Long Beach, Vancouver Island, B.C.

PART II

COASTAL SEDIMENT PROBLEMS

Breaker Beach, Vancouver Island, B.C.

CHAPTER 39

TIME-INTERVAL PHOTOGRAPHY OF LITTORAL PHENOMENA

by

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ABSTRACT

The collection of most data on littoral phenomena usually is based on the requirement of personnel and equipment actually being on-site for specific periods of time.

An approach to minimize this requirement involves the use of a photographic technique, using time-interval cinematography. Two such systems have been used at sites in California; Point Mugu and Newport Beach. This method incorporates commercially available 16 mm motion picture cameras with automatic lenses, remotely programmed to shoot selected lengths of film at predetermined periods during a day, everyday. At Point Mugu the camera, housed in a weatherproof enclosure mounted atop an existing 100-foot tower, records shoreline conditions, wave characteristics and existing weather twice a day for a period of 20 seconds per exposure.

The cameras are normally serviced on a weekly basis but are capable of longer unattended operation. To date this method has provided data which on preliminary anaylsis has revealed it to be of significant value for the purposes intended.

INTRODUCTION

In the last few years, increased use has been made of ground and aerial photography to provide a permanent record of the dynamic and interrelated forces that converge at the shoreline. The requirement for trained individuals to operate the wide variety of cameras and accessory equipment, and that the recorded image represents but a minute instant of time are the most serious drawbacks to such methods of documentation.

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In an attempt to provide continued documentation of the littoral zone, cinematography has been employed to record shoreline conditions over long periods of time. This method, called time-lapse photography (Beck, 1971), provides a number of still pictures taken at precise time periods but does not reveal in real time the rapidly changing forces that are present in the littoral zone. Time-interval photography similar to time-lapse photography but significantly different in its mode of operation, does reveal this dynamic interplay of forces.

Time-interval photography consists of taking motion pictures for a time period separated by another relatively longer time period. It thus differs from time-lapse photography in the number of actual frames exposed. Figure 1 illustrates this comparison. Its advantage is that for areas of interest where motions of the subject occur over very short periods of time, such as wave action, the motion is documented. Because of the time period between exposures, excess film is not used indiscriminately and economy is achieved as in time-lapse photography. Also, it enables the time history of a subject to be compressed and easily reviewed in a matter of minutes versus normal cinematography which could require hours for similar periods of observation.

The U. S. Army Corps of Engineers has employed this system of photography to document shoreline conditions and littoral forces at two locations in southern California. The Coastal Engineering Research Center (CERC), in a comprehensive study of the functional effects of groins, has used a time-interval photographic system to supplement those methods usually used to document shoreline and sea surface conditions. This field study, entitled Prototype Experimental Groin (PEG), located near Point Mugu, California, has been in operation since the spring of 1969 and film has been collected for nearly the entire period of time. The U. S. Army Engineer District, Los Angeles, has used a similar system to collect data on a beach erosion control project at Newport Beach, California, for approximately two years.

EQUIPMENT

Basically, the system of time-interval photography depends on the use of a relatively precise 16 mm motion picture camera with an automatic lens, a self contained power source, a timing device to actuate the camera, and a suitable housing to protect this equipment from the corrosive atmosphere of the coastal environment and vandalism. Other than these considerations, the system merely requires coordination of commercially available equipment to attain the desired objectives. The two systems employed by the U. S. Army Corps of Engineers are similar, though each uses different components. Detailed descriptions of each are presented.

A. Prototype Experimental Groin (PEG), Point Mugu, California

1. Location of Installation. The Prototype Experimental Groin (PEG), Point Mugu, is located on property of the U. S. Pacific Missile Range,

Point Mugu, California. This site, approximately 60 miles northwest of Los Angeles and 10 miles downcoast of Port Hueneme. A description of the PEG project has been made by Riese (1971) and the U. S. Army Engineer District, Los Angeles (1968). This area is one of active longshore material movement and is near the site of a major U. S. Army Corps of Engineers project where sand bypassing operations across a submarine canyon have been in progress since 1953 (Savage, 1957, Herron and Harris, 1966).

An oblique aerial photograph of the PEG field site is shown on Figure 2. The location of the remotely operated time-interval camera is on top of a 100-foot tower situated on the back beach area. The camera is oriented seaward and diagonally downward to include a view of the experimental structure, approximately 600-feet of shoreline and the nearshore water surface. A typical view as seen by the camera is shown in Figure 3.

