THE CAMOUFLAGE PROGRAM OF SOUTHERN CALIFORNIA

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Military authorities have told us many times that we must expect at least a "token" raid in this area, or any other portion of the country for that matter, and we must be prepared for it. Such a raid would bring forth wide-spread demand for the camouflage of all vital industry and utilities, as it did in England after the first German bombs were dropped. It is, therefore, essential to have a complete plan ready in order that millions of dollars will not be wasted in needless ineffective camouflage.

In the year following Pearl Harbor, methods of industrial camouflage have been worked out to meet the local needs in all parts of the United States, and specific area plans are rapidly being developed to cover the most vital areas.

This article will deal only with the camouflage of industrial plants, utilities, and similar installations and will not attempt in any way to describe military camouflage or military installations.

CAMOUFLAGE OR PROTECTIVE CONCEALMENT

Camouflage, or protective concealment, as the Office of Civilian Defense prefers to call it, can be defined as the science or art of confusing the identity of an object for the purpose of deceiving or bewildering the observer.

Protective concealment of industry is interested primarily in the bewildering of the bombardier. At best, the bombardier has less than a minute to find his target, get set on it and discharge his bomb. It is not always essential under these circumstances that the target be entirely obscured from the sight of the bombardier.

It is anticipated that in this area we need expect only high-level, precision bombing. Therefore, we need only carry our camouflage plans far enough to deceive a bombardier flying at altitudes of twenty to thirty-thousand feet. This greatly simplifies our problem because from such altitudes colors are no longer discernible, but only the texture and depth of tone are apparent. Also, the height of objects cannot be easily estimated from such altitudes unless they throw distinct shadows.

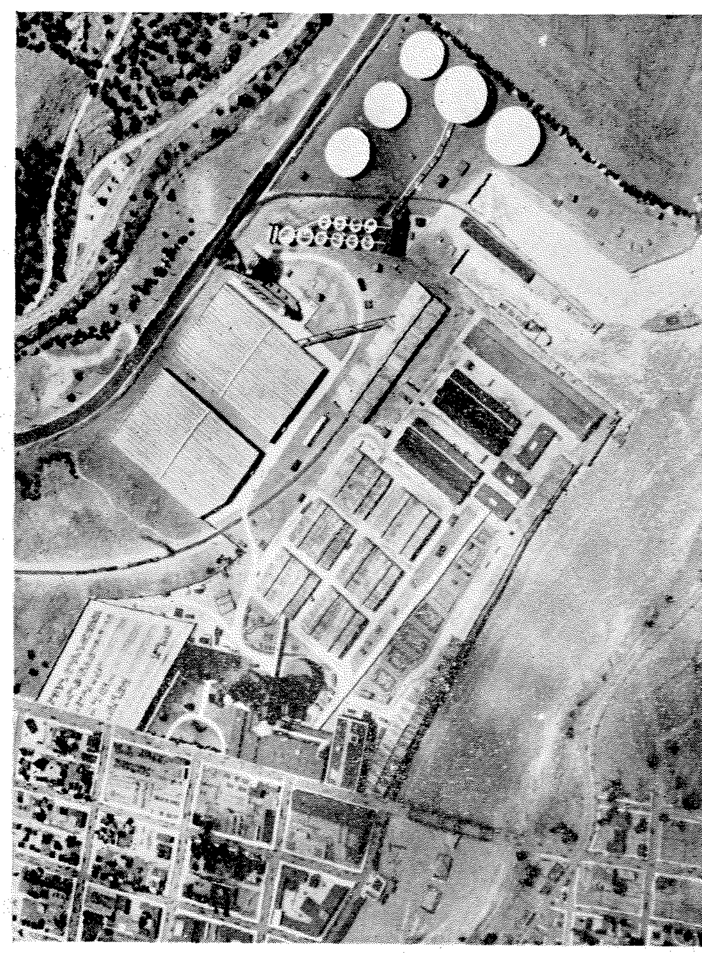
GENERAL PRINCIPLES OF CAMOUFLAGE DESIGN

As in any other field of design, there are certain general principles in camouflage or protective concealment that must be taken into consideration in order that the solution to the problem may be adequate. The more important of these are described below:

Camouflage is no protection against night bombing or area bombing—that is, mass bombing by large numbers of planes. However, it is a protection against precision bombing, which is our main concern in this area. Many targets may be naturally camouflaged because of their surroundings and should have nothing done to them. An industrial building in a built-up industrial area, if of the same general size and shape as the surrounding buildings, cannot be easily spotted from the air. Probably anything done to such a building would make it a better target.

