P.E.P.S.*
Raymond
film-tape-audio productions
phoenix, arizona u.s.a.
1702 n 44 th st. 85008 602 275-9111
* PHOTOGRAPHIC EVALUATION OF PAVEMENT SURFACES

Raymond film production
phoenix arizona u.s.a.

July 31, 1979

REPORT #1 - PEPS (Photographic Evaluation of Pavement Surfaces)

BASIC CONSIDERATIONS - REVIEW

Highway engineers generally agree that the type, direction and percentage of cracks found on the surface of a paved roadway can be used to evaluate the suitability of design and construction of a roadway.

They also agree that a thorough understanding of these surface features could lead to the developement of a preventative maintainance schedule that could result in significant savings in materials, manpower, energy and money.

This report summarizes the results of utilizing various types of photographic equipment, films and conditions of photography in order to establish the measurement procedures most suitable for obtaining the 'history' of a pavement surface.

THE METHOD

A short length of highway which was representative of most of the conditions of deterioration that a highway surface undergoes was located by ADOT on a narrow country road serving the farming areas of West Phoenix.

The road - 91st Ave. a mile South of Buckeye Road - had lane widths of only 12' and was oriented N-S along the grid lines of virtually all roads in this area.

Since it had been previously determined that all photography would be accomplished utilizing the existing standard formats, films and equipment; it was necessary to layout on the road surface the center-lines and corner marks of the standard format for both 16mm and 35mm motion picture cameras.

The standard motion picture format ratio of both 16mm and 35mm is 1.33 : 1. The motion picture format was utilized instead of the 'still' format of 1.5 : 1 because the cameras, film and subsequent rapid viewing and handling equipment already exist.

Refering to photograph #1 - utilizing the center of the South bound lane as vertical centerline of the film format, corner markers were placed to represent lane widths of 8' - 10' and 14'. On the 14' lane width the frame overlapped the roadway centerline and the shoulder.

Continued.....

The principal purpose of the three lane widths was to establish the capability of lens and film to record the smallest possible detail and to learn if there were any significant differences in resolution between the narrowest and widest lanes.

To further measure resolution a standard resolution chart, utilized primarily to test lens performance, was placed in the center of the frame for the 8' and 10' lanes and also in the center and one corner of a 14' lane. This chart contained detail for finer than any found on the road surface in the form of significant cracks.

Referring to photograph #2 - All photographs in this study were made from one height above the pavement surface -- 14' from surface to camera. This was done to eliminate complicating resolution comparisons. Field widths were accomodated utilizing lenses of variable or different focal lengths.

The camera height of 14' was chosen as it represented the maximum film plane to road surface distance that might eventually be used.

In addition to the resolution chart a Macbeth standard color chart and 18% gray cards were added for reference purposes.

Another feature of the test procedure which was used to reduce measurement variables was to photograph the same area at different hours of the day. This was done to see if there would be any significant effects due to sun angle and color of the sun light.

In addition heavy shadows were permitted to fall across the pavement surface to see if useful data could be recovered from both sunlit and shadow areas.

FILMS USED

All films with the exception of the Infra-red color film were negative/positive type of film. There are several important reasons for this choice.

Continued.....

