage to provide greater flexibility in analysis of the data, that is, so that a possible determination can be made that a particular design element is significantly better at withstanding a particular kind of damage.
- o Limitations on the utility of the design which are <u>intrinsic</u> to the design itself (e.g. the expected useful lifetime of a door) or <u>extrinsic</u> to the design (e.g. the remaining lifetime of the building in which the new design is installed).
- o <u>Phased installation</u> of the design, e.g. replacing doors as they are damaged, as well as <u>one-shot installation</u>, e.g. renovating the entire floor while the occupants are on vacation.

Development of the complete methodology for establishing the cost-effectiveness of the remedial design over the expected remaining lifetime of the BEQ in which it is installed (or over the expected useful lifetime of the design itself) should be undertaken during the Demonstration Program in accordance with the principles and procedures of economic analysis (benefit-cost analysis) outlined in the ECONOMIC ANALYSIS HANDBOOK, NAVFAC P-442, Department of the Navy, Naval Facilities Engineering Command, June 1975.

COST ESTIMATE FOR DEMONSTRATION PROGRAM

A. Doors (Target Hardening Design Concept)

1. Materials--wood door, solid-core (particle board), 20 minute UL labeled, with paint grade birch face and no ventilator louver.

Quantity	Item	Unit Cost	Extended Cost
52	Wood Door	$62	$3224
52	Painted (mat'l/labor)	20	1040
		TOTAL	$4264

Materials estimates are based on current West Coast prices, including freight, provided by three manufacturers. Prices are expected to increase eight to twelve per cent (8-12%) per year and vary with the distributor. Bulk prices will probably not be available because the quantities are not large enough.

Quantitites of doors include a ten per cent (10%) overage for inventory to provide for replacement during the nine-month data-collection period after the change has been made.

2. Labor--although installation by base work crews may be employed to execute the work, an estimated price for installation by a private contractor follows.

Quantity	Item	Unit Cost	Estimated Cost
48	Remove existing door for salvage	$ 6	$ 288
48	Install new door	90	4320
		TOTAL	$4608

Labor estimates are based on current West Coast prices adjusted for San Diego, California.

B. Door Hardware (Behavior Modification)

1. Materials--cipher, push-button lock (see specifications).

Quantity	Item	Unit Cost	Extended Cost
58	Cipher lock (heavy duty) w/striker plate	$212*	$12,296
58	Cipher lock (non-institutional) w/striker plate	$ 63*	$ 3,654
52	Passage latchset	35	1,820
		TOTAL	$ 5,474

Latchsets may be salvaged or converted from hardware in use on existing doors, and heavy-duty hinges should be reused if in good working order.

Quantities of hardware include a twenty per cent (20%) and ten per cent (10%) overage, respectively, for inventory to provide for replacement during the nine-month data-collection period after the change has been made.

2. Labor--although base work crews may be employed to execute the work, an estimated price for installation by a private contractor follows.

Quantity	Item	Unit Cost	Extended Cost
48	Hardware Installation	$30	$1,440

Labor estimates are based upon the records from Cecil Field and adjusted for the West Coast and the current market.

*Unit cost is list price quoted by the manufacturer June 1979. The maximum discount offered is 1/3 off list price. It is recommended that the less expensive (56% less) hardware assembly be considered for use in the demonstration program as a behavior modification approach rather than in combination with a target hardening approach (i.e., the heavy duty lock).

SPECIFICATIONS FOR CHANGES IN THE DOOR/DOOR HARDWARE DEMONSTRATION PROGRAM

1. APPLICABLE PUBLICATIONS

1.1 The documents guiding the rehabilitation of BEQs are:

1.2 DOD 4270.1-M, "Construction Criteria Manual"

1.3 NAVFAC DM-8, "Fire Protection Engineering"

1.4 NFPA #101-1976 (or later edition), "Life Safety Code"

1.5 Uniform Building - latest edition (I.C.B.O.)

2. Prior approval has to be obtained from proper Naval authority before any of the selected products and installation techniques can be used in the demonstration program.

3. Rooms with the rehabilitated doors will not have ventilation louvers and, therefore, other provision may have to be made to satisfy room air supply. (See Appendix page A-5 for Discussion of Fire Safety Issues.)

