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ALTERNATIVE DESIGNS FOR CCTV TRAFFIC  
SURVEILLANCE SYSTEMS

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Research Report Number 173-1

Development and Evaluation of On-Freeway Traffic Control  
Systems and Surveillance Techniques

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## ABSTRACT

This report is one of a series that presents the findings of a research project entitled "Development and Evaluation of On-Freeway Traffic Control Systems and Surveillance Techniques" sponsored by the State Department of Highways and Public Transportation in Texas in cooperation with the U.S. Department of Transportation, Federal Highway Administration. Areas covered include the following: testing and evaluation of low light level television cameras for traffic surveillance, use of television traffic surveillance systems during hours of darkness, low volume incident detection using television, and alternatives for the location of the cameras relative to the roadway lanes.

Key Words: Traffic Surveillance, Closed Circuit Television, Television Cameras, Low Light Level Cameras, Television Camera Location

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## SUMMARY

Freeways and expressways carry a sizeable portion of the total traffic volume in urban areas. As the construction of new facilities tapers off, the efficient use of existing freeways becomes critical if a high degree of mobility and safety is to be preserved. To better understand and develop methods for improving traffic flow, the State Department of Highways and Public Transportation of Texas (SDHPT) in cooperation with the Federal Highway Administration sponsored a research project entitled "Development and Evaluation of On-Freeway Traffic Control Systems and Surveillance Techniques." This report, the first of a series, deals specifically with the selection and location of closed circuit TV cameras for a freeway surveillance system.

A leased, low-light-level camera was tested to determine its potential for freeway surveillance at night. Field studies were conducted at the Texas A&M Research Annex and on the North Central Expressway in Dallas to evaluate the camera's performance under dark and low-light-level conditions.

Observations concerning the individual and combined effects of the camera location dimensions also were made using the leased camera and the North Central Expressway Surveillance Center in Dallas. These effects included mounting height, camera spacing, and the offset of the cameras from the freeways lanes.

Experiments were also conducted with the leased camera mounted on a high-reach service truck on the elevated section of IH-10 in Austin, before it was opened to traffic. This allowed SDHPT personnel to evaluate various camera mounting heights and locations.

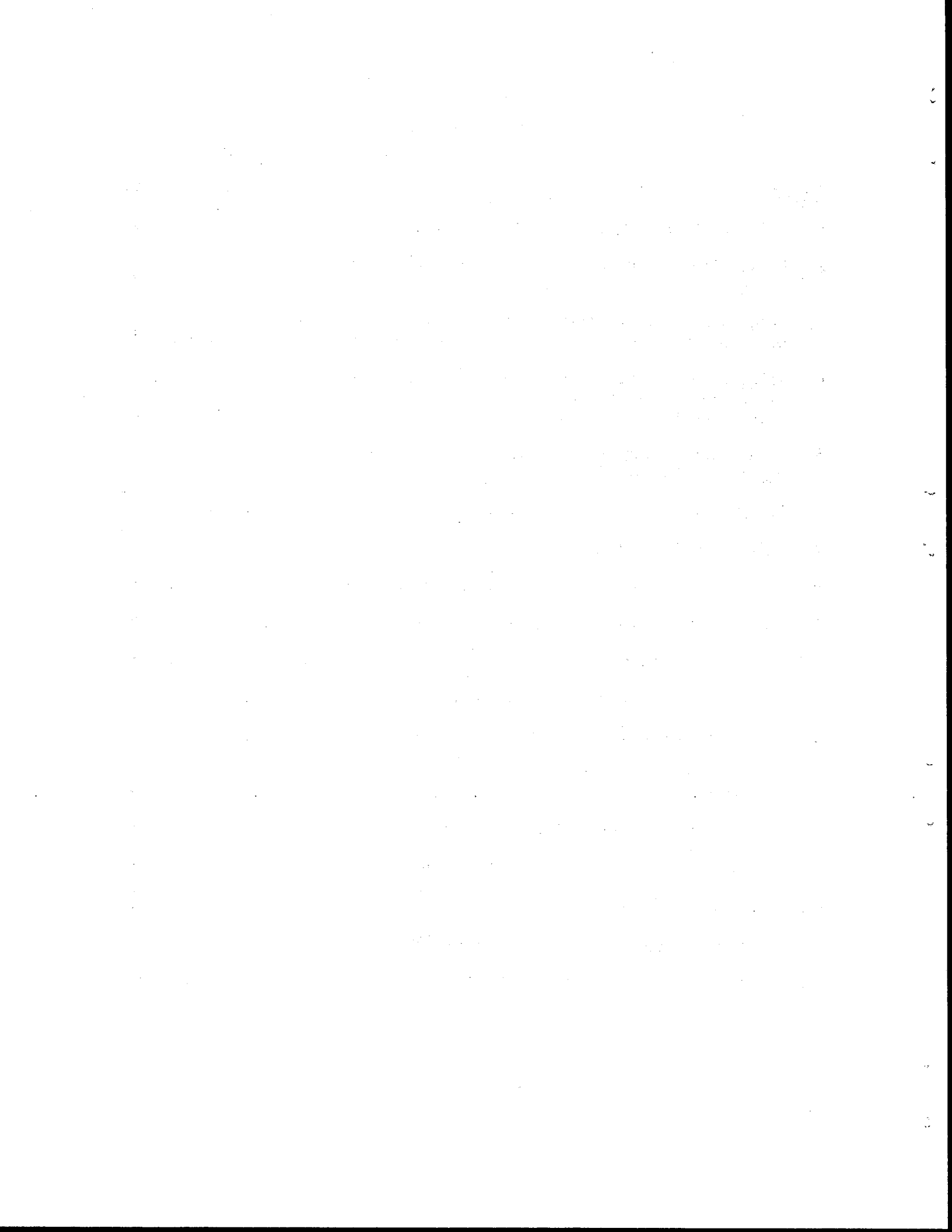
Suggestions for the selection of TV cameras and their location are provided with regard to system design. System limitations are also outlined concerning the feasibility of using TV surveillance for low volume incident detection.

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## INTRODUCTION

### Scope of Study

Closed circuit television (CCTV) has been proven as a useful tool for bridge, tunnel and freeway surveillance at a variety of locations throughout Texas and the United States. Other applications of CCTV, such as industrial surveillance and security, have prompted the development of a new generation of cameras which, through the use of more sophisticated electronics, are capable of producing a good quality image under relatively low light level conditions. The significance of this from the standpoint of freeway surveillance is the potential for detecting incidents on the freeway during the day and night. Under distant viewing conditions such as those required for freeway surveillance, auxiliary lenses also can be used to improve the performance of the CCTV system. While cameras traditionally have been mounted on existing light poles adjacent to the freeway, certain advantages appear to be gained from considering other mounting equipment and dimensions.

This report contains a discussion of the evaluation of a Low Light Level Closed Circuit Television (LLLCCTV) camera as well as some of the factors that should be considered in camera location.

### Objectives

Most of the freeway television surveillance systems now in use consist of conventional CCTV cameras mounted on top of light poles. Certain potential advantages exist from using more sophisticated cameras in other mounting locations.

Therefore, it is the objective of this paper to evaluate the advantages of improved cameras and to suggest design alternatives concerning camera location.

## DISCUSSION OF IMPROVED CAMERAS

This discussion is based on observations made using a leased low light level camera with pan and tilt accessory as shown in Figure 1. Cameras of this type are manufactured by various companies and, whereas several cameras were demonstrated, only one was tested on a lease basis. Specifications for the leased camera are listed in Appendix A. The remote control group for the camera and pan and tilt accessory are shown in Figure 2. Tests were conducted under laboratory conditions at the Texas A&M Research and Extension Annex outside of Bryan, Texas, and under actual field conditions in Austin and Dallas, Texas. Video tape recordings were made where possible to document observations.