July 31, 1979

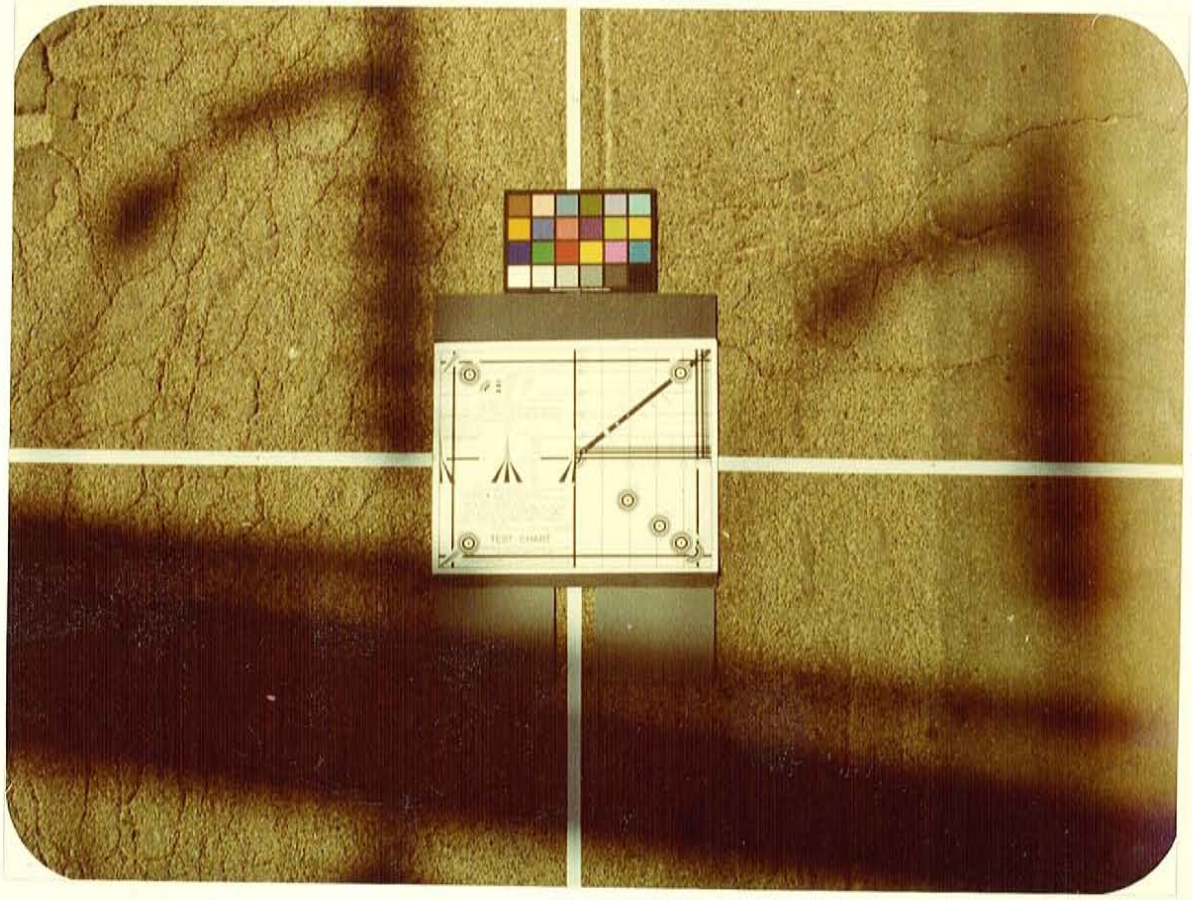
REPORT #1 - PEPS

Page.....3

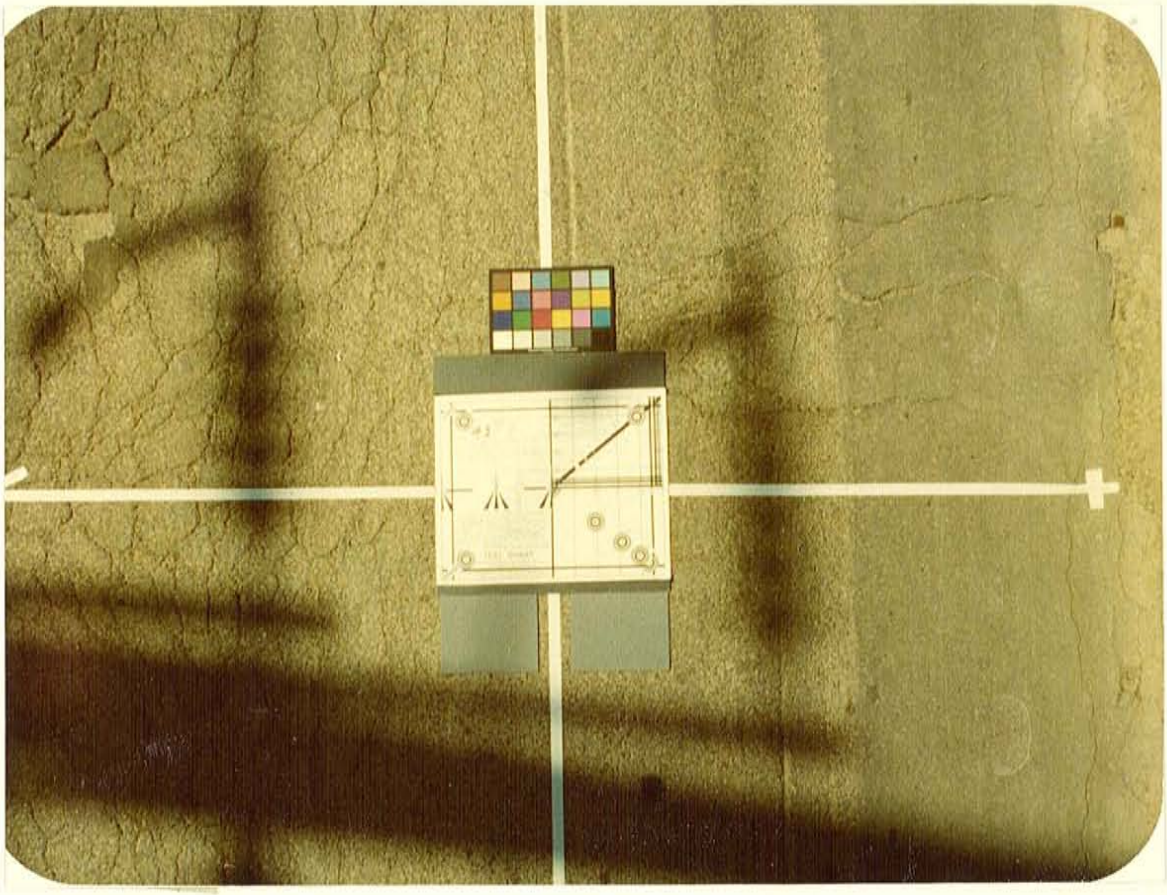
Negative films are all, relatively, fast emulsions. They are very fine grained, have great tonal range, have great exposure latitude and can be 'pushed' in processing to increase the film speed rating. They are available in both 16mm and 35mm format and can be processed by standard methods.