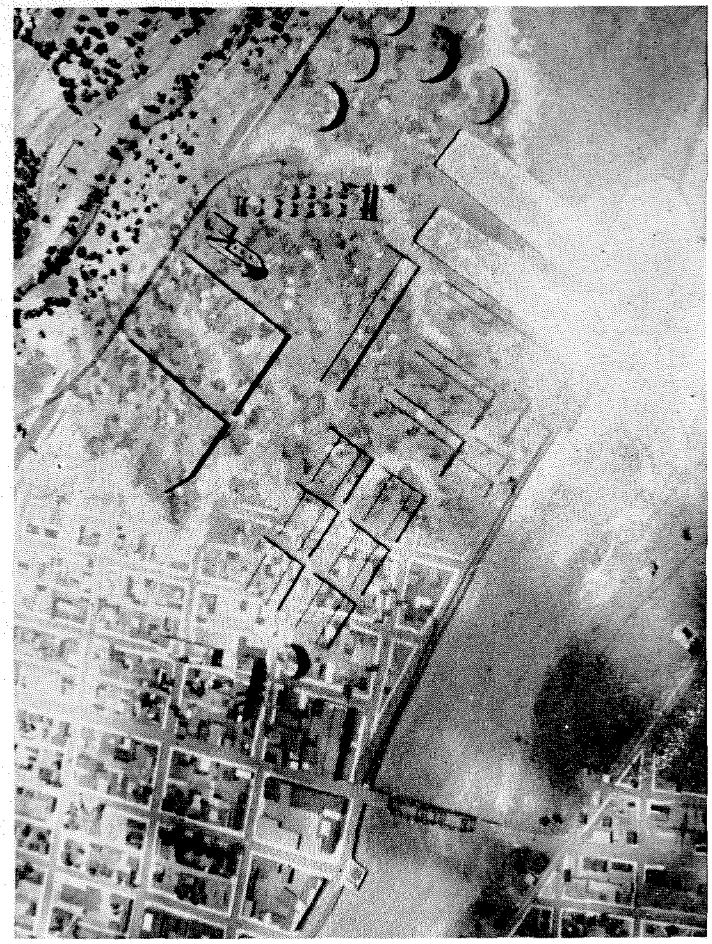
Landmarks that may lead the pilot to the target are as important to the camoufleur, if not more so, than the target itself. Bridges, highways, inersections, curves in river-beds are good examples of such landmarks. Many of these are extremely difficult to camouflage. In general, the best camouflage job is the simplest one. The more complicated the plan becomes, the more easily it is detected. It is also true the more complicated it becomes the more it will cost to build and maintain. Complicated methods of camouflage make the area camouflaged more difficult for industry to use and tend to increase the cost of production and also to retard it. Therefore, no more camouflage should he used on any project than is absolutely essential.

A poor job of camouflage is worse than none. To illustrate: A water company painted an elevated tank a dull color to match the surrounding area hoping to reduce its visibility from the air. The result was most unexpected. After painting, the tank was easily spotted in aerial photographs, while on earlier photographs it was difficult to locate because the dust of many years had given it not only the color but the tone and texture of the ground.



Photograph of model, courtesy of Premier Oil and Lead Works

Fig. 1. Industrial plant as seen by bombardier from about 5,000 feet elevation.



Photograph of model, courtesy of Premier Oil and Lead Works

Fig. 2. "Tone down" of same plant. Note shadows. Actual bombing would probably be from much higher altitudes.