### Technological Improvements of Cameras

Several features have been incorporated into television camera systems which enhance their use in freeway surveillance. These are listed below with a brief description of each.

#### Image Intensifier

Low Light Level Closed Circuit TV (LLCCTV) cameras are referred to as such due to their ability to produce a usable image given a relatively low light level. This light level is comparable to that found at night on urban streets and freeways illuminated with conventional or high-mast luminaires. The low light capability in cameras of this type is due mainly to modification of the image tube which senses the light entering through the lense system. While various manufacturers have developed different types of image tubes, the leased camera utilized a silicon intensifier target vidicon tube which is claimed to be over 500 times as sensitive to light as the standard vidicon tube camera.

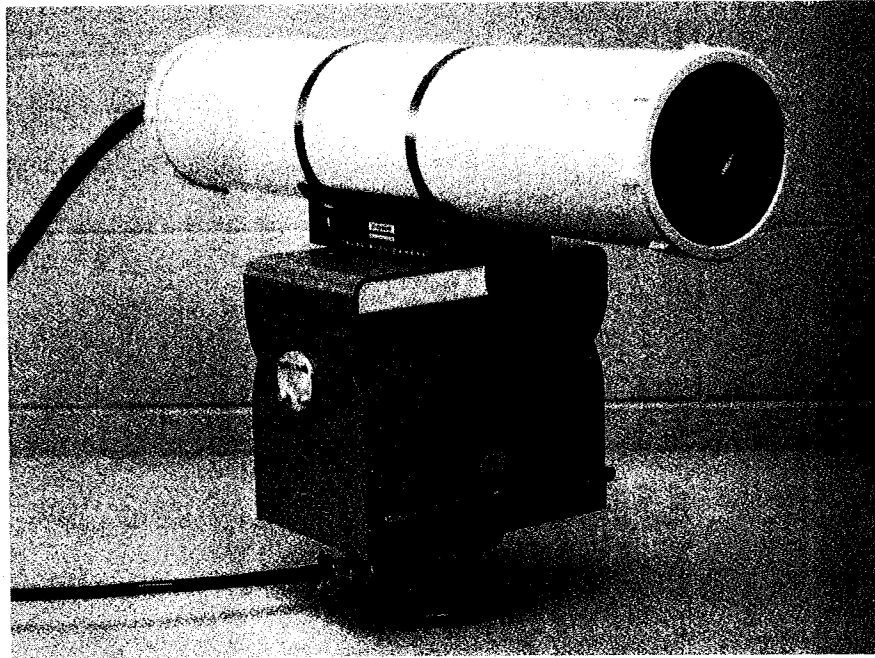


Figure 1. CCTV Camera with Pan and Tilt Accessory

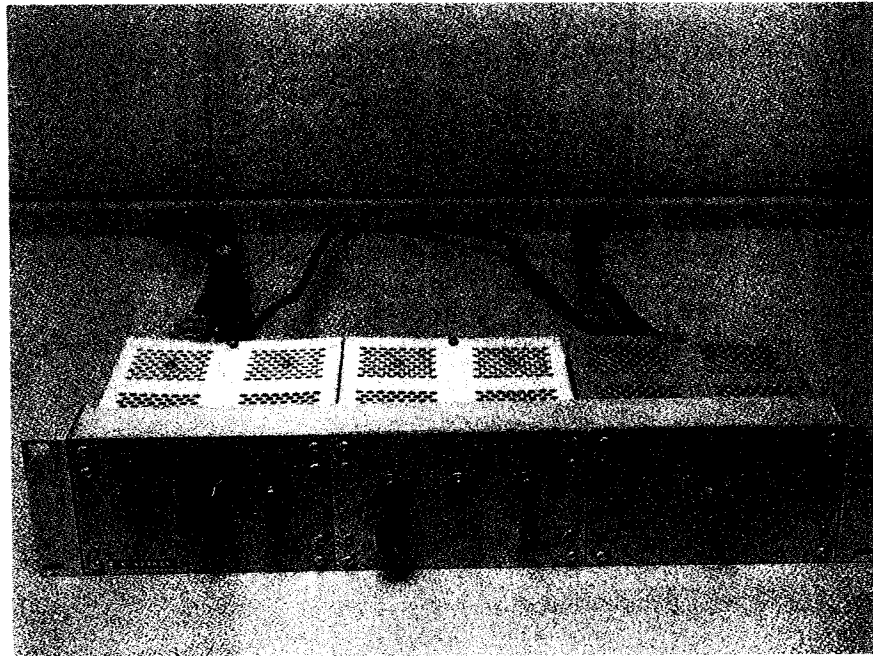


Figure 2. Remote Control Group for CCTV Camera and Pan and Tilt Accessory

### Automatic Iris Control

By sensing the light level in the scene that is being televised, the automatic iris control opens or closes the iris, thus regulating the amount of light reaching the image tube. In the case of the leased camera, the iris also could be controlled manually.

### Zoom Lenses and Focal Length Extenders

The majority of surveillance systems now in existence utilize the zoom lens feature to view distant scenes and to magnify a particular scene such as a stalled vehicle. Focal length extenders can also be included in the lens system to increase the maximum viewing distance which, in turn, increases the camera spacing.

### Peaking Clippers

An additional feature incorporated into some LLLTV cameras is an electronic device called a peaking clipper which reduces the amount of "blooming" from intense light sources such as car headlights and tail-lights, luminaires and commercial lighting for advertising. Previous to this improvement, older cameras would cause a majority of the picture to "wash out" when a bright light entered the scene being televised. This improvement allows vehicles stopped in a dark area to be viewed adjacent to a lane of moving vehicles with headlights turned on.

### Performance of Improved Cameras

The leased camera showed a marked improvement for night viewing over the older vidicon image tube cameras such as those used in Dallas or Houston. Earlier cameras produce a very limited image at night that usually consists of only the headlights of vehicles on a gray background. A low

light level TV camera is capable of producing a picture with greater contrast that defines the roadway, intersections, and vehicles. Figures 3 and 4 illustrate the difference between the images produced with a standard vidicon tube and a low light level TV camera. Note the details of the vehicle and roadway markings, in Figure 4, that are indiscernible in Figure 3.

While low light level TV cameras require very little light for operation, results of the field tests indicated that some artificial light, in addition to moonlight or starlight, is needed. Minimum light levels listed in manufacturers' literature appear to have been calculated with the simplest of lens systems attached to the camera. Zoom lenses and extenders absorb a portion of the light emitted from the scene, thereby decreasing the amount of light that reaches the image tube.

Studies were conducted at the Research Annex to correlate degradation of the TV picture with the decrease in illumination of the scene being televised. Two mercury vapor luminaires placed on a 40-foot tower were used as the light source. Light levels expressed in horizontal foot candles were recorded at 12.5-foot increments away from the luminaire perpendicular to the line-of-sight of the camera. A camera mounting height of 40 feet and a 500-foot camera-to-target spacing were used. Video tape recordings were made of the experimenter and light meter at each of the locations. The light meter reading was relayed to the operator of the video tape recorder via two-way radio and was in turn recorded on the audio track of the video tape recorder.