The Infra-red color film is a reversal process and produces a direct positive. It was included to establish a reference point for heat absorption of the highway surface.

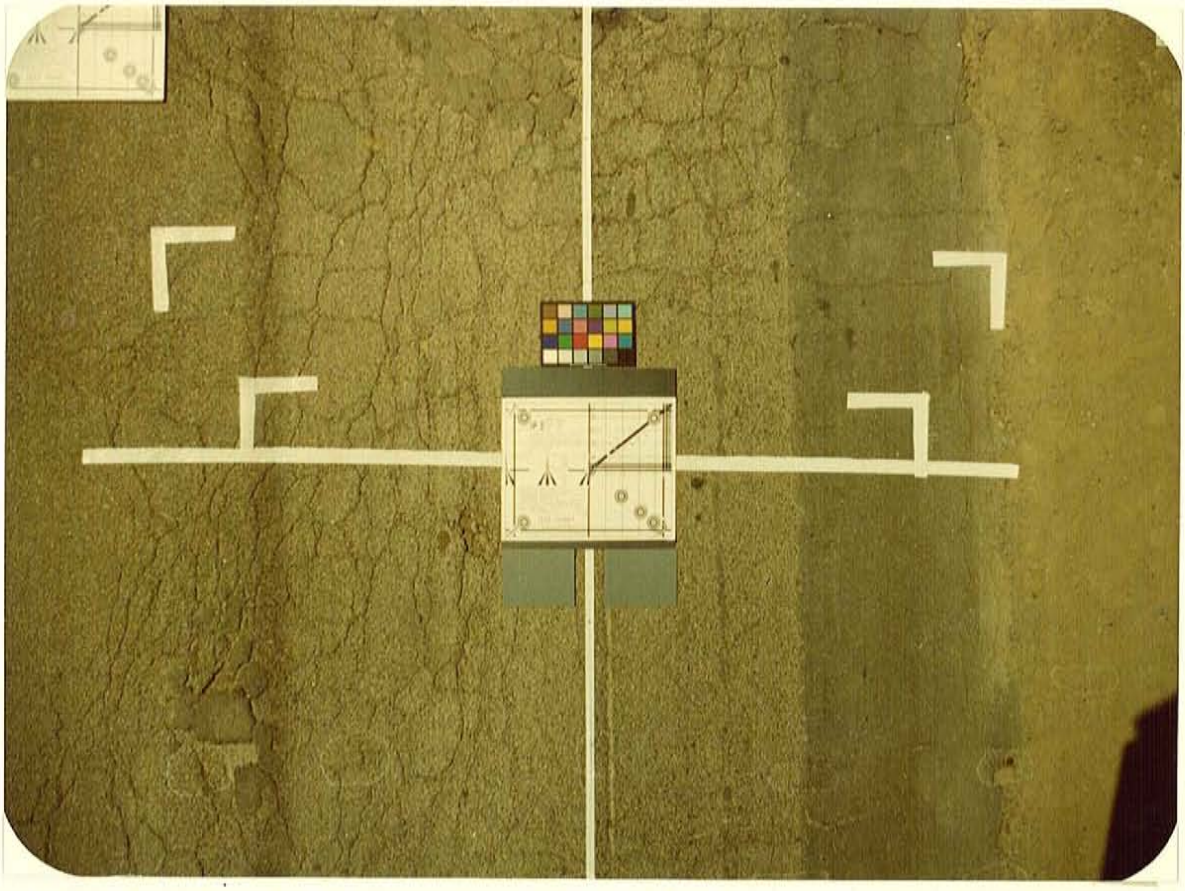
The results of this study are shown in the following photographs. each page contains the pertinent data for each photograph.