From the air the shadow of an object may be many more times obvious than the object, itself. Saw-tooth roof construction, casting a series of shadows on the roof of the building, stands out like a house on fire and can be seen for many miles by the bombardier. It has also been found that streets that have been painted in order to camouflage them can be easily spotted by the shadows cast by the curbs. The subduing of shadows is the most difficult problem the camoufleur has.

All nations now use photography in reconnaisance work. To help deceive the camera, it is essential that infra-red reflecting paints be used when the foliage of the surrounding area is infra-red reflecting. It should be pointed out that in general it is impossible to deceive the camera and all camouflage can be broken down by the use of photography, although in many cases numerous shots will be needed. But this is not so serious as it sounds since it is still essential that the bombardier see the target in order to hit it with the bomb. So, if we can delay him even a few seconds in finding it—although he may know exactly how it looks when camouflaged from a study of the photograph, we have accomplished our purpose.

In camouflage work, it is not essential to pay attention to too much detail. Objects six feet or less in diameter as a rule do not show up with individual identities from 10,000 feet in the air. The camoufleur is wasting time to put small shrubs around the houses or to make little paths in the yards. What is essential is that the general background tone and texture are the same as that of the surrounding area including the effect of such objects.

THE THREE CLASSES OR STAGES OF CAMOUFLAGE

With the above basic principles in mind, we can divide protective concealment into three classes or stages depending upon the degree to which we carry out the work and the money spent thereon.

The first stage, or "minimum job", can be called the "tone down," and will be satisfactory for ninety per cent of the camouflage work done. It consists primarily of painting a building or structure so that it blends with the background by the use of dull paints with color and reflective capacities similar to the ground or shrubbery in the area. Informal and native landscape patterns may be used to help blend the area in with the surrounding territory. Reflective surfaces, such as skylights, windows, etc., may be painted or colored so that no light is reflected. The "minimum job" does not do away with the tell-tale shadows, although their effect may be somewhat hidden by planting.

The second stage, or "average job", carries the work of the camoufleur one step further and distorts the shape of the building or structure by the use of contrasting colors in the "tone down" and by the use of excrescences. Excrescences are shrubs, trees, or structures used to change the shape and appearances of buildings and the shadows they cast. The story is told

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Photograph of model, courtesy of Premier Oil and Lead Works

Fig. 3. "Complete job" on same plant through use of many excrescences. In many cases more use could be made of nets.

since employees on different shifts cannot very well ride to and from work together, hence it is not so popular as inter-plant staggering, which would mean shifting the hours of every employee one way or the other at a plant.

The development of staggering hours plans has fallen into the hands of traffic engineers in most cases, and where a city or industry has not had such an engineer in their employ, state and national organizations have come to their assistance. The surveys of working hours and transportation load fluctuations requires the engineering approach to work out solutions. In most cases the engineer then has found it necessary to become a combination politician-salesman in order to secure the approval of the merchant groups, the school groups, and the industrial interests, in making the hours changes.

Elimination of 1/3 to 1/2 the usual number of bus and street car stops, shortening of lines, and elimination of jogs and detours in lines have been necessary to further conserve the mass carriers.

In regard to movement of buses and street cars, the office of Defense Transportation has issued the following: "Traffic regulations and controls have generally been operated to facilitate the movement of automobiles. During the present emergency the movement of mass transit vehicles should take precedence, and the efficient movement of such vehicles should be the major consideration in the timing of traffic control devices."

Thus traffic engineers are hard at work devising ways and means of curtailing service to the minimum essential, and speeding up the schedules through congested areas by giving the "breaks" to the mass carrier wherever possible.

Today, the bus rider finds that he has to walk a couple of blocks to the bus stop, where formerly he was picked up at his door step. His hours of work have probably been changed, to lessen the peak load on the buses, and yet today he probably has to stand up since the buses are filled to overflowing as never before. But the bus rider and the motorist today are finding out what a luxury transportation has been in the past, and they are beginning to be glad to find standing room in a bus or a seat in a car full of war workers.

What can the traffic engineer expect for the future?