SPECIFICATIONS FOR DOOR CHANGES

1. APPLICABLE PUBLICATIONS

1.1 The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

1.2 U.S. Department of Commerce, Commercial Standards (CS) and Voluntary Product Standards (PS):

PS 51-71 Hardwood Plywood
PS 1-74 Softwood Plywood

1.3 National Woodwork Manufacturers Association (NWMA):

I.S. 1-73 Hardwood Veneered including Hardboard and Plastic Faced Flush Doors

Standard Door Guarantee, 1974 Edition.

I.S. 4-70 Water-Repellent Preservative Non-Pressure Treatment for Millwork.

1.4 Underwriters' Laboratories, Inc. (UL):

US 10(b)-1970 Fire Test of Door Assemblies.

1.5 Architectural Woodwork Institute (AWI):

Architectural Woodwork Quality Standards - 1973 Edition.

2. QUALITY CONTROL

2.1 Doors shall be the product of a manufacturer who can furnish supported evidence that it is in business and operating as an individual, company, firm or corporation having a trade name or mark which is recognized by the wood door manufacturing industry and has the capability and sufficient production capacity to meet construction schedules in the production of doors complying with the contract requirements.

3. SUBMITTALS

3.1 Shop Drawings:

3.1.1 Submit shop drawings, including details and schedules, to the Contracting Officer for approval. Indicate the location of each door, elevation of each type of door, details of construction, marks to be used to identify the doors, locations and extent of hardware blocking, and armor reinforcing, and if factory-primed or factory finished, materials and methods to be used. Submit shop drawings and door schedule promptly following receipt of approval to the door manufacturer.

3.1.2 Door finish hardware is specified in the accompanying specification. Coordinate shop drawings, templates and schedule of doors, hardware, painting and finishing as necessary to insure that doors shall be properly finished, machined for hardware and ready to hang in existing frames.

3.1.3 Take field dimensions of existing frames and make all adjustments in door and door hardware dimensions to accommodate existing site conditions.

3.2 Certificates:

3.2.1 Submit to the Contracting Officer promptly after receipt of the notice to proceed, the manufacturer's certified statement of his qualification as required herein. In the event of rejection another manufacturer's certification shall be submitted within thirty calendar days after the date of the notice of rejection.

3.2.2 Promptly following receipt of approval of the door manufacturer, submit certifications in triplicate for the Contracting Officer's approval attesting that the doors meet specified requirements. Certification shall be jointly signed and attested to by the Contractor, the door manufacturer and the door installation specialists.

3.2.3 Submit certification in writing that doors are guaranteed for a period of not less than one year from date of acceptance of the project. Conditions of guarantee shall be as stated in NWMA I.S. 1, Standard Door Guarantee.

4. DELIVERY AND STORAGE

4.1 Delivery doors in unopened packages, labeled to identify contents.

4.2 Store doors in fully covered, well ventilated dry areas and protect from extreme changes in temperature and humidity.

5. LABELING

5.2 Each door shall have affixed labels or notarized certificate of conformity identifying the manufacturer as the authority responsible for labeling accuracy, the fire resistance class, sound transmission class, core construction of flush doors adhesion bond type, face wood veneer grade and preservative treatment.

6. FLUSH DOORS

6.1 Except as otherwise specified, flush doors shall meet the requirements of NWMA I.S. 1 and AWI Quality Standards Illustrated. If the two standards conflict, the latter shall govern.

6.2 Doors will be standard 3'-0" x 7'-2" x 1-3/4" adjusted to accommodate existing site conditions.

6.3 For paint finish, doors shall be birch face custom grade, solid core (particle board) edge glued to wood frame.

7. FIRE RESISTANT DOORS

7.1 Doors shall be of solid core (particle board) flush construction and shall meet the performance requirements of the Underwriters' Laboratories, Inc., for the fire resistance class of 20 minutes, and as described in UL(10)b for the appropriate class.

8. ADHESIVES AND BONDS

8.1 Adhesives and bonds shall be in accordance with NWMA Standard I.S. 1, using requirements for type II bond for interior doors.

9. TOLERANCES

9.1 Allowable tolerances shall meet requirements of I.S. 1 and AWI Quality Standards Illustrated, for size, squareness and warp or twist tolerance. In case of conflict, the latter standard shall govern.

10. PREPARATION

10.1 All doors shall be pre-machined and prepared by the manufacturer, as required to provide clearance at all edges for existing site conditions. Mortising and cutting for locks, bolts, closers, hinges or other purposes shall be provided except for surface applied hardware. Doors shall not be cut or machined to sizes smaller than those for which they were originally manufactured.