2. Basic Components. The time-interval photography system employed at this site utilizes the following equipment:

(a) Bolex, model H-16, Rex 4, 16 mm motion picture camera.

(b) Vario Switar 86 EE, automatic zoom lens. Zoom range 18 to 86 mm, angle of view 34° to 5.2°, maximum aperture f/2.5, minimum aperture f/16.

(c) Bolex Perfectone Motor. This motor runs the camera at a synchronous 24 frames per second.

(d) Power supply; two systems are available: a portable 12 VDC battery pack and a 110-120 VAC to 12-13 VDC converter.

(e) CERC designed intervalometer.

(f) CERC designed weatherproof aluminum shelter.

Detailed information on this photographic equipment is published in Paillard Incorporated Catalogue (1966) and the Professional Photographic Catalogue (Fuller and d'Albert, Inc. 1971).

Figure 4 shows the combined camera, lens and motor. Components of the power supply have been combined with the intervalometer, and a schematic of this portion of the system is shown as Figure 5. (A list of parts used in this installation is attached as part a. of Appendix I.) A photograph of the completed unit is shown as Figure 6.

As mentioned in the list of equipment, an all weather enclosure made of aluminum was designed to provide protection of the basic equipment. It is a 2-foot cube, all welded unit with a flanged hatch for access, and a 6-inch viewing port for the camera. This port, protected by plexiglass and a movable door, provides the window for the camera. The interior of the enclosure has been lined with a 2-inch thick layer of polyurethane foam to provide insulation and vapor barrier for any possible passage of humid air. Figure 7a shows initial stages of construction of the enclosure; Figure 7b presents the completed product, ready for field installation.

2. Mode of Operation. As designed the intervalometer allows the selection of up to and as many as 24 different periods of operation per day. Since the film selected for use and the automatic lens of the camera require sufficient ambient light for operation, the actual number of exposure periods are restricted to daylight hours, normally from 2 hours after sunrise to 2 hours before sunset.

Once the time(s) of exposure(s) has been selected the entire operation then becomes automatic. At the selected hour(s) the timer energizes a motor which opens the door of the camera view port; furnishes electrical power to the camera; allows the automatic iris of the lens to adjust to ambient light; starts the camera motor, which in this case runs for 20 seconds, exposing 480 frames of film; then turns off the electrical power to the camera; closes the view port door and recycles the timing mechanism to its start position. It is then ready for the next programmed exposure whether it is 1 or 24 hours later. The entire sequence of operation actually takes approximately 3.5 minutes of which 20 seconds are used for film documentation.

The period of programmed exposure may be varied from 10 to 30 seconds. Because the camera has only the capacity for 100-feet of film the 20 second exposure period was selected, enabling approximately 8 days of unattended operation with one exposure period taking place each day.

B. Beach Erosion Control Project, Newport Beach, California

1. Location of Installation. The Beach Erosion Control Project; Newport Beach, California, is located some 50 miles southeast of Los Angeles. It is an area of intensive shoreline development and the beach is used extensively for recreational purposes. Deterioration of the shoreline has required the reconstruction and periodic sand nourishment of the beach. Subsequent installation of a groin system to stabilize the beach has provided protection for the developed residential area and necessary room for beach recreation. A detailed description of this project and adjoining area has been published by the U. S. Army Engineer District, Los Angeles (1972).

An oblique aerial photograph of the study area for the time-interval camera installation is shown as Figure 8. The camera is located on the top of a 40-foot telephone pole and is oriented to view the beach, nearshore water surface and groin system in a northerly direction. A typical view as seen by the camera is shown in Figure 9.

2. Basic Components. The time-interval photography system employed at this site utilizes the following equipment:

(a) Beaulieu, Model R16, automatic 16 mm motion picture camera.

(b) Angenieux 4 x 17 automatic zoom lens. Zoom range 17 to 68 mm, angle of view 41° to 11° maximum aperature f/2.2, minimum aperature f/22.

(c) Power supply; Beaulieu Model R16 electric handgrip with rechargeable battery and 110-120 VAC.

(d) U. S. Army Engineer District, Los Angeles, designed intervalometer.

(e) U. S. Army Engineer District, Los Angeles, designed camera enclosure.