There is the certainty of great increases in urban and suburban travel. Public and private aviation will mushroom almost unbelievably, probably superceding much of our pre-war long-distance motor vehicle and train trips, where time-saving is important and cost is not too much a factor. But the use of the motor vehicle for short trips will be an essential part of our transportation network. The average length of motor vehicle trips has been 15 miles, and will probably continue to be about that. It is generally agreed that planes will not supercede cars for short trips! So folks will still need cars.

Federal funds will aid construction of parkways and freeways, functioning as arteries for the great masses of motor traffic that will flow into and out of cities, and between cities not too far apart.

The traffic engineer will continue to function as a Highway Transport "Operations" Engineer, a field the importance of which has long been recognized by the railroads, and which is rapidly coming into its own in highway transportation. His field of operation will continue to cover the subject: (1) geometric highway design, (2) road surface characteristics, (3) terminals—their location, design and operation, (4) methods of securing efficient highway transportation, (including accident prevention and public education), (5) vehicle performance, (6) traffic capacity, speed, composition and other characteristics of the traffic stream, (7) driver characteristics and driver behavior, (8) methods of supervision and control of both vehicular and pedestrian traffic, (9) the use of relationships of metropolitan highway transportation systems to other transportation facilities and to city planning, and (10) highway transport economics.

The traffic engineering profession, in meeting the challenge offered by the war production transportation problem, is undergoing a broadening influence which cannot fail to benefit the engineer, as he works more closely with public groups in staggered hours and tire conservation programs and with industrial groups in solving their transportation problems.

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of a bombardier who had been ordered to bomb a large gas holder. After making a thorough study of the maps of the area, he and his pilot made their flight but could not find the target. They circled and tried again, but again were unable to find it. Then they returned to the base and new photographs were taken of the area. Minute study of these photographs finally indicated that a square platform had been erected on top of the tank, so that instead of a round object and its shadow for which the bombardier was looking, there now existed a square structure and its shadow. On the next trip the bombardier hit the target.

The painting of large, flat factory roofs or large ground areas such as landing fields to simulate the surrounding area, can be done with surprising success. Streets are continued, by painting, up the walls and over the roofs of structures or across the runways. Sometimes, in order to get the proper texture, it is essential that shavings or similar material be imbedded in the paint. This is especially true where simulated turf is painted on the runways. Houses or other small buildings are simulated by areas of light and dark, the dark portion acting as the shadow, painted directly on the "tone down" background color. They should be made to appear like other buildings in the neighborhood.

Because of the change in character of foliage with the seasons, it is essential that the backgrounds, or "tone down" color be changed with the seasons. Also, the paints used are generally somewhat darker than the colors in the surrounding territory because they tend to fade.

In this stage of camouflage, it is impossible to do much with the automobile parking lot. The protective concealment of parked cars is one of the most difficult problems we have because of the many reflective surfaces that a car presents. It has been suggested that cars could be painted a dull tone similar to that used in buildings, but as long as they have many glass surfaces present, this seems of little use. If room is available, cars can be dispersed; trees and shrubs planted to hide them, and the area painted to conform to the adjacent areas. This will usually double the area now used, but it is probably cheaper than using the third stage of camouflage. Perhaps the rubber shortage will help considerably if people start going to work by means other than private automobiles.

The third stage, or the "complete job," is only used where neither the first nor the second stage is satisfactory and where the importance of the target warrants the spending of considerable money. It consists of all the work done under stages one and two, and in addition the removal of all shadow lines as far as possible. Parking areas used for both cars and planes, or areas used for the storage of material, must be covered instead of being painted in order that they may still be used. To eliminate the shadows and to hide the work going on adjacent to the buildings, a system of nets supported by cables which in turn are supported by other cables, poles, or buildings is used. The netting used in this locality is chicken fencing of light gauge wire. It is rather thinly covered (25% to 50% of the area) with some material such as feathers or glass wool, to give texture and a surface to paint. The method of fastening on the feathers is interesting. The netting is dipped in asphalt, or other adhesive material, and the feathers are then dropped on at a rate to give the correct texture as the netting is moved along under the feather bin. The netting and feathers are then passed in front of large fans in order that the feathers not well fastened to the netting will be removed. Millions of square yards of this material have been manufactured and used. This netting is then painted, a similar procedure to that outlined for buildings in the second stage being used.