11. FACTORY FINISHING

11.1 All exposed surfaces on both faces, all four edges, and all surfaces formed by machining for hardware that will not be concealed shall be finished with manufacturer's standard wood preservative treatment.

11.2 Finished doors shall be protected with individual wrapping such as polyethylene bags or with wrapping meeting requirements of Federal Specification LLL-D-581.

12. FIELD PAINTING

12.1 All exposed surfaces on both faces, all four edges, and all surfaces formed by machining for hardware that will not be concealed shall be finished to match existing doors in color and texture.

13. INSTALLATION

Install doors only after completion of all other work which would raise the moisture content of the doors or damage the surface of the doors. Doors shall be fit, hung and trimmed as required for the openings they will close. Provide a clearance of 1/8 inch at sides and top and a clearance of 1/2 inch at bottom. The lock edge of doors shall be beveled at the rate of 1/8 inch in 2 inches. Seal cuts made on the job immediately after cutting, using a clear water-resistant varnish or sealer.

MANUFACTURERS:

Algoma Hardwoods, Inc.
100 Perry Street
Algoma, WI 54201

Cal-Wood Door
P.O. Box 1656
Santa Rosa, CA 95402

Weyerhaeuser Architectural Doors (Roddis)
P.O. Box 130
Marshfield, WI 55449

SPECIFICATIONS FOR DOOR HARDWARE CHANGES

1. GENERAL

1.1. Where the finished shape or size of members taking hardware is such as to prevent or make unsuitable the use of the exact types specified, suitable types shall be furnished as the type specified and of ample size for the service required. All modifications in hardware, necessary to meet any special features of the project, shall be made to provide the required operative or functional requirements. Hardware that will be attached to metal shall be made to standard templates so far as practicable.

1.2 Provide acceptable templates of all hardware items for use by manufacturers of doors and frames, as required.

1.3 Hardware for labeled fire doors shall be in accordance with recommendations contained in NFPA's Standard No. 80.

1.4 Hardware specified to be reused shall be removed, packaged and marked for the proper opening, inspected, cleaned and reconditioned to insure first class operable condition prior to reinstallation.

1.5 Substitution of materials will not be permitted except where specifically provided for herein.

2. APPLICABLE PUBLICATIONS

2.1 The following publications form a part of this specification to the extent indicated by the references thereto:

2.1.1 Federal Specifications (FS)

FF-H-111c	Hardware, Builders; Shelf and Miscellaneous

2.1.2 American National Standards Institute (ANSI)

ANSI A156.1-1970	Butts and Hinges
ANSI A156.2-1972	Locks and Lock Trim
ANSI A156.6-1972	Architectural Door Trim
ANSI A156.7-1972	Template Hinge Dimensions

2.1.3 Builders Hardware Manufacturer's Association

BHMA 1301 June 1969 — Materials & Finishes Standards

2.1.4 National Fire Protection Association

NFPA No. 80-1974 — Standard for Fire Doors and Windows

3. SUBMITTALS

3.1 Submit for approval four copies of catalogs and descriptive literature of all finish hardware. Also submit affidavits certifying that all items of hardware meet all specification requirements.

3.2 Submit three copies of certification by independent testing laboratory attesting that hardware contemplated for labeled fire door units complies with requirements for each classification indicated.

4. FASTENINGS

4.1 Suitable type fastening devices shall be provided for installation of hardware items. Installation shall provide against shock and tampering. Exposed fastenings shall match contiguous material and finish of hardware items, be inconspicuous and, where practicable, shall finish flush with surrounding surfaces. All fastenings shall be of materials compatible with material contacting hardware surfaces.

5. HARDWARE ITEMS AND LOCATIONS

5.1 Hinges shall be reused existing hardware in existing locations or conform to the specifications below.

5.1.1 Hinges shall conform to applicable provisions of ANSI A156.1 and dimensions of template hinges shall conform to ANSI A156.7.

5.1.2 Width of hinges shall be as required to clear trim when door is opened to 180 degrees. Increase the width designated if required.

5.1.3 Hinge locations: Existing location or top hinge, 5 inches between hinge top and rabbet of head jamb; bottom hinge, 10 inches between hinge bottom and finish floor, and intermediate hinge, equidistant between top and bottom hinges.