Detailed information on this photographic equipment is published in Beaulieu R16 Instruction Manual and Professional Photographic catalogue (Fuller and d'Albert, Inc. 1971).

A schematic of electrical circuitry of the camera, intervalometer and power supply is shown on Figure 10. A photograph of the assembled unit is shown as Figure 11.

The enclosure used in this installation is a modified electronic equipment cabinet that, although not completely weatherproof, has provided sufficient protection over extended periods of time. It is insulated with styrofoam and screen type filters for temperature control and exclusion of humid air. A list of parts used in this installation is attached as part b. of Appendix 1.

3. Mode of Operation. Similar to the mode described for the preceding site, this installation differs only in the length of exposure. Because of the selection of time delay relays, the exposure time is limited to 8 seconds.

EXAMPLES OF DATA

Installations of equipment of this type are overly comprehensive of the data recorded. Usually there will be more information available than planned for; much of which could possibly be used in other analyses. Each investigator will, by design, be interested in a selected number of parameters and ignore a number of others visible in the film. The fact that with proper care the film will last indefinitely allows other investigators to review the film innumerable times, each to his own satisfaction. The two installations described are intended to record littoral forces and responses of the shoreline; however, there is additional data recorded for purposes other than those intended, such as recreational use of a beach, the number of people present on the beach, and recording construction progress of shore protection structures.

A. Prototype Experimental Groin (PEG), Point Mugu, California

The original intention of the camera installation was to qualitatively document wave climatology of the area, shoreline responses, and the functional effects of a littoral barrier in retaining materials. These data are to supplement that obtained by conventional means which normally are obtained at much longer time intervals than those prescribed for the camera.

Detailed analysis of the photographic data is in progress. However, for the purpose of this paper an example of the type of analysis being made is presented. Table 1 shows data extracted from the film for the month of March 1972. From this table it can be seen that positive wave period (for a minimum of two wave crests) can be determined; estimates of direction of wave approach, wave height and tide condition can be made. Additionally, should the area be used for recreational purpose, the number of persons and their activity can be counted and delineated. Less specific conditions of the beach and the nearshore environment are also recorded. Construction activity, weather conditions and visibility, outstanding beach features such as scarps and debris, types of waves which are breaking on the beach are a few examples noted.

Correlation of the data shown in Table 1, especially that of wave conditions was made from independent sources and shows strong agreement. If no other source of data were available it would prove invaluable; in this example it allowed data normally obtained by observers and/or electronic instruments which were either not present or missing because of equipment failures to be determined. Correlation and comparison of the data from two such sources reinforces the reliability of each.

At the present time, the functional response of a groin as it reacts to littoral forces has not been determined from the photographic data. Steps are being taken to apply mathematical solutions to this problem by rectification of the oblique view to that equal to a vertical view. This will enable direct measurements to be made. As presently envisioned this will not require true photographic rectification but simply measurements made on the viewed image which are then mathematically corrected to those which would appear in a vertical view.

B. Beach Erosion Control Project, Newport Beach, California

Data for the installation at Newport Beach, California, could be shown but the analysis would be similar for that shown in Table 1; therefore for brevity, detailed analysis will not be pursued in this paper.

OPERATIONAL PROBLEMS

For the most part minor operational problems have been encountered; those which have occurred are worthy of mention.

One problem has been that concerned with salt air corrosion of the various electro-mechanical parts. If care is not taken to prevent the free exchange of the atmosphere from the camera enclosure, such parts will readily corrode to a point where the equipment will not function properly. The addition of a low heat source within the enclosure (a 15-25 watt light bulb) or sufficient vapor barrier protection was found to be a solution to this problem.

The location of the camera installation and proper planning of the exposure interval and repetitive exposure sequence will reduce the problem of servicing the camera. Primarily such servicing is concerned with changing the film. A solution to this problem is, of course, the use of cameras with larger film magazines than those used so far. Cameras having 400 and 800-foot capacity are available and will essentially extend the period of operation by a factor of 4 and 8 compared to those used to date.

Positioning of the camera equipment with the requirements for easy access and supplementary power, although not always easy, can be made easier if existing facilities can be utilized. In the case of the installation at Point Mugu, a 100-foot tower was available for the camera installation. At Newport Beach, a 40-foot telephone pole had to be installed. At first glance each seemed satisfactory, and in general each is, but climbing the tower in strong winds can be hazardous to personnel. If sufficient height can be attained in nearby buildings, access and enclosure problems can be reduced by using a window in the upper floors of the building.