Figures 5, 6, 7, 8, 9, and 10 depict the television images produced at 2.6, 0.60, 0.30, 0.15, 0.10, and 0.08 footcandles, respectively. From these observations it appears that a considerable amount of detail and contrast

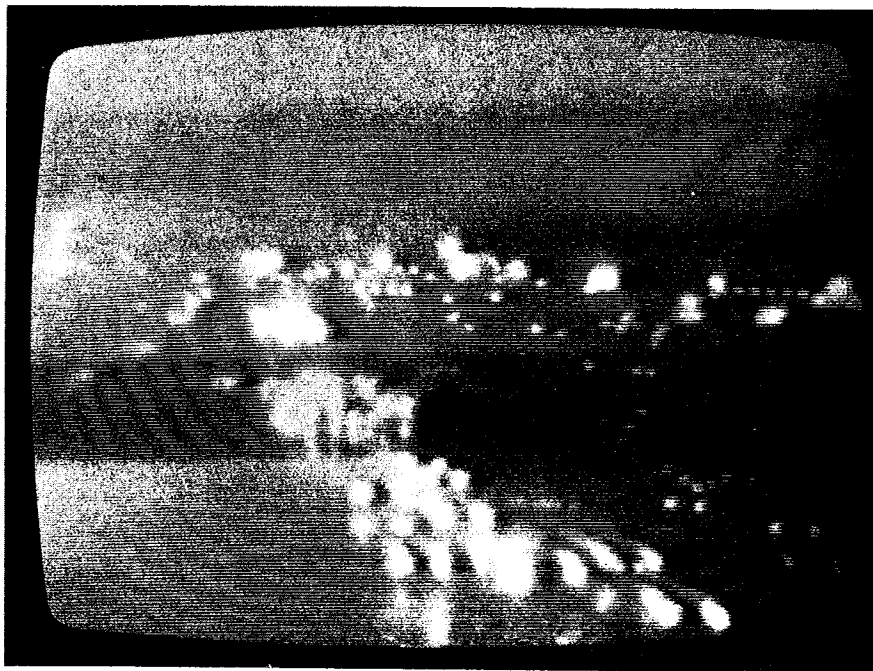


Figure 3. Television Picture of North Central Expressway Under Dark Conditions with Standard Vidicon Tube Camera

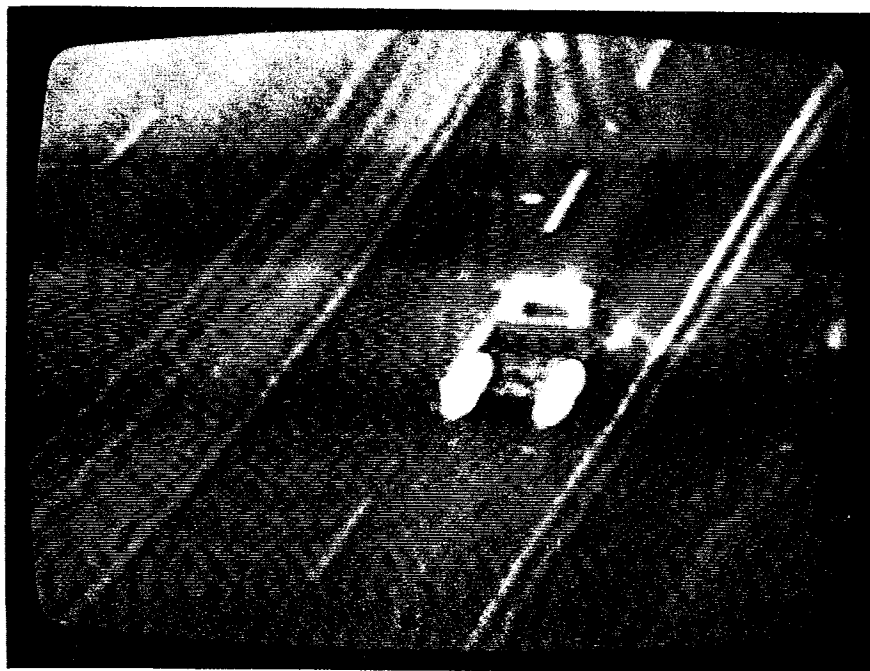


Figure 4. Television Picture of Vehicle on North Central Expressway Under Dark Conditions with Low Light Level Camera



Figure 5. Television Picture of Data Collector  
and Light Meter at 2.60 Footcandles