DATE	-	MAY 18, 1979
FILM TYPE	-	EKCO 5247-2
LANE WIDTH	-	8' - [Vertical Distance 6.01]
HT. of CAMERA		14'
LENS	-	35mm
EXPOSURE	-	Normal
TIME of DAY	-	9:39 A.M. Low East sun shadows are of the pole and insulators of the power line adjacent to the road.



DATE	-	May 18, 1979
FILM	-	5247-2
LANE WIDTH	-	10' [Vertical distance 7.51']
HT. of CAMERA	-	14'
LENS	-	28mm
EXPOSURE	-	Normal
TIME of DAY	-	9:50 A.M.



DATE	-	May 18, 1979
FILM	-	5247-2
LANE WIDTH	-	14' [vert. dist. 10½']
HT. of CAMERA	-	14'
LENS	-	28mm
EXPOSURE	-	Normal
TIME of DAY	-	9:50 A.M.

July 31, 1979

REPORT #[illegible] PEPS

Page....[illegible]

In order to establish a base from which to compare film type, lens focal length, best lane width and height of the camera, the following types of films were utilized.

A. FILM TYPES

1. Eastman Kodak Color Negative Film
   ECN 5247-2 (35mm)
2. Fuji Color Negative
   Type 8517 (35mm)
3. Eastman Kodak Color Negative
   ECN 7247-2 (16mm)
4. Eastman Vericolor Professional Short Exp.
   VPS (35mm)
5. Eastman Infra-Red Color Reversal
   (45mm).

Film types 1,2 and 3 are made primarily for use in motion picture cameras. Films 1 and 2 are 35mm and have the ANSI standard sprocket hole which is designed for pin registration of the film as it is exposed regardless of frame rates. Film number 3 is 16mm and has the ANSI standard sprocket hole for pin registration in 16mm cameras.

The emulsion of the films numbered 1 and 3 are identical.

Film number 2 is a new improved emulsion from Fuji in Japan which has some desirable characteristics not found in the other two films.

All of the films are compatible with the same processing chemicals.

Film Type #4 the VPS is actually designed for use in 35mm 'still' cameras. The sprocket hole is also ANSI standard but is a different shape than that used in motion picture cameras. It can be used in a motion picture camera. The 35mm size is available in 100' loads maximum.

Continued.....

July 31, 1979

It was included for reference purposes in this study for two reasons. First it is the standard in the professional 'still' photography business and provided a cross reference and secondly in a 100' length of film there are 600 frames available and it would provide an alternate source.

A total of 140 exposures were made in a 'still' mode. However these exposures were all made at 1/500th of a second and 1/1000 of a second to simulate the exposure that would be made from a moving vehicle.

In actual practice an exposure more nearly ranging from 1/750 to 1/1000 of a second will be required.

LENSES USED

The lenses used were the following:

1. A 28mm fixed focal length
2. A variable focal length lens with a focal length range of 35 to 85mm.
3. A 5.7mm fixed focus lens.