To date, detailed mathematical analysis of film has proved extremely difficult because of the lack of a visible horizon in the field of view. If sufficient visual coverage can be attained while still maintaining the object of interest, and include a horizon, the analysis will be greatly simplified.

FUTURE IMPROVEMENTS

The rapid advances being made in optical surveillance and measurement systems can only enhance the methods described so far. Remotely controlled, closed-circuit television systems are presently in use for numerous purposes. Examples are monitoring passage of ships through locks, fish counting dams, monitoring instruments located at distant locations and recording man's endeavors on the moon. Application of such a closed-circuit television can allow many locations to be monitored and recorded at a single central location. The ability of panning, tilting and zooming in are all remotely controlled and should allow important occurrences to be recorded for later analysis. Should sequences recorded be of little or no value, rendered useless with time, or analysis completed, present systems allow reuse of the magnetic recording tape a distinctive financial saving over that using photographic films.

Until recently nightfall has restricted the use of cameras and television. Recent advances in light amplification systems (GTE Sylvania, 1972) are becoming available which now allow available light, moonlight, starlight, earthshine and infra-red radiations to be used as the sole source of illumination. These devices, although costly, do allow night observation of the parameters previously described, where at present few comprehensive instruments recording during this period of the day can be compared to the visual image.

Applications of remotely controlled closed-circuit television and camera systems using light amplification devices can add information to that which is presently being collected.

CLOSURE

Use of a camera as a scientific tool for recording pertinent data have been established (Janke, 1972). The applications described have shown it to be a useful complement to the usual and accepted methods of recording littoral phenomena and in some instances a supplement to those methods or sole source of data. Increased use will allow expanded coverage, with a greater time base, of the littoral environment and the forces which converge at the shoreline.

"Data presented in this paper, unless otherwise noted, were obtained from research conducted by the United States Army Coastal Engineering Research Center under the Civil Works research and development program of the United States Army Corps of Engineers. Permission of the Chief of Engineers to publish this information is appreciated. The findings of this paper are not to be construed as official Department of the Army position unless so designated by other authorized documents."

Table 1. Data obtained from time-interval camera, P.E.G. Pt. Mugu, Ca.