Figure 6. Television Picture at 0.60 Footcandles

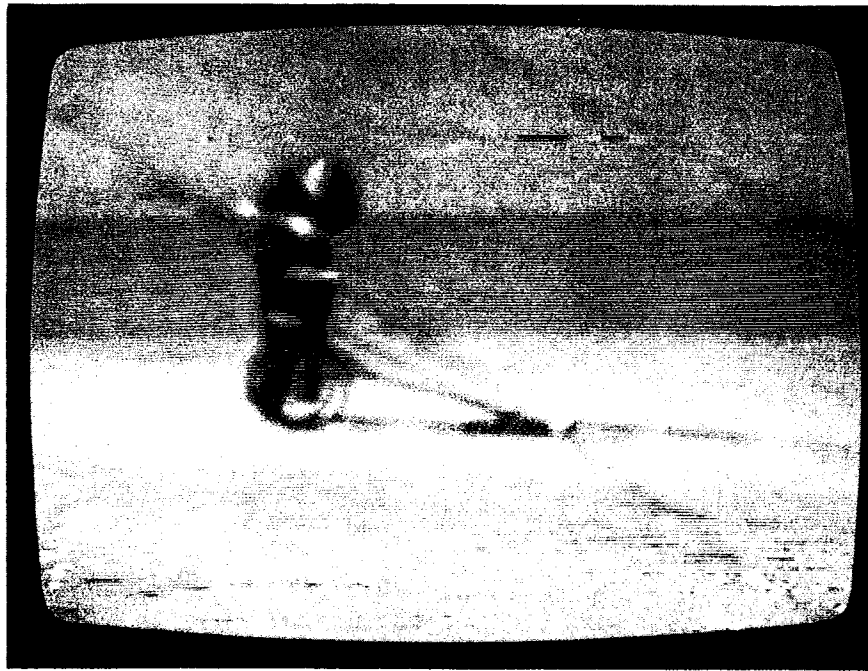


Figure 7. Television Picture at 0.30 Footcandles



Figure 8. Television Picture at 0.15 Footcandles



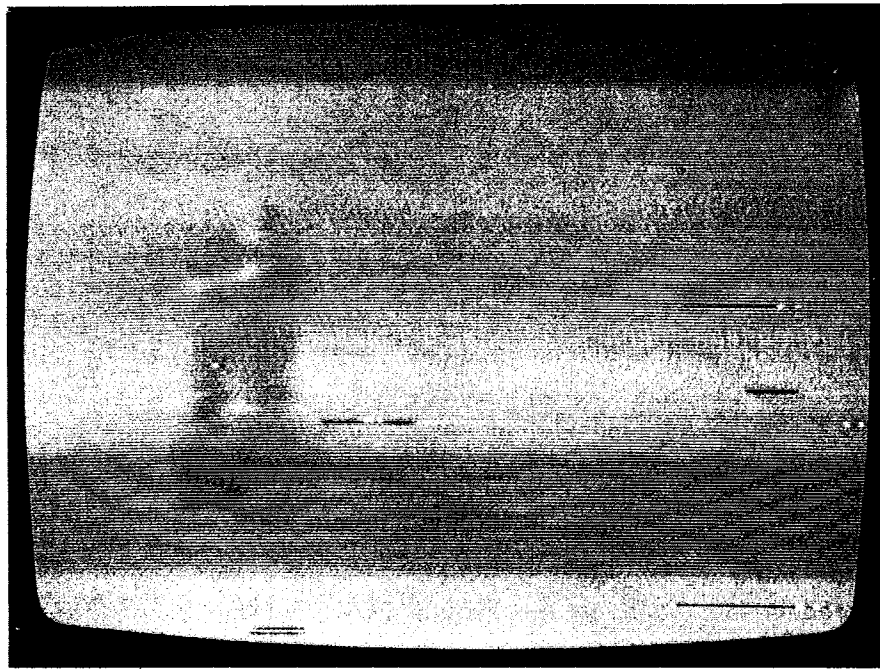


Figure 9. Television Picture at 0.10 Footcandles

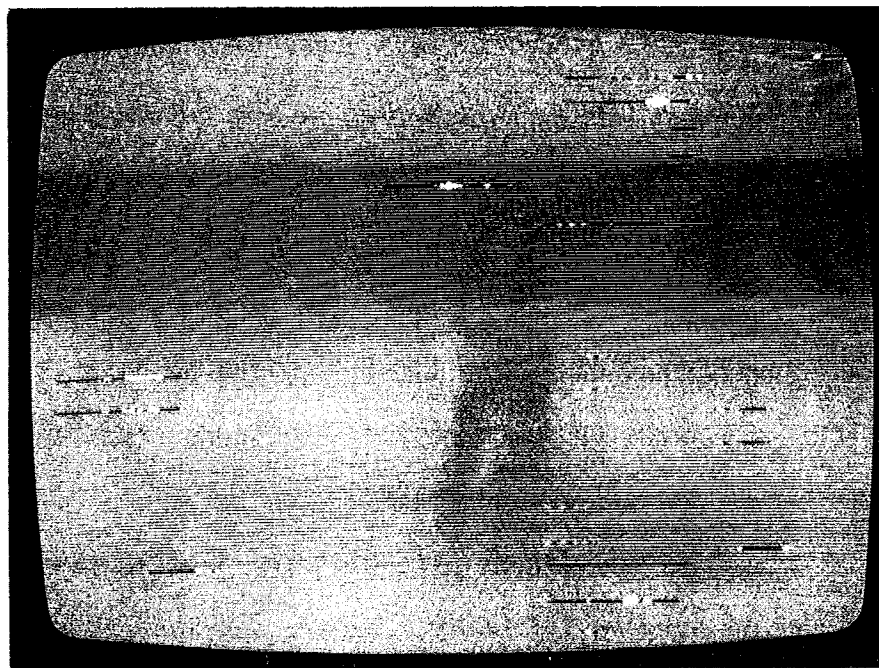


Figure 10. Television Picture at 0.08 Footcandles

is lost at less than 0.15 footcandles. Thus, the minimum amount of light needed on the pavement surface is in a range of 0.15 and 0.30 footcandles. In most circumstances illumination levels of this magnitude are provided by street lighting and/or commercial lighting in the area of the freeway to be televised. The slight reduction in camera sensitivity due to the use of auxiliary lens systems appears to be outweighed by the benefits of the lens system.

The automatic iris control and light adjusting circuitry of the camera performed well over a wide range of light levels from bright sunlight to moonlight and maintained an optimum picture without repeated adjustments by the operator. This could be especially helpful during morning and evening hours when ambient light levels change most rapidly or at night when panning between relatively well-lighted and dark areas. Although the test camera contained a manual override iris control, experimentation indicated that manual control resulted in no picture improvement over automatic control. This occurs because under very low levels of illumination the iris is already fully opened by the automatic control, and the manual override has no further effect. The one use of the manual control is in the reduction in "blooming" from vehicle lights. This is accomplished by limiting the amount of light entering the camera. The problem, of course, is that as the light from the headlights is decreased so is the light incident upon the rest of the scene, thus decreasing the overall quality of the television image.

Zoom lenses and focal length extenders are "musts" for a camera system in order to provide for maximum camera spacing. Use of these accessories in Dallas provided viewing distances in excess of 4000 feet. Figure 11 shows a portion of the North Central Expressway as viewed with

the 2X extender removed. Figure 12 is a similar scene with the extender in the camera. Note the magnification of the overpass structure in Figure 12. The distance from the camera to the structure was approximately 2130 feet. The apparent increase in blooming of headlights shown in Figure 12 was due to the fact that the video tape was made near dusk as drivers began to use their headlights.

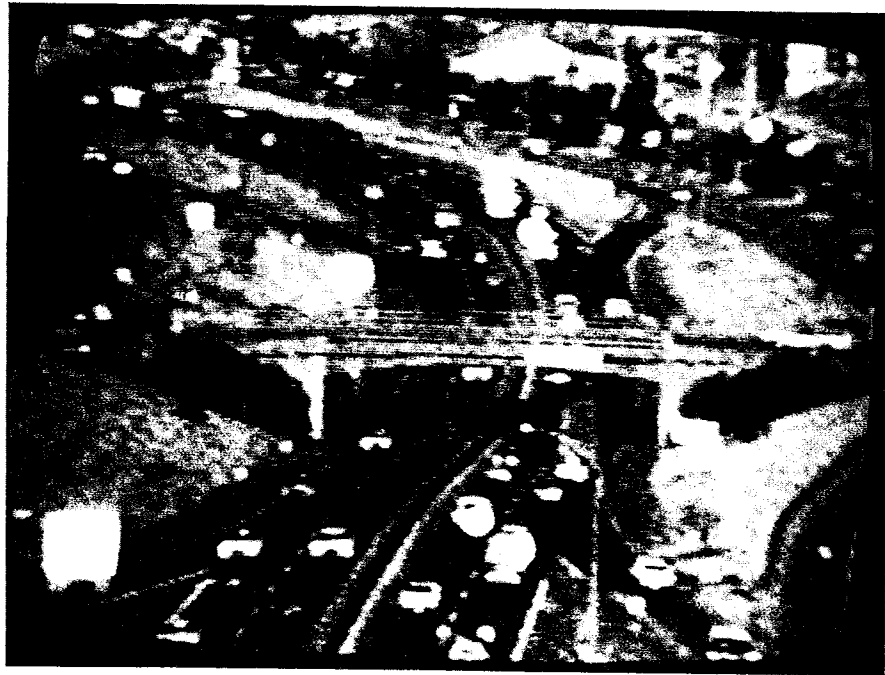


Figure 11. Televised Scene without 2X Extender



Figure 12. Televised Scene with 2X Extender

## DISCUSSION OF CAMERA LOCATION

A second task in this research was the evaluation of typical camera location dimensions now in existence and the investigation of potential benefits derived from altering these dimensions.

### Background

Most existing freeway surveillance systems utilize cameras mounted on top of luminaire poles, resulting in mounting heights of 40 to 50 feet. The cameras usually are located close to the main freeway lanes at 2000- to 3000-foot spacings in order to provide continuous coverage.

To evaluate nonstandard camera location dimensions, studies were conducted both at the Research Annex and at the North Central Expressway CCTV installation in Dallas. Tests at the Research Annex were conducted with the leased camera mounted on the movable ring of the high mast pole originally built for luminaire testing. This arrangement permitted the evaluation of mounting heights up to 140 feet. A pan and tilt unit was used for aiming the camera at the scene to be televised. The TV equipment and temporary mounting hardware are shown in Figure 13. Figure 14 shows the ring in a partially raised position.

In the Dallas studies the LLL TV camera was substituted for a roof-mounted, standard vidicon camera at the Noel Page building. This building houses the North Central Expressway Surveillance Office which is the control center for an eight-camera freeway surveillance system. The leased camera was mounted approximately 145 feet above and 100 feet away from the mainline freeway lines. Figures 15 and 16 are views of the roof mounted camera from the ground and from the roof.