TIME OF DAY (Sun Angle)

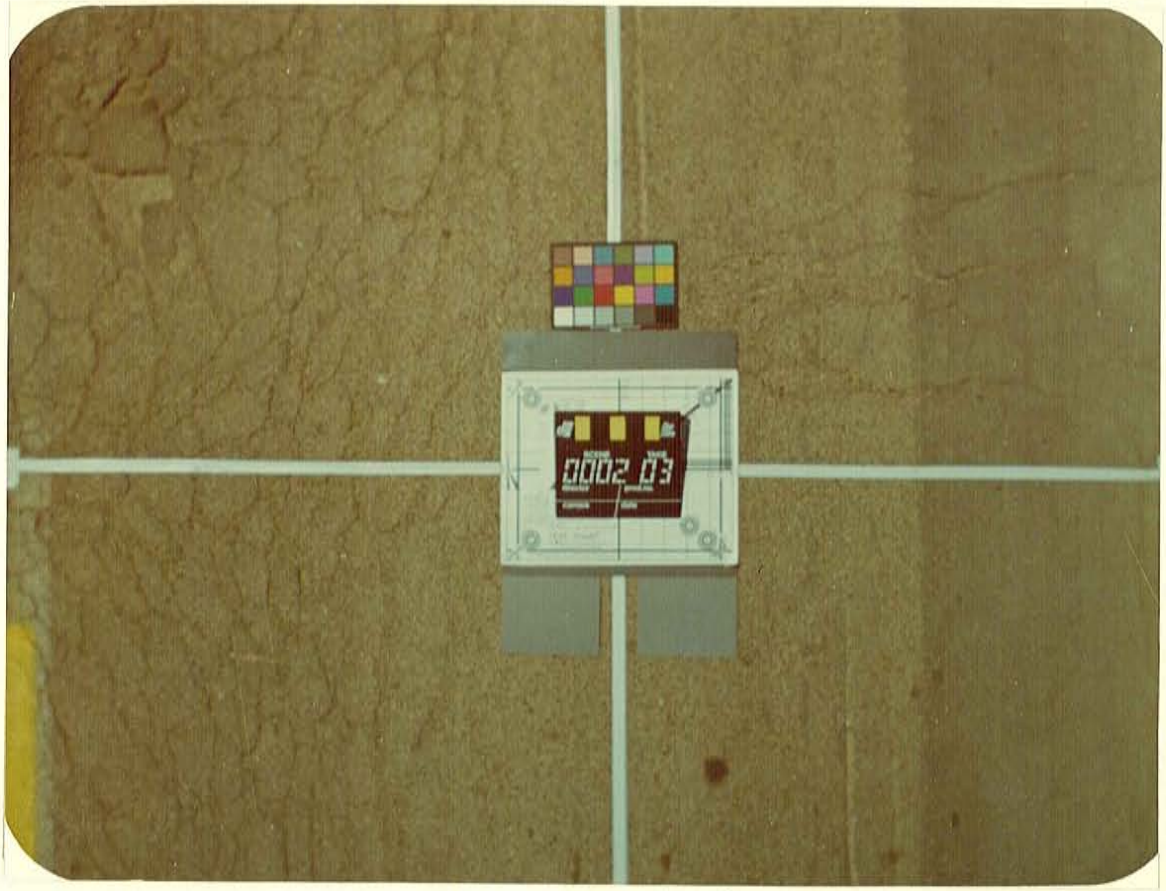
One of the basic reasons for utilizing a negative type of film is greater versatility than reversal type films.

1. It has greater exposure latitude
2. It can be processed to produce a greater range of contrasts
3. It has greater tonal range
4. It has finer grain
5. Both one to one transparency prints and enlarged transparencies can be made from the negative.
6. Paper prints up to 16 X 20 can be made. These characteristics would be desirable if the road surface was to be photographed from 'dawn to dusk' under various lighting conditions.