March 1972

Day	Time	Breaker Period	Wave Direction	Surf Condition	Tide Condition	No. of Surfers in Area	Comments
1	0900	-	-	-	-	-	-
	1500	-	-	-	-	-	-
2	0900	-	-	-	-	-	-
	1500	-	-	-	-	-	-
3	0900	-	-	-	-	-	-
	1500	11.0	WSW	2	L-	0	Clear, Sunny; Large beach scarp.
4	0900	8.5	WSW	3	H+	0	" "
	1500	9.5	SW	2	H-	0	Clear, Sunny; Beach scarp.
5	0900	0	0	0	0	0	Fog, zero visibility.
	1500	13.8 (?)	0	0	0	0	Fog, limited visibility.
6	0900	16.8	SW	2	0	0	Fog, Visibility 700-800feet.
	1500	16.6	SW	1	H-	0	Overcast, good visibility; Beach scarp.
7	0900	13.1	SSW	1	H+	0	Haze, visibility 2500 feet; Beach scarp.
	1500	17.2	SSW	1	H+	0	Overcast skies; Beach scarp; Observers on beach.
8	0900	18.5	SW	1	H-	0	Overcast skies; Beach scarp flattening.
	1500	19.3	SW	1	H-	0	Clear, Sunny; Beach scarp flattening.
9	0900	13.2	SSW	1	H-	0	" "
	1500	14.2	WSW	2	L-	0	Clear, Sunny, Strong offshore wind.
10	0900	15.6	SW	2	L-	0	Clear, Sunny; Slight beach scarp.
	1500	13.6	SW	3	L+	0	Clear, Sunny; Observers on beach.
11	0900	0	0	0	0	0	Fog, Visibility 600-700 feet.
	1500	13.7	SW	1	L+	0	Fog, Visibility 1500 feet.
12	0900	17.3	SW	3	H+	0	Overcast skies, Rain (?); Beach scarp.
	1500	14.0	SW	4	L-	8	Overcast skies, Waves have overtopped berm.
13	0900	12.1	SW	2	H+	0	Overcast skies, Slight haze, Beach scarp.
	1500	17.3	SW	2	L+	0	Overcast skies; Survey party on beach.
14	0900	13.3	WSW	1	H-	1	Overcast skies; Survey in progress.
	1500	12.3	SW	2	L+	0	Overcast skies; Survey in progress.
15	0900	6.6	SW	2	H-	0	Overcast skies, rain; Beach scarp.
	1500	19.3	SSW	1	L+	0	Overcast skies; Survey in progress; No scarp.
16	0900	15.7	WSW	1	H-	3	Overcast skies; Survey in progress; Wave overtopped berm.
	1500	-	SW	2	L-	0	Overcast skies.
17	0900	15.8	SW	1	H-	0	Overcast skies; Survey in progress.
	1500	6.2	SW	2	H-	0	Overcast skies; Survey in progress.
18	0900	12.0	SW	2	H-	2	Overcast skies; Slight haze.
	1500	9.8	SW	2	H-	0	Clear, Sunny.
19	0900	9.4	SW	1	L+	5	Overcast skies; Waves have overtopped berm.
	1500	15.6	SSW	2	H-	0	Clear, Sunny; Beach scarp.
20	0900	12.6	SW	1	L-	0	Overcast skies; Two people on beach.
	1500	15.8	SW	2	H-	2	Clear, Sunny.
21	0900	14.4	SW	2	L+	3	Overcast skies.
	1500	12.7	SW	2	H+	0	Clear, Sunny; Beach scarp.
22	0900	12.0	SW	1	H-	0	Overcast skies; Survey in progress.
	1500	6.5	WSW	1	L-	0	Clear, Sunny; Local wind wave; Kelp on beach.
23	0900	12.4	WSW	2	H-	0	Clear, Sunny; Large beach scarp.
	1500	14.3	SW	2	L-	0	Clear, Sunny; Large beach scarp.
24	0900	10.5	WSW	3	H+	0	Clear, Sunny; Observers on pier; Beach scarp.
	1500	6.8	WSW	2	L-	0	Clear, Sunny; Navy beach patrol; Beach scarp.
25	0900	11.8	SW	2	H+	0	Clear, Sunny; Navy beach patrol; Beach scarp.
	1500	7.9	SW	2	L-	0	Clear, Sunny; Large beach scarp.
26	0900	6.0	SW	3	H-	0	Overcast skies; Beach scarp.
	1500	5.5	WSW	3	L+	0	Clear, Sunny; Navy beach patrol; Beach scarp.
27	0900	7.0	WSW	3	H-	0	Clear, Sunny; Observers on pier; Large beach scarp.
	1500	14.4	WSW	3	H-	0	Clear, Sunny; Construction second groin begins.
28	0900	13.5	WSW	1	H-	3	Clear, Sunny; Scarp smoothing.
	1500	11.9	SW	1	L-	0	Clear, Sunny; Excavation for new groin.
29	0900	6.0	WSW	2	H-	2	Clear, Sunny; Plunging breakers.
	1500	6.7	WSW	2	L-	0	Clear, Sunny; Continued construction.
30	0900	13.8	SW	1	H-	2	Clear, Sunny; No scarp.
	1500	14.8	SSW	1	L-	3	Clear, Sunny; Welding taking place.
31	0900	10.0	SW	1	H+	0	Clear, Sunny; Driving sheet pile.
	1500	15.6	SW	1	L+	2	Clear, Sunny; Driving sheet pile.

NOTES
1. All times shown Pacific Standard Time.
2. Breaker period in seconds.
3. Wave direction from which waves are coming; Groin oriented in SW - NE direction
4. Surf condition qualitative using Beaufort Scale for Sea State.
5. Tide condition H+ Rising to high tide (flood)
   H- Falling from high tide (ebb)
   L- Falling to low tide (ebb)
   L+ Rising from low tide (flood)