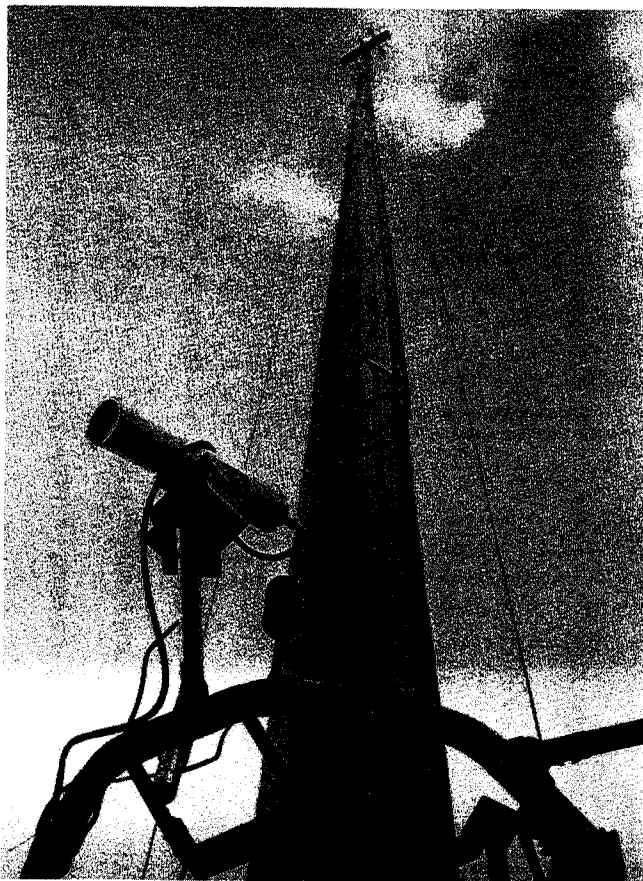


Figure 13. Leased Camera Mounted on High Mast Pole at Research Annex

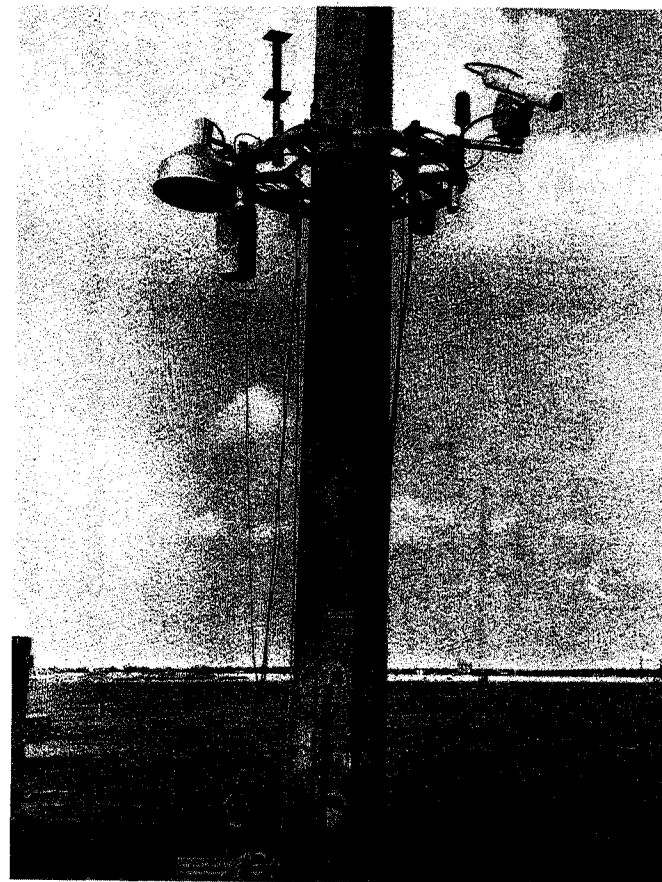


Figure 14. Leased Camera in Partially Raised Position

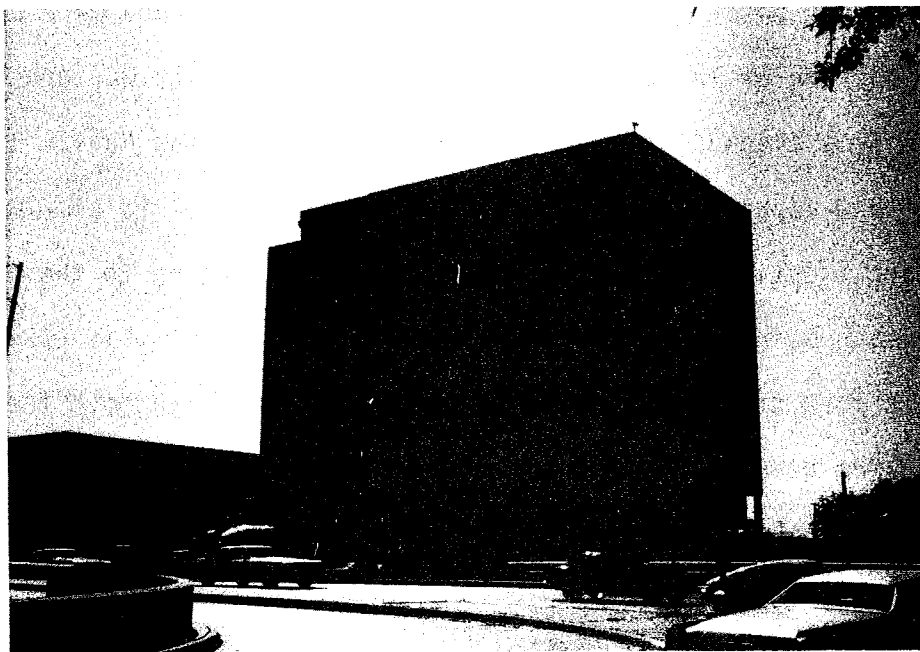


Figure 15. Ground View of Roof-Top Mounted Camera

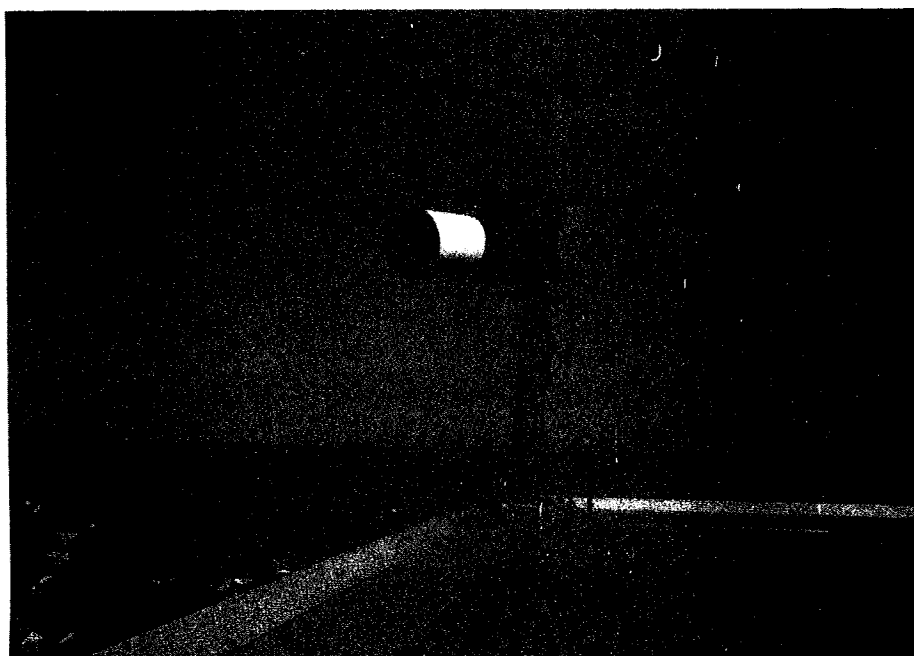


Figure 16. Roof Top View of TV Camera

Additional observations using the leased camera were made on the elevated portion of IH 35 in Austin before the facility was opened to traffic. This allowed State Department of Highways and Public Transportation and Texas Transportation Institute personnel to simulate various camera location dimensions by attaching the camera to the bucket of the highreach maintenance vehicle. Camera location on this particular roadway is more critical because of the need to observe both the elevated lanes and the older lanes below and between the elevated lanes.