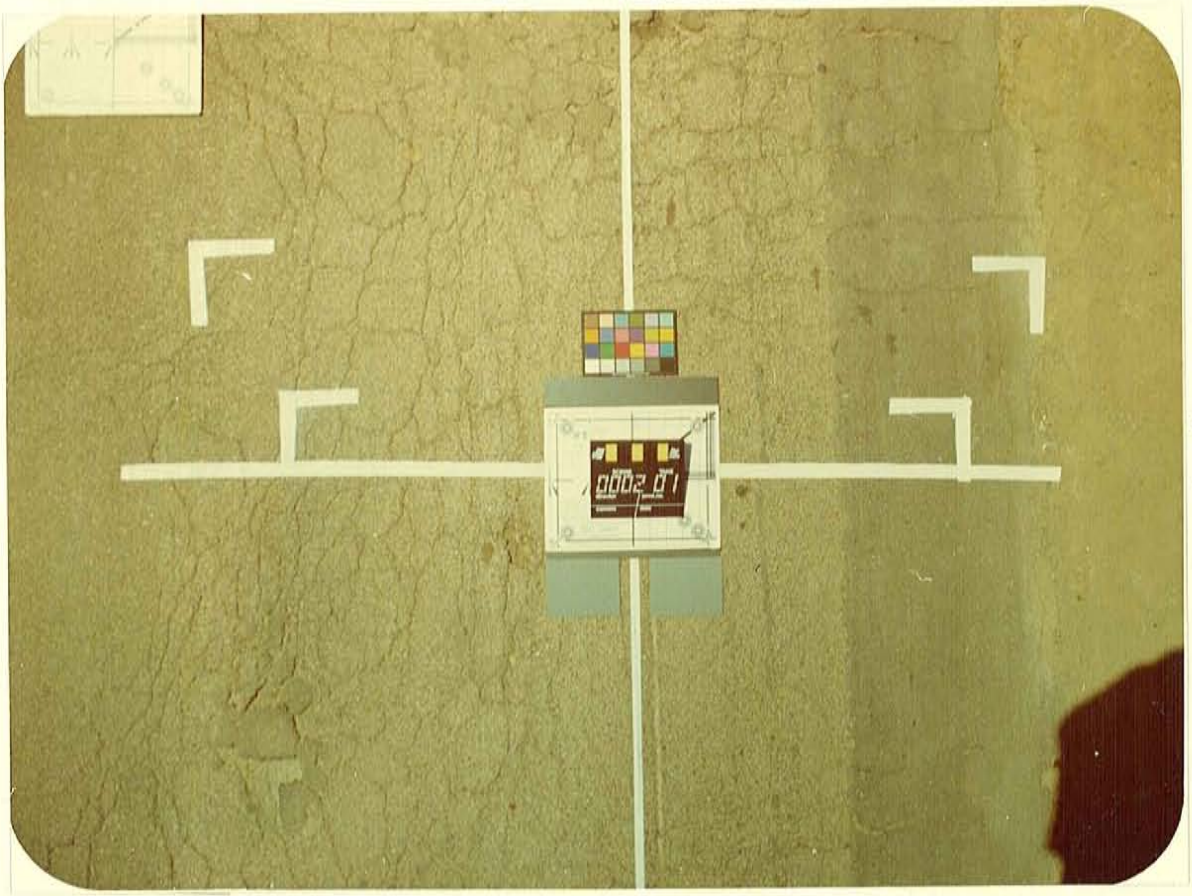
The following three photographs were made one hour later than the previous photographs. The sun angle here is fairly representative of the 'flatest' lighting conditions that would be found.

Continued....

DATE	-	MAY 18, 1979
FILM	-	Fuji 8517
LANE WIDTH	-	8' [Vert. Dist. 6.01']
HT. of CAMERA	-	14'
LENS	-	35mm
EXPOSURE	-	Normal
TIME of DAY	-	10:56 A.M.



DATE	-	May 18, 1979
FILM	-	Fuji 8517
LANE WIDTH	-	10' [Vert. Dist. 7.51']
HT. of CAMERA	-	14'
LENS	-	28mm
EXPOSURE	-	Normal
TIME of DAY	-	10:56 A.M.



DATE	-	May 18, 1979
FILM	-	Fuji 8517
LANE WIDTH	-	14' [vert. dist. 10.50']
HT. of CAMERA	-	14'
LENS	-	28mm
EXPOSURE	-	Normal
TIME of DAY	-	10:56 A.M.

July 31, 1979

REPORT #1 PEPS

Page.....6

The following photograph was also made on Fuji 8517 but was made at 3:07 P.M. It shows an 8' lane width, a low afternoon sun angle and was rigged to have a heavy shadow cast across approximately half the field.

Although the negative film has great range the print shows that recording of crack detail is beyond the range of the film. This limitation will have to be taken into account when doing crack studies.