Painting of nets is usually done before they are installed. In laying out, on the netting, the colors for houses, streets, etc., care must be taken so that when these will match where the nets meet on erection. Of course, maintenance painting or change in the character of foliage must be done while the nets are suspended. These nets will weigh somewhat less than half a pound per square foot and can span up to fifteen feet. The structural design of the cable system and its supports presents a specific problem which will be discussed later.

Probably the simplest case of the use of nets is known as "flat topping," and is nothing more than netting supported on light cables or wooden framing between the eaves of the roofs in saw-tooth or similar construction. After this has been installed, the problem of camouflage on this roof is identical with that of the flat roof building.

Sometimes, as a variant, portions of netting are left out and the saw-tooth built so as to look like a house or a garage. It will cast its own shadow, thereby heightening the camouflage effect. It also reduces the cost to some extent. This procedure and other similar variants are very helpful and effective on extremely large roof areas.

Usually the next area considered after a flat topping of the roof is the parking lot. Here, the netting and cables are carried on poles and the feathers are thinned out near edge of the nets until there is nothing left. By this process the shadow of the netting is gradually dispersed and cannot be picked up from the air. Generally, the poles are twelve to fourteen feet high and the netting may drop as low as eight feet above the ground between them.

In the "complete job" nets must be run out from all the buildings to hide the work going on between and around them as well as to cut out their shadows. Sometimes, these nets may be carried as much as four hundred feet away from the buildings. Usually, after the nets have been installed the problem is the same as in the second stage except over much wider areas. Many times, to make the camouflage more effective, excrescences made to resemble houses, trees, or other structures are erected directly on top of the nets, although their use is not absolutely essential for effective camouflage against high altitude bombing.

Although not a problem of the camofleur, it should be noted that the problem of air conditioning in these buildings, painted dark colors with net stretched over and around them on all sides and with all windows closed because of the night blackout requirements, becomes difficult. This prohlem is being partially solved by the use of infra-red reflecting paint.

There are two types of protective concealment that have not heen mentioned in the preceding discussion because they do not fit into the particular patterns of camouflage, but are of a special nature. The first of these is the use of dummy targets. A dummy plant or structure is erected to look from the air exactly like the original. It is usually placed from one-half to one mile away. If the landmarks have been satisfactorily taken care of, the bomhardier will usually aim at the dummy target. There are instances in Europe where photographs definitely proved the existence of dummy targets and complete camouflage of the actual objective, and yet the bombardier with this knowledge can not resist the desire to homb the one he can see rather than the one he knows to be protected.

The use of dummy targets is extremely expensive because they must not only look like the actual plant hut must also appear to be in use; that is, the roads, parking lots, etc., must show signs of activity. Their use is not warranted in any protective concealment work except the camouflaging of the most vital industries.

The second special type of protective concealment is the use of smoke. This is a rather new development and there is not much information as yet available to the public, but all indications are that it may be used to great advantage for protection against both day and night attacks. Its primary purpose is to reduce visibility, cut out light penetration and hence obscure the target and reduce shadow lines.

Under the first stage, or "tone down," the use of planting was mentioned. This is a little used field which appears to have tremendous possibilities. If many of our industrial plants had not removed the natural growth around them and had been more careful of the dispersion of buildings, probably very little money would now have to be spent on protective concealment. Much can still be done by the planting of proper trees and shrubs in the areas around many existing plants. With proper care and feeding, certain trees and shruhs will grow surprisingly fast and will before long not only offer considerable protective concealment but will help beautify our industrial areas.