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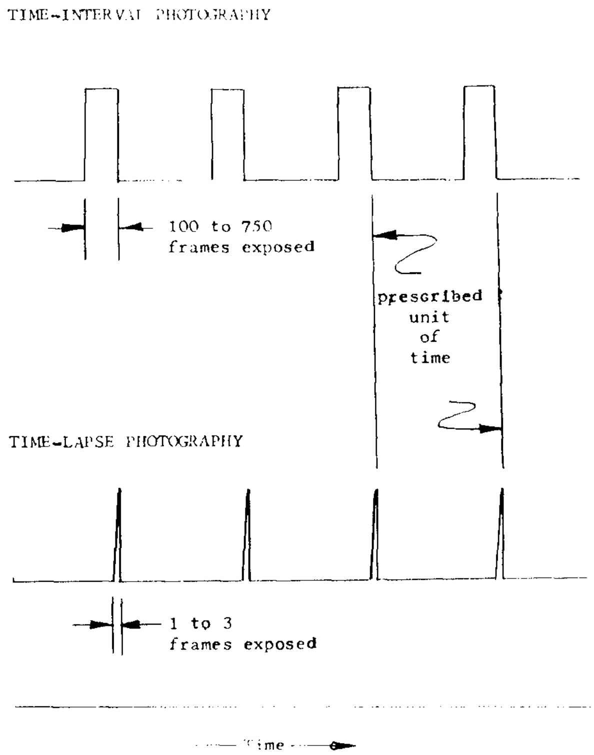

Figure 1. Comparison of time-interval and time-lapse cinematography, showing relation of time of exposure to time between exposures.

Fig. 2. Oblique aerial of CERC's Prototype Experimental Groin, Point Mugu, California

Fig. 3. Typical view of shoreline as seen by the remote time-interval camera, Point Mugu, California