5.2 Locksets and latchsets.

5.2.1 Locksets and latchsets shall conform to applicable provisions of ANSI A156.2, Series 81, Grade 1, of function indicated in hardware schedule.

5.2.2 Latchsets may be salvaged or converted from hardware in use on existing doors or Schlage D10S or equal.

5.2.2.1 Unless shown otherwise, centers of knobs shall be 43 inches above finish floor.

5.2.3 Locks shall be cipher, metal push-button type: Simplex Pushbutton Lock #DL-200 with #101 surface strike, or equal <u>or</u> UNICAN Pushbutton Lock #1000-2 with key override. Selection is to be determined by the NAVY Civil Engineering Laboratory.

5.2.3.1 Dead bolt or dead latch centers shall be 52 inches above finish floor with an ASA 161 2-3/4" standard backset.

5.2.3.2 Lock core shall be permanently inscribed with a number that identifies the lock manufacturer. Only manufacturer's name or trade mark shall be visible after installation.

5.3 Door Silencers shall be existing or conform to the specifications below.

5.3.1 Door silencers shall conform to FS FF-H-111, Type 1337A.

5.3.2 Location--metal frames; three on strike jamb of frames for single doors. Silencers are not required on frame for labeled fire door or if existing; NFPA No. 80 requirements shall govern.

5.4 Door trim shall conform to ANSI A156.6.

5.5 Door stops shall be existing or conform to the specifications below.

5.5.1 Door stops shall conform to FS FF-H-111 types 1526, 1328 or 1330 as approved. Door stops shall be provided and located to prevent contact between door hardware, door, or both, and adjacent wall surfaces, or other parts of the building including ducts, columns, pipes and radiators.

6. <u>INSTALLATION OF HARDWARE</u>

6.1 Finish hardware items shall be installed according to the manufacturer's instructions unless otherwise specified herein.

6.2 Suitable type fastening devices shall be provided for installation of hardware items.

6.3 Exposed fastenings shall match contiguous material and finish of hardware items; be inconspicuous and where practicable shall finish flush with surrounding surfaces.

7. PROTECTION

7.1 Hardware including exposed trim and strikes (except painted hinges) shall be removed for painting and shall be replaced after painting is finished as part of this section.

7.2 All hardware installed under this contract shall be inspected, cleaned and repaired or replaced as required to place in proper operating condition at completion of this contract.

8. HARDWARE SCHEDULE

8.1 The manufacturer's name and catalog numbers specified herein are for material identification and quality and functional description. Equal products approved by the Contracting Officer are acceptable alternatives.

8.2 Each door to have:

1 Cipher Dead Bolt Lock* (non-institutional)	Simplex DL-200
1 Strike*	Simplex #101
1 Latchset*	Existing or Schlage D10S
1 Stop	Existing or BHMA L12141, BHMA 1201
1½ Pair Butt Hinges	Existing or BHMA A8112

*OR

1 Cipher Deadlatch (heavy duty)	Unican #1000-2 with key override

DOOR DAMAGE REPORT FORM

NAME OF PERSON SUBMITTING FORM ______________________

DATE _____/_____/_________

BUILDING (Circle One) 90 91

FLOOR (Circle One) 1 2 3 4

ROOM NUMBER ______________________

DAMAGE TYPES	✓	POSSIBLE CAUSE
Hole or Break in face of door (other than around lockset)		
Hole or break in door around lockset or knob		
Knob Missing		
Lock Broken		
Vent grille missing or broken		
Deadbolt lock broken		
Door split around lockset		
Hinge damaged or pulled away		
Other (describe)		

INSTRUCTIONS TO THOSE MAKING REGULAR INSPECTIONS: On the form above indicate the building, floor and room number where you observe damage to a sleeping room door. Then note the type of damage with a check mark (✓) and indicate beside it the possible or probable cause.

DOOR REPAIR REPORT FORM

NAME OF PERSON SUBMITTING FORM ____________________

DATE _____/_____/__________

BUILDING (Circle One) 90 91

FLOOR (Circle One) 1 2 3 4

ROOM NUMBER ____________________

LENGTH OF TIME TO MAKE REPAIRS ____________________

COST OF MATERIALS ____________________

NUMBER OF PERSONS MAKING REPAIRS ____________________

HOURLY RATES OF REPAIR CREW MEMBERS ____________________

DAMAGE TYPES	✔	REPAIR MADE
Hole or Break in face of door (other than around lockset)		
Hole or break in door around lockset or knob		
Knob Missing		
Lock Broken		
Vent grille missing or broken		
Deadbolt lock broken		
Door split around lockset		
Hinge damaged or pulled away		
Other (describe)		

INSTRUCTIONS TO THOSE MAKING REPAIRS: Indicate with a check mark (✔) on the above form the type of damage which you are repairing and write beside it the type of repair you made.