STRUCTURAL CAMOUFLAGE

The almost universal method for supporting nets is by cables, although on some short spans wooden beams have been used. The loads generally used in design are very light: vertical loads, including both live and dead, one-half pound per square foot; horizontal loads due to drag effect of wind, one-half pound per square foot of netting surface on all surfaces; a horizontal load on surfaces with a slope of 30° or more, of five pounds per square foot of vertical projection; a live load on main cables of 200 pounds concentrated to take care of a man working.

Some of the other limitations of design are that a net supported directly on a cable should produce maximum cable sag of not more than six per cent of the span with an average sag of all cables of not more than three per cent. This will keep the end slopes of the cables flat enough so that they will not cast shadows. Sloping cables supporting nets should be limited to a maximum slope of about 20° with the horizontal, except when facing the south.

Most of the buildings built in this area before 1933 do not have adequate strength to resist the pull of cables. If advantage is taken of earthquake bracing installed in buildings since 1933, they usually can be used to support and anchor the cables. However, special connections must be made in all cases, and in many cases some minor additional bracing is needed. When no building is available for anchorage, concrete "deadmen" weighing up to thirty tons are installed. When anchor cables are installed at steep angles, as they must be in some cases, the columns adjacent to "deadmen" carry extremely high loads and the design of footings may become quite serious.

DESIGN PROCEDURE

In designing the protective concealment for an industrial plant, the first step is to obtain complete photographs from the air of the area and enough information on the size, area, and roof construction of the building so that models of the entire area can be made.

After the models have been made, various camouflage schemes that blend in with the general camouflage plan in that area, as set up by the Office of Civilian Defense, are tried and photographs taken of the model. After one of these is chosen and developed to its final form, plans are made in order that this work can be carried on in the field.

OFFICE OF CIVILIAN DEFENSE SET-UP FOR PROTECTIVE CONCEALMENT

The Office of Civilian Defense has set up a standard procedure for the handling of all camouflage problems except those of the armed forces. Each city and county has appointed a camouflage officer whose duty is to act as liaison between the office of Civilian Defense, Protective Construction Division and industry in their respective areas. If any industrial firm desires information regarding the protective concealment of its plant, the Protective Concealment Division of the Office of Civilian Defense will make a complete study of it and report the results. The request is made through the local camouflage officer who obtains the necessary information and transmits it to the O. C. D. They then proceed with a complete design of the camouflage as outlined above and obtain the army's approval of the final layout. The approved plan is then transmitted to the plant by the local camouflage officer. If the officials of the plant wish to carry out this plan, an O. C. D. approved camoufleur is employed to prepare detailed plans of construction and to handle the work in the conventional manner. If the industrial firm does not wish to do the work at this time, at some later date the army may require the work to be done if it feels it is essential that this particular plant be camouflaged.

COMMERCIAL BROADCASTING

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services, usually international in scope. In one sense this is a handicap to the broadcaster for it is felt that there are times when other means of transmission would be superior to existing wire line facilities. For example, one school of thought believes that with the increasing knowledge and improvement in the use of the ultra high frequency radio spectrum (above thirty megacycles) an improvement in program transmission would result with no increase in cost of service, and without congestion in the radio spectrum.

The actual path over which network programs reach all member stations is a vast system of wire lines leased for twenty hours a day from the telephones companies at an annual aggregate rental of over three million dollars. Between New York and Chicago there is a "round robin" circuit and from Chicago to the Pacific Coast a "reversible" circuit. Added to this basic pattern are several supplementary "legs" radiating to all parts of the country and via short wave radio to other countries. A "round robin" circuit is one in which a program is always transmitted in a given direction around a "loop", regardless of the point of origin. For example when New York originates a program it travels over the telephone wires to Chicago via Schenectady and Cleveland, enters the Chicago network control board and passes out again to New York via Pittsburgh and Washington.

It is dead-ended at New York. Should a switch in program origin from New York to Chricago be necessary, Chicago would open the loop and New York would connect the incoming and outgoing circuits. The program thus travels eastward over a southern route and back again over a northern route. The elapsed time for program to travel to New York and back to Chicago again is one fifth of a second. Each station along the line gets a "feed" as if it were listening in on a party line. The

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