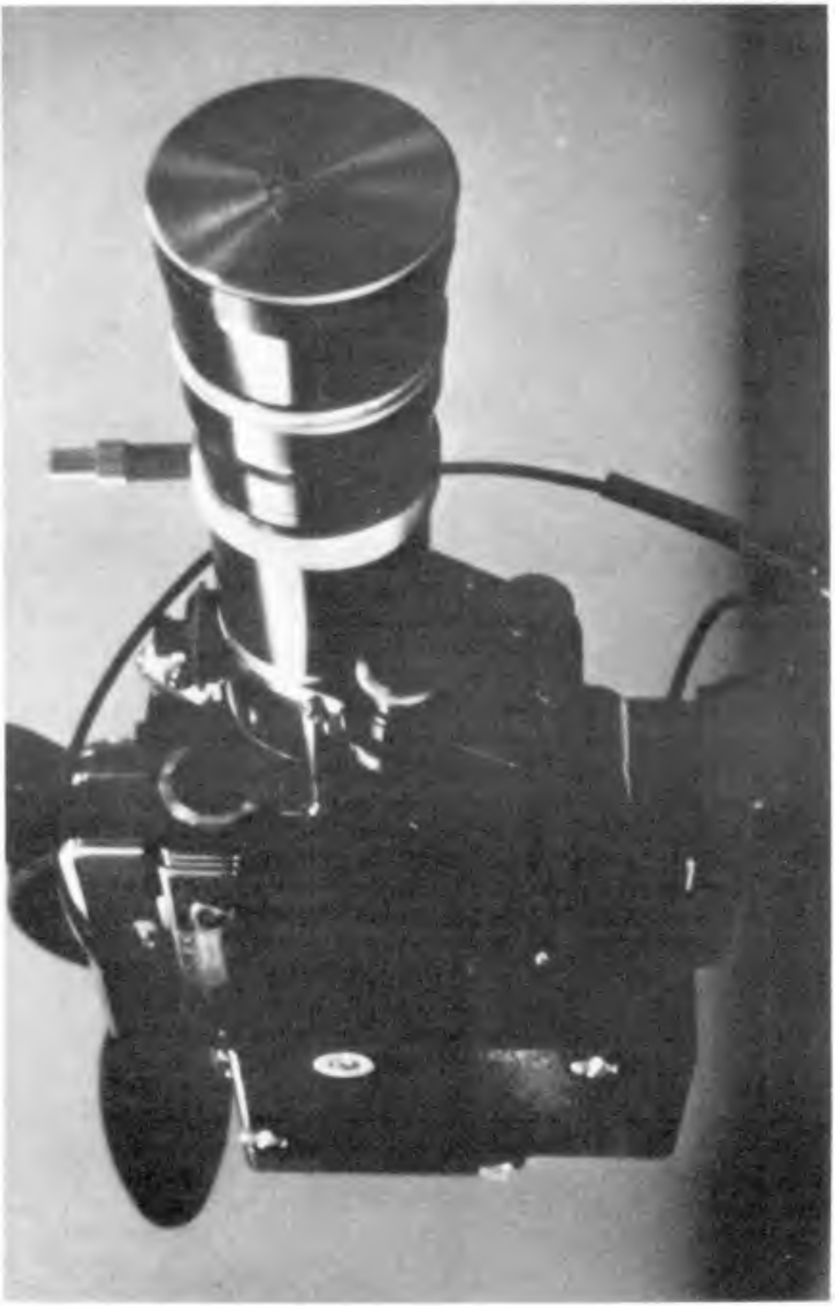

Fig. 4. View of CERC Bolex 16 mm movie camera used for time-interval photography

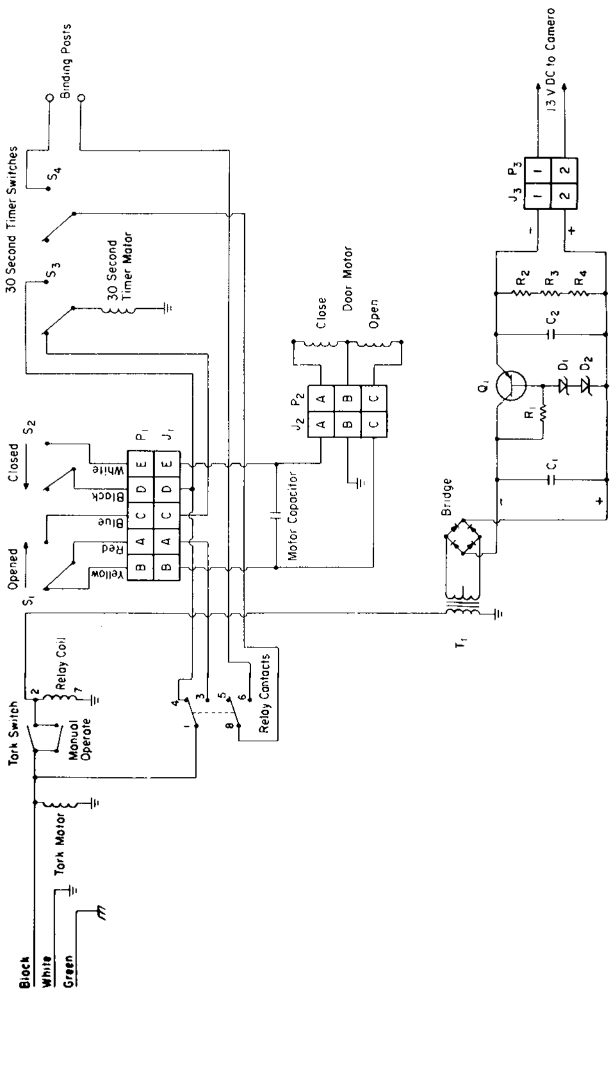

Fig. 5. Schematic of CERC time-interval photography camera, power supply and intervalometer

Fig. 6. Photograph of completed CERC time-interval photography, power supply and intervalometer

Fig. 7a. View of CERC time-interval photography weatherproof shelter in its initial stages of construction

Fig. 7b. View of CERC time-interval photography weather-proof shelter as installed in the field

Fig. 8. Oblique aerial of Newport Beach, California

Fig. 9. Typical view of shoreline as seen by the remote time-interval camera, Newport Beach, California