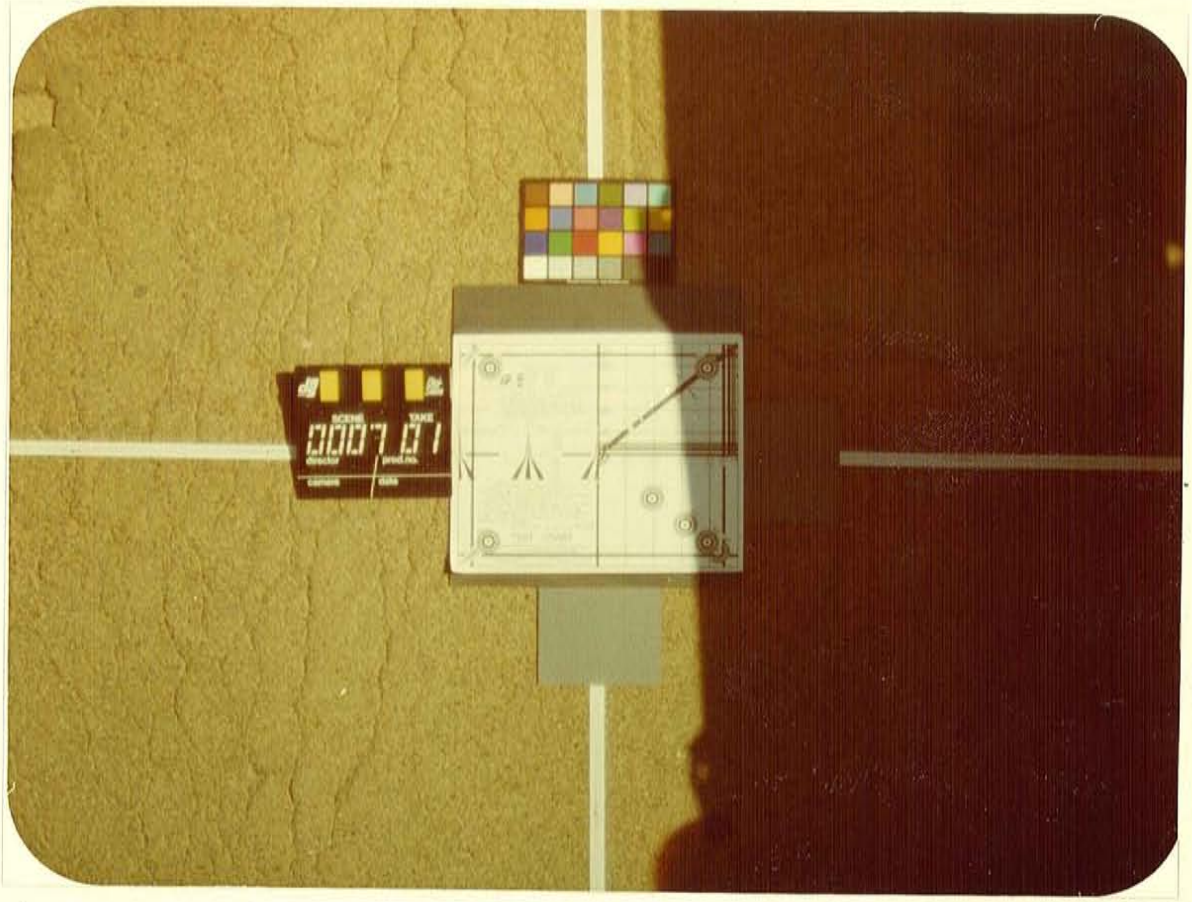
The attached infra-red color film is available only as reversal type and is a 'still' film only. The film speed is the same as color negative and this sample was photographed through a #15 yellow filter.

The inclusion of this film was a last minute consideration It would require further study to evaluate it's usefullness.

SUMMARY - (Conclusions and recommendations)

It appears that a 35mm color negative film is the most desirable method for the PEPS program.

Although a 16mm color negative was used in the study the results were so poor that they were not included in this report. The requirements for PEPS are quite different than the HODS program where a 16mm reversal film is used quite succesfully. (The HODS program film would be considerably improved if a 16mm color negative film were used. A test made about three years ago confirmed this.)



DATE	-	May 18, 1979
FILM	-	Fuji 8517
LANE WIDTH	-	8' [vert. dist. 6.01']
HT. of CAMERA	-	14'
LENS	-	35mm
EXPOSURE	-	Normal
TIME of DAY	-	3:07 P.M.