OFFICE OF THE SUPDT.OF MINES
SHOBHAPUR MINE
PO:PATHAKHERA,DIST:BARDHAMAN
460 449.

PK/SOB/SO/2A/ 1297 15.10.93

To

The General Manager(Lab & Field Study),
CMPDIL(HQ),
Gondwana Place,
Ranchi-834 008.(Bihar).

Dear Sir,

Sub: Final report of subsidence survey work over 1East, depillaring panel at Shobhapur mine by your survey team during 1990 onwards.

.....

In reference to our letter No.PK/SAN/SOB/Mines Safety/122 dtd. 16.1.90, we deputed your company for collecting the subsidence datas since April'90, over 1 East, depillaring panel of Shobhapur mine which your survey team has completed the job since long back. So far, we have not been provided the final report of subsidence study over the panel. In the preliminary report face I June 1991 subsidence contour plan given to us by your Surveyor/ASO, Shri Bhattacharjee, is also not to the mark, as per the angle of draw calculated through your end and as per theoretical calculation as well as colliery practical calculation work by our survey department.

You are requested to send us the final report at the earliest, so as to get benefit to our company and also to satisfy the mines department. We will be very thankful to you for sending it at early date, because it has already become too late.

Yours faithfully,

SUPDT. OF MINES
SHOBHAPUR MINE

cc to:The Sub Area Manager,Shobhapur Sub Area.

CMRS Project No. 85

MT/PF/17/83

CENTRAL MINING RESEARCH STATION, DHANBAD.
(Council of Scientific & Industrial Research)

SURFACE SUBSIDENCE GROUP

A report on

Subsidence Investigations Over Panels C and D in Upper Workable Seam of Pathakhera Mine No.2 in Pathakhera Area of Western Coalfields Limited.

By

P. Tiwary and N.C.Saxena

Team

S.Tiwary, Md.Yasin, A.Roy, J.P.Roy, Final, B.Kumar, S.Samanta, N.C.Saxena and B.Singh.

1987

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CMRS reserves the right to publish the results of research for the benefit of the industry.

S U M M A R Y

Subsidence observations taken over panels C and D in Upper Yorkable and panel 2- West in Lower Yorkable seams have been described. The effect of