#### Camera Location Considerations

The location of the cameras within a freeway surveillance system is determined by three dimensions: mounting height, camera spacing and the distance from the freeway lanes to the camera. The following discussion relates the experience gained from this research concerning these three dimensions.

##### Camera Mounting Height

The potential advantages of greater mounting heights are to 1) reduce the glare or "blooming" caused by the vehicle lights and luminaires, and 2) prevent sight blockages caused by vehicles and permanent structures along the freeway.

Although the newer cameras have peaking clippers which reduce the occurrence of blooming, a certain amount still occurs. Mounting the camera higher was considered as a method of preventing vehicle headlights from shining directly into the camera. To test this theory, observations of a vehicle were made at the Research Annex with the following variables:



- Vehicle Lights

- Headlights (dim)

- Park lights

- Tail lights

- No lights

- Vertical Distance (mounting height)

- 40 feet

- 100 feet

- 140 feet

- Horizontal Distance (vehicle to pole base)

- 500 feet

- 1500 feet

- 2500 feet

- Ambient Light - Moonlight

Comparison of the pictures obtained with the camera at the 40-, 100-, and 140-foot levels did not appear to show any noticeable reduction in blooming at increased heights. This is understandable when a comparison of the vertical distance (40 to 140 feet) is made with the relatively large horizontal distance (2500 feet). Also noted during the studies was the fact that the other vehicle lights such as parking, brake, and tail lights result in some blooming even though these light sources are not as intense as headlights. Apparently this is due to the automatic iris control being fully open resulting in the maximum amount of light being let into the camera.

The potential for sight blockages increases along a freeway as the viewing distance increases. Overpass structures, other vehicles and changes in vertical and horizontal geometry all tend to fall between the

camera and the scene being televised. For this reason additional mounting height may permit looking over some of these obstructions. Figures 17 and 18 are views of the freeway from cameras mounted at 40 and 145 feet, respectively. In both scenes the camera was "zoomed in" all the way to show the maximum sight blockage caused by other vehicles, overpass structures and street lighting fixtures. The sight blockage problem at the Dallas site is possibly not as severe as it would be on a facility with a more undulating gradeline or a larger number of overpass structures.

The cost of providing the additional height must be considered from both a first cost and maintenance cost basis. The construction of a tower to be used solely for a television camera would be quite costly compared to the cost savings of mounting the camera on a luminaire pole. There exist, however, several alternatives to using a separate tower. One of these involves use of the tower for the transmission of microwave CCTV signals. If a taller pole is needed for line-of-sight signal transmission, the increased camera mounting height would be available at virtually no extra cost.

Another possible method of attaining increased mounting heights would be the inclusion of CCTV with high-mast luminaire installations. There appear, however, to be several distinct disadvantages with this type of arrangement. First, the intense light emitted by these luminaires attracts a large number of insects that would cause severe maintenance problems on the lens faceplate of the camera. Also, the design of these lighting towers does not provide for a great amount of resistance to bending produced by wind loadings. This movement probably would exceed an acceptable level for aiming and focusing a television camera. Finally, the type of luminaire lowering devices now in use would not be easily

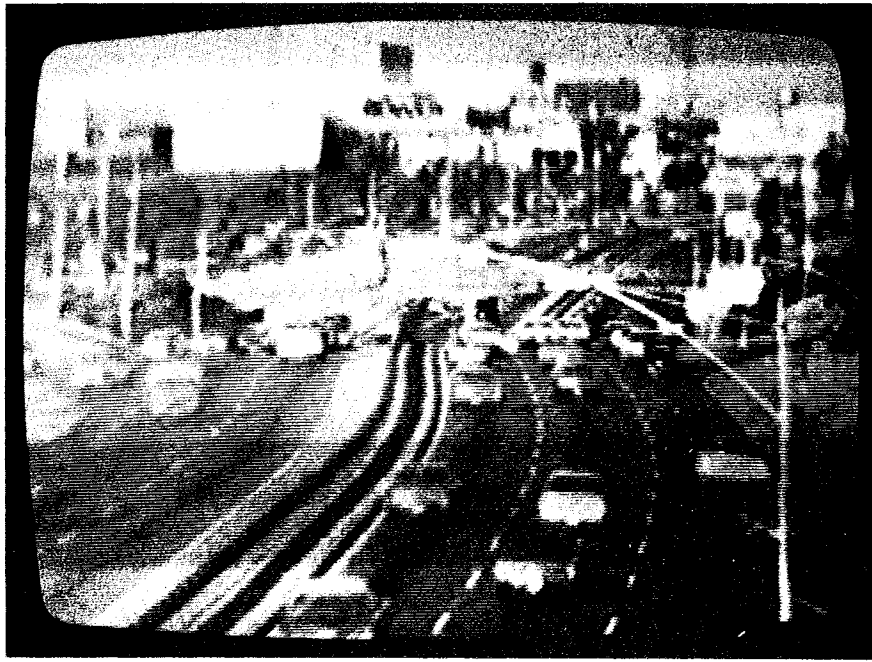


Figure 17. View from Camera at 50-foot Mounting Height



Figure 18. View from Camera at 145-foot Mounting Height

adaptable to the mounting of a camera. The inclusion of CCTV with high-mast lighting systems should be approached with these considerations in mind.

High-rise office buildings along major freeways also should be considered as camera mounts. An example of this is the camera located on the roof of the Noel Page building along the North Central Expressway in Dallas. The major advantage of this scheme is that mounting hardware is quite simple, and the roof provides a relatively stable and vibration-free mount. Also, maintenance can be performed from the roof resulting in reduced maintenance costs and disruption to traffic. The major problem of this arrangement is attaining permission from the building owners to use the roof. The decision to allow a camera to be mounted on the roof may be based on whether office space is being leased in the building as is the case at the Texas Transportation Institute's office in Dallas. Preliminary agreements concerning leased roof space would need to be made before designing a system based on this type of mounting.

The attitudes of building managers concerning the use of roof-mounted, traffic surveillance cameras were sampled by sending a questionnaire to 31 building managers in Houston. (The questionnaire and cover letter are shown in Appendix B). All of the buildings chosen were at least three stories high and near one of the Houston freeways. A total of 18 replies were received and are summarized below:

QUESTION 1. *Would you permit a television camera to be located on the roof of your building under the following conditions?*

RESPONSES:

	<u>Reply</u>	<u>Number</u>
Yes	At no cost and as a public service.	7
Yes	On a lease basis for roof space.	4
Yes	On a lease basis but only if office space is also leased in the building.	<u>3</u>
	TOTAL Yes . . . . .	14
No	(Under any circumstances)	<u>4</u>
	TOTAL Replies . . . . .	18

QUESTION 2. *If your answer to the above question was to lease space what would you consider a realistic charge for:*

RESPONSES:

The three replies received for roof space only were \$25, \$50, and \$100/month.