MONTHLY REPORT ON BEQ POPULATION

NAME OF PERSON SUBMITTING FORM ______________________

DATE _____/_____/_________

BUILDING ______________________

INSTRUCTIONS TO BEQ MANAGERS/STAFF: On the first day of each month, write in the space below the number of residents assigned to each wing of each floor at the end of the previous day (the last day of the previous month). Also indicate the grades and types (radio, morse code) of students on each floor.

FLOOR	TOTAL	STUDENT TYPES	GRADES
1A	________	________	________
1B	________	________	________
2A	________	________	________
2B	________	________	________
3A	________	________	________
3B	________	________	________
4A	________	________	________
4B	________	________	________

LOG OF MAJOR EVENTS

INSTRUCTIONS TO BEQ MANAGER/STAFF: Note on this form major events in the BEQ which might affect vandalism. Some examples are school/class graduation of BEQ residents or a fire in the building. Also be careful to note which building the log refers to.

BUILDING (Circle One) 90 91

DATE	EVENT
______	______________________________
______	______________________________
______	______________________________
______	______________________________
______	______________________________
______	______________________________
______	______________________________
______	______________________________
______	______________________________
______	______________________________
______	______________________________
______	______________________________

Appendix

Since the Demonstration Program requires a rather long time period before any findings could influence changes in design of Bachelor Enlisted Quarters and since during that time most bases will continue to struggle with ways to minimize vandalism-type damage, some of the administrative responses cited by personnel contacted in connection with this project might be useful.

These responses, some of which are in use, were gathered during the initial telephone interviews with command personnel at 13 Navy bases and during the site visits to eight of those bases. In addition, command personnel from two other bases which were contacted early in the project volunteered their administrative solutions via letter.

Many of these administrative responses parallel those suggestions made in the BOSTI study which preceded this project, and in several cases, command personnel said they had read the BOSTI report and found it useful in their anti-vandalism efforts.

These administrative responses are discussed below.

Five bases volunteered that they were trying the so-called "unit integrity" concept for berthing assignments. This means that sailors from the same unit, school or tenant command are grouped together in a single BEQ or a particular section of a BEQ. Command personnel at these bases said they felt the use of this concept would deter vandalism; in one case, an administrative officer said the tenant commands are responsible for inspecting their men's sleeping rooms, a factor he thought might curb some problems.

It is perhaps somewhat ironic that this switch to "unit integrity" followed on the heels of the BOSTI study which concluded that such berthing assignment "was more frequently associated with higher vandalism costs than was assignment of berths through availability." The command at one base, in response to the previous study, was in the process of mixing BEQ residents rather than assigning them by unit/school. And at another base, one BEQ which had unit integrity had very visible vandalism-type damage (particularly graffiti), but, according to command personnel, that unit had the highest retention rate of any unit on the base--an interesting trade-off.

One difficulty base commanders must wrestle with is how to deal with a case of vandalism when the vandal is known or could be found out. At one base, the host command requires that disciplinary action be taken by the tenant commands and that the action be reported back to the host command. At some other bases, individuals caught for vandalizing BEQs are taken to Captain's Mast and fined; the results of that Mast (the amount of the fine) are then made public, as a possible deterrent to other would-be vandals.

One command said that the bill for repair of a damaged item is sent to the tenant command or the tenant command is given an opportunity to identify the vandal, who then has two choices: he can be placed on report and go to Captain's Mast, where he will be fined, probably even more than the replacement cost of the item, or he can "voluntarily" replace the damaged property. Since any fines levied against sailors go into the general fund of the Navy and are not specifically available to the command to pay for the repair/replacement of a damaged item, command personnel frequently expressed a greater desire to have sailors pay for the repairs, either by contacting a contractor directly or by giving the money to their commanding officer who would then pay the civilian contractor for doing the work.

At one base visited, command personnel said that vandalism problems had diminished greatly since tenant commands had been given responsibility for the BEQs in which their sailors live. At this same base, there is a host/tenant agreement which sets out tenant command responsibility for damage beyond normal wear and tear in the BEQs.