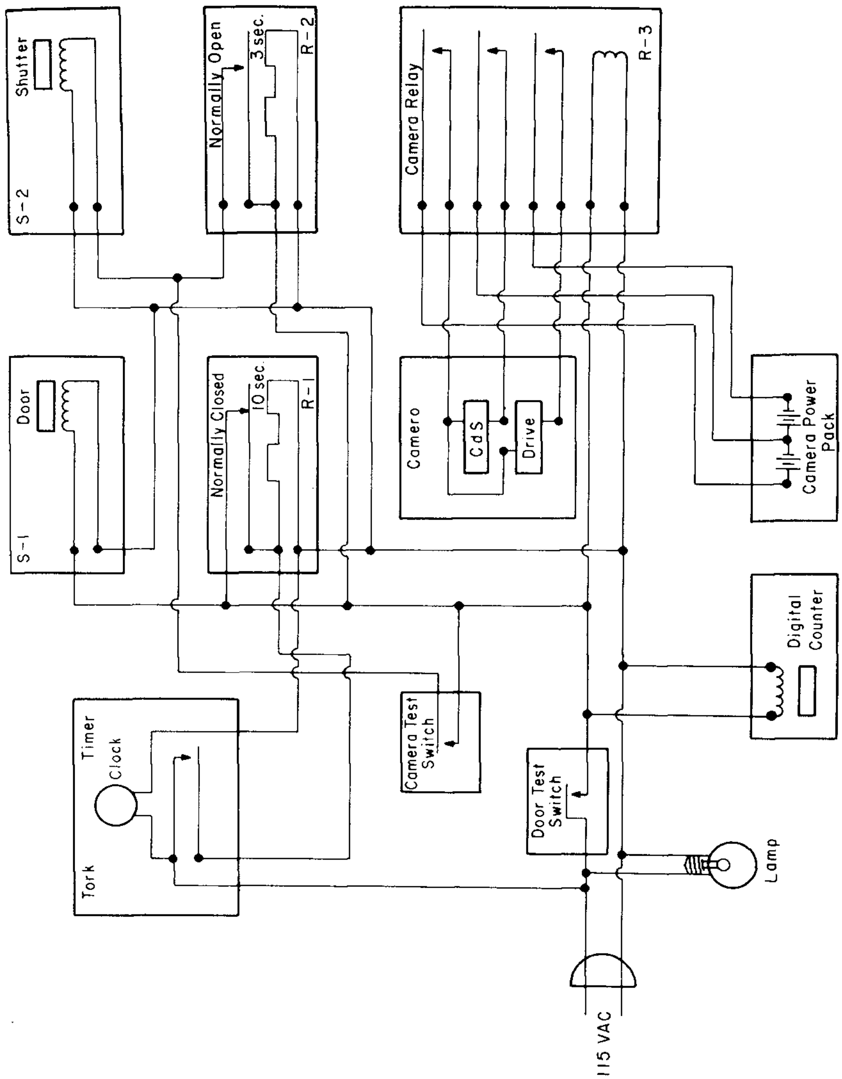

Fig. 10. Schematic of U. S. Army Engineer District, Los Angeles, time-interval photography camera, power supply and intervalometer

Fig. 11. Photograph of assembled U. S. Army Engineer District, Los Angeles, time-interval camera and accessories in enclosure

APPENDIX

A. List of electronic parts, time-interval camera, Prototype Experimental Groin, Point Mugu, California (refer to schematic, figure 5).

relay	Potter & Brumfield; No. KRP11AG
S_1, S_2 (door switches)	Robertshaw; No. BRD 2-2M
30 second timer	Industrial Timer Corp.; Mode 1MC-2
Door motor	Bodine 115 VAC, 60 cycle, single phase, 7.5 watts imput, 2 rpm, continuous duty, 95 oz. in, capacity 0.85 mfd, type KYC-22RC.
Motor capacitor	0.8-0.9 mfd; 220 VAC
J_1	Amphenol No. 145-55
J_2	Amphenol No. 165-16
J_3	Amphenol No. 80-PC2F
P_1	Cannon No. CA 3106 B145-5P-A105
P_2	Amphenol No. 165-13
P_3	Amphenol No. 80-MC2M
T_1	Triad No. F-25X, fillament 12.6 VCT
Bridge	Motorola No. MDA 952-2
C_1, C_2	Mallory No. HC-2060KK, 6000 mfd, 2 VSP
R_1	150-2
R_2, R_3, R_4	11-2, 5W
D_1	Motorola No. IN3016
D_2	Motorola No. IN3829
Q_1	Motorola No. 2N1544
Manual switch	Arrow Hart No. 81015AW

B. List of electronic parts, time-interval camera, Newport Beach, California (refer to schematic, figure 10).

S-1	Guardian switch 18 contact, 115 amp, 115 VAC
S-2	Control Corp. push solenoid No. 831-401, 115 VDC, 1"
R-1	Amperite time delay relay, No. 24F2329, 115 C 10
R-2	Amperite time delay relay No. 24F2329 115 No. 3
R-3	Potter & Brumfield, general purpose relay, 3PDT, No. 24F2893