The only reply received for office space also was "cost depending on sq. ft."

QUESTION 3. *Are you located:*

RESPONSES:

<u>Reply</u>	<u>Yes</u>	<u>No</u>	<u>No Answer</u>
In the central business district.	7	3	8
Along the freeway	16	2	0

QUESTION 4. *How many floors high is your building?*

RESPONSES:

<u>No. of floors</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>9</u>	<u>10</u>	<u>17</u>	<u>18</u>	<u>22</u>	<u>26</u>	<u>27</u>	<u>47</u>
Frequency of reply	2	1	1	3	1	1	2	1	2	1	1	1	1

QUESTION 5. *Comments*

RESPONSES: (Representative samples)

1. "Taller buildings are located on both sides of this building."
2. "Sorry, we do not allow any antennas or camera locations on our buildings."
3. "Roof space would have to be sublet from ( ) since they have exclusive lease rights to roof area."
4. "Access only with the permission of the General Manager and during normal business hours. Written assurance that neither weight nor electrical load would be disruptive."

This rather limited sample of building managers indicates that consideration should be given to roof-mounted cameras in the design of a traffic surveillance system.

In addition to the first cost of cameras and equipment, there are also ongoing maintenance costs. The majority of maintenance activities for CCTV systems are related to either signal transmission equipment or the cameras themselves. For this reason a system should be designed so as to facilitate camera maintenance, adjustment, and cleaning. Currently, installations with mounting heights of approximately 50 feet are accessible with a boom and bucket truck of the type used for signal and street light maintenance. High mount cameras, however, would be beyond the range of this equipment and would require either a lowering device or a workman to climb the towers. Either of these choices coupled with the cost of the other tower itself, would increase greatly the overall cost of the system. Roof top-mounted cameras appear to be the easiest to maintain.

### Camera Spacing

The major cost items for a freeway surveillance system are the cameras, the control center and the signal transmission equipment. An efficient design, therefore, is one that minimizes the number of cameras and transmission lines, and still fulfills the objectives of the system. Two major considerations were observed to affect the number of cameras and the camera spacing needed.

The first of these relates to whether total coverage of the freeway is needed at one time. Most surveillance systems now in use provide nearly continuous viewing of the freeway by using a camera spacing about equal to the maximum viewing distance. An alternative to this would be to locate cameras at spacings equal to about twice the maximum viewing distance, thus reducing by half the number of cameras. During higher volume traffic conditions, an incident occurring in a nontelevised area, and would cause a fluctuation of traffic upstream in a televised area, and the TV camera could be panned around to view the incident. Low volume incident detection with this camera arrangement, however, would not be possible which, in itself, is a serious drawback.

The second major design input is whether the camera system is to provide full surveillance at night. From observations made in Dallas, it appears that even with low-light-level cameras, the effective maximum viewing distance at night is less than that during the day. The alternatives then are to either design for daylight conditions and not have the entire freeway in view at night or to design for nighttime conditions using closer camera spacings and be overdesigned during the day.

### Camera Offset from Freeway Lanes

The third dimension of camera location is that of offset or the distance that the camera is located perpendicularly from the freeway lanes. At most existing installations the cameras are placed on luminaire poles located on structures spanning the freeway resulting in very small offset distances. Increasing this distance tends to increase the probability that a vehicle in one lane may block the view of a vehicle in an adjacent lane. With increased mounting heights, however, this problem is alleviated due to the ability to look over the tops of vehicles.

Studies were conducted at the Research Annex to determine the effect of camera offset on glare or blooming from headlights. The target vehicle was video-taped as it approached the camera, first with no offset and then with a 100-foot offset. The conclusion from these experiments was that no appreciable reduction in headlight glare was accomplished by increasing the distance from the camera to the roadway.



## SUGGESTIONS FOR SYSTEM DESIGN

The following observations concerning the selection of camera equipment and the location of these cameras are based on this research and on day-to-day observations at the Dallas freeway surveillance site.

### Selecting Cameras

Experience with the leased camera and demonstrations of several other brands of cameras would indicate that Low Light Level Closed Circuit Television (LLLCCCTV) cameras will, as they are purported to, produce usable pictures under relatively low light levels. The use of electronic devices such as peaking clippers does indeed reduce the amount of blooming which was a serious nighttime problem in earlier cameras. Auxiliary lenses such as zoom lenses and focal length extenders should be included due to their ability to increase the maximum viewing distance.

### Camera Location

The three dimensions of camera location are mounting height, camera spacing and the distance from the freeway lanes to the camera. Cameras used in freeway surveillance traditionally have been mounted on standard luminaire poles resulting in mounting heights of from 40 to 50 feet. Although this arrangement proved generally to be adequate, the potential for sight blockages is reduced greatly by using 100-to 200-foot mounting heights. The construction of towers to accomplish this height would be quite expensive, and the addition of CCTV to existing high-mast luminaire poles does not appear feasible. An alternative to constructing towers is demonstrated by the camera located on the roof of the Noel Page building in Dallas.

Camera spacing depends upon the maximum viewing distance of the camera. The leased camera using a 2X extender and zoom lens provided a daytime viewing distance of about 4000 feet when mounted on the roof of the Noel Page building. This viewing distance was established as the distance at which an incident along the freeway could be viewed adequately to determine the number and type of vehicles involved and whether other objects or people were also on the freeway. This viewing distance could be considerably less where luminaire pole top-mounted cameras are used on freeways with numerous sight obstructions. Nighttime viewing distances in the range of 2500 to 3000 feet are less than in the daytime and, for this reason, will govern the design of a 24-hour system. A system using greater camera spacings also can be used that provides the capability to view any point on the freeway but not all of the freeway at the same time.

Cameras usually have been located fairly close to the freeway lanes because they were mounted on luminaire poles. At these traditional mounting heights, keeping the camera close more or less over the freeway lanes tended to reduce the number of possible sight obstructions. At greater mounting heights, such as those provided by roof-top locations, the increased distance from the freeway lanes is not a problem.

In designing a freeway surveillance system, location of the cameras can be accomplished most easily on a trial-and-error basis where possible. Experience from this research indicated that manufacturers are most cooperative in demonstrating their products and sharing their experience from similar situations.

#### System Limitations

Even though low light level cameras exhibit improved night viewing

characteristics, the use of these cameras for low volume incident detection appears to be somewhat limited. During daylight hours and heavier vehicle volumes, incidents are easily noticed due to disruptions in the traffic stream. At night, however, the freeway surveillance system observer would be viewing a limited number of vehicles. If one of these vehicles were pulled off onto the shoulder with its lights off, it would attract very little attention and thus escape detection. Closed Circuit TV may serve better as a confirmation of another low volume incident detection system such as those using vehicle detections and a computer to determine whether a vehicle has failed to proceed through a control section.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The text notes that records should be kept for a minimum of seven years and should be accessible to authorized personnel at all times.

2. The second part of the document outlines the specific requirements for record-keeping. It states that all transactions must be recorded in a clear and concise manner, using a standardized format. This includes recording the date, amount, and description of each transaction. The text also requires that records be kept in a secure and protected environment, with access restricted to authorized personnel only.

3. The third part of the document discusses the role of internal controls in ensuring the accuracy and reliability of financial records. It notes that internal controls should be designed to prevent errors and fraud, and to ensure that all transactions are properly recorded and reported. The text emphasizes that internal controls should be regularly reviewed and updated to reflect changes in the business environment.