At another base, the fire and security watches were being retained to emphasize their "responsibility" for maintaining good order and discipline in the BEQs. This was enforced by their being put on report for failing to carry out this responsibility; the punishment they receive from being on report is then made public as a lesson to others.

The musing suggestion of one base commander that one occupant of each room should be put in charge of that room and held responsible for its condition was a reality at two other bases, in at least a limited fashion. At one base, the senior man in each "module" is responsible for cleaning up graffiti in that module, either by doing it himself or finding the perpetrator and having him do it. The first base commander, who was primarily thinking aloud and had not tried out the idea, thought it would be even better to rotate the responsibility among all occupants; that way, each sailor would know that one day he would be held accountable, and thus he might take better care of the facilities.

At one of the bases, the command has instituted a check-in/check-out procedure which includes noting the material condition of the room and a furniture inventory.

Since the loss of keys is a primary reason for damage to sleeping room doors--sailors, unable to get in by using their keys, resort to kicking in the door--various bases have tackled this problem in a variety of ways: when a key is lost or a resident moves out, the tumbler is removed and retumbled and new keys are issued; a new key costs $10, and, according to BEQ staff, once sailors realize how high the cost is, they are more careful about keeping track of their keys; a key-duplicating machine is installed in the BEQ office so that new keys can be made more easily than by waiting for the base locksmith to do it.

COST ESTIMATE OF EXISTING MATERIALS TO BE REPLACED IN THE DEMONSTRATION PROGRAM

CEILINGS: DEMONSTRATION PROGRAM

Materials to be replaced--standard mineral fiber acoustical tile; does not include suspended "T" grid which is existing and will not be replaced.

Quantity	Item	Unit Cost*	Extended Cost
1080	**2 x 4 tile (8sf)**	**44¢/sf**	**$ 3,800**
1000	**2 x 2 tile (4sf)**	**44¢/sf**	**1,760**
		TOTAL	**$ 5,560**

***Unit cost includes invested cost of material and labor. It is estimated that at least 60% of the existing tiles may be salvaged for reuse which would reduce the total investiment to $3,890.**

DOORS/HARDWARE: DEMONSTRATION PROGRAM

Materials to be replaced--wood door, solid core, with ventilator louver (hardware to be reused or salvaged).

Quantity	Item	Unit Cost*	Extended Cost
48	Wood Door	$175	$ 8,400

*Unit cost includes invested cost of material and labor. It is estimated that at least 90% of the existing doors may be salvaged for reuse which would reduce the total investment to $4,874.

DISCUSSION OF FIRE SAFETY ISSUES IN THE DOOR/HARDWARE DEMONSTRATION PROGRAM

Existing Door/Hardware Design

The Door Schedule, sheet A-16 dated revised 2 May 1968 of the construction documents for BEQs 90 and 91 at the Naval Training Center, San Diego, CA lists a solid core wood door with a bottom ventilator louver. There is no fire rating listed in the remarks column.

The site visit to BEQs 90 and 91 determined that the existing type of door typically found on sleeping room entries was a solid core (gypsum filled) fire rated, labeled door but with a bottom ventilator louver which invalidates the labeled fire rating.

Assessment of Fire Rating

According to current National Fire Protection Association standards, NFPA 101 and 90A, neither the type of door scheduled nor the type of door installed would qualify for any fire rating. This is because of the ventilator louver installed in the door. According to current NFPA 90A:

> 2.2.2 Public Corridors. Public corridors in institutional and residential occupancies shall not be used as a portion of a supply return, or exhaust air system serving adjoining areas other than toilet rooms, bathrooms, shower rooms, sink closets, and similar auxiliary spaces opening directly on the corridor.

Recommendations

Therefore, since BEQs 90 and 91 are "non-conforming occupancies" and since only a small percentage of the doors in these BEQs are to be changed in the demonstration program, it is recommended that the new doors be undercut to provide ventilation equal to that which is now provided by the louver. An NFPA 101 representative noted that undercutting a door provided for less smoke infiltration than the louver, albeit a marginal difference. Furthermore, because so few doors will be changed in the demonstration program, it appears to be an expensive and unnecessary cost to require an alteration to the mechanical system to satisfy room air supply in what will still be overall a "non-conforming occupancy" unless the entire building were to be renovated to conform with current NFPA requirements.