4. The fourth part of the document discusses the importance of transparency and accountability in financial reporting. It states that financial statements should be prepared and presented in a clear and understandable manner, and that they should be subject to independent audit. The text also notes that management should be held accountable for the accuracy and reliability of the financial information they provide.

## APPENDIX A

### SPECIFICATIONS, MODEL 2855 SERIES COHU CCTV CAMERA

#### ELECTRICAL SPECIFICATIONS

INPUT SIGNAL REQUIREMENTS (No input signal is required if camera contains one of the plug-in sync generator options):

Composite sync (1 to 5V p-p); the synchronizing signal waveform may be either to EIA RS-170 Specifications or to CCIR Specifications.

INPUT POWER REQUIREMENTS:

100-130V ac, 50/60 Hz, 40 watts maximum (200-260V ac available on request).

VIDEO OUTPUT SIGNAL:

1.0V or 1.4V p-p composite, white-positive, from 75-ohm source.

VERTICAL SWEEP RATE:

50/60 Hz (same as power line frequency)

HORIZONTAL SWEEP RATE:

15,750 Hz for 30 frames/second or 15,625 for 25 frames/second.

SCANNING PATTERN:

525 lines/frame, 30 frames per second 2:1 interlaced (or 625 lines/frame at frame rate of 25 per second for operation with 50 Hz Power).

IMAGE TUBE TYPE:

2855 Series Camera - One inch silicon-intensifier target (RCA Type 4804-P2).

GRAY SCALE RENDITION\*:

2855 Series Camera - Resolves all 10 shades of gray on EIA TV Resolution Chart 1956 with  $4 \times 10^{-4}$  footcandle highlight illumination on vidicon faceplate.

\*All light levels are 2854°K (incandescent) illumination.

#### GEOMETRIC DISTORTION AND SCAN NONLINEARITY:

Maximum or 4% total distortion within diameter equal to picture height.

#### SENSIVITY TO LIGHT\*:

2855 Series Camera - With  $4 \times 10^{-4}$  footcandle highlight illumination on faceplate the camera supplies on 1.7V p-p video output signal (see Figure 1-5).

#### MAXIMUM VIDEO TRANSMISSION DISTANCE:

1000 feet without degradation (using RG-11 foam type cable).

#### SCAN FAILURE PROTECTION:

On occurrence of a vertical or horizontal deflection failure the target voltage is removed from the vidicon and the scanning beam is biased off.

#### AUTOMATIC LIGHT RANGE\*:

2855 Series Camera - Video output remains constant to within 6 dB for changes in scene brightness from  $4 \times 10^{-3}$  footlambert to  $10^4$  footlamberts with f/1.4 lens, or from  $2 \times 10^{-2}$  footlambert to  $10^4$  footlamberts with 10.1 zoom lens.

#### RESOLUTION:

2855 Series Camera - 700 lines at center, 400 lines at corners with 4:3 aspect ratio).

#### RESOLUTION STABILITY VS. TEMPERATURE:

Meets stated specifications over a temperature range from 0°C to +50°C (+32°F to +122°F). Limiting resolution is reduced less than 100 TV lines at extremes in temperature range from -20°C to +60°C (-4°F to +140°F).

#### RESOLUTION STABILITY VS. VOLTAGE VARIATION:

No change when ac line voltage stays within specified limits.

### MECHANICAL

#### DIMENSIONS:

Length: 27 inches

Diameter: 6.015 inches

WEIGHT:

Net: 27 pounds

Shipping: 33 pounds

TYPE OF LENS MOUNT:

16-millimeter "C" type (enclosed)

CAMERA MOUNTING:

Three threaded 1/4"-20 holes in base of camera accept standard tripod, pan and tilt, or pedestal mounting screws.

CABLE CONNECTORS:

A single Bendix PC-07-18-30P connector is provided for video output signal, ac input power, optional remote controls, optional input synchronizing signal and optional intercom.

ACCESSORIES:

A partial list of accessories that can be obtained from Cohu or one of its sales representatives for use with a 2855 Camera includes:

- a. Internal sync generator module (to CCIR or to EIA RS-170 Specifications)
- b. Motorized zoom and focus lenses
- c. Motorized pan and tilt units
- d. Fixed camera mounts
- e. Remote controls for accessories and internal functions of camera
- f. Test equipment (test jig, dot bar generator, vidicon simulator)
- g. Intercom

ENVIRONMENTAL

AMBIENT TEMPERATURE LIMITS:

-20°C to +60°C (-4°F to +140°F)

STORAGE TEMPERATURE LIMITS:

-65°C to +85°C (-85°F to +185°F)

AIR PRESSURE LIMITS:

Sea level to 59,000 feet standard

SHOCK:

15 g, any axis (nonoperating)

VIBRATION TOLERANCE:

5 to 50 Hz with 0.03 inch total excursion; 55 to 1000 Hz with peak random vibration of 5 g.

HUMIDITY:

Up to 100%

EXPLOSION:

To MIL-E-5400M, Para. 3.2.24.10.

SAND AND DUST:

To MIL-E 5400M, Para. 3.2.24.7.

SALT ATMOSPHERE:

To MIL-E-5400M, Para. 3.2.24.9.

FUNGUS:

To MIL-E-5400M, Para. 3.2.24.8.



# TEXAS A&M UNIVERSITY

## TEXAS TRANSPORTATION INSTITUTE

6333 GULF FREEWAY  
HOUSTON, TEXAS 77023

### *FREEWAY SURVEILLANCE AND CONTROL DEPARTMENT*

Dear Building Manager:

The Texas Transportation Institute, is conducting a study for the State Department of Highways and Public Transportation and the Federal Highway Administration regarding the use of closed circuit television for traffic surveillance. The Texas Transportation Institute and the City of Dallas are currently operating a freeway surveillance system of this type on the North Central Expressway in Dallas. Similar systems have been used in Houston, Detroit, and Minneapolis.

To obtain a continuous view of the traffic facility, it is important to mount the cameras as high as possible. This can be accomplished by placing the cameras on separate structures, such as towers or on the roofs of buildings adjacent to the roadway. While we have sufficient data on the cost and design of separate structures, we need information regarding the use of roof-top mounted cameras. We are sampling the attitudes and policies of building owners and managers such as yourself concerning installations of this type. Your answers to the attached questionnaire will be held in strictest confidence and anonymity. You will not be contacted again and there is no commitment whatsoever on your behalf.

In a surveillance system of this type the cameras would be owned and operated by the city and used only to observe traffic in order to improve traffic flow and increase traffic safety. The roof space needed would be quite small, probably a five-foot square area. Occasional access to the roof would be required for the maintenance of equipment. Power and signal circuits would be provided by the city.

Your cooperation in filling out the enclosed questionnaire is appreciated. A stamped, self addressed envelope is included for your convenience.

Sincerely,

Donald A. Andersen  
Assistant Research Engineer

DAA/jr

Enclosures

Questionnaire

Project 173

1. Would you permit a television camera to be located on the roof of your building under the following conditions?

Yes No

At no cost and as a public service.

On a lease basis for roof space

On a lease basis but only if office space is also leased in the building.

2. If your answer to the above question was to lease space what would you consider a realistic charge for:

Roof space only \$ \_\_\_\_\_/month.

Roof space and office \$ \_\_\_\_\_/month.

3. Are you located:

Yes No

In the central business district.

Along a freeway.

4. How many floors high is your building? \_\_\_\_\_

5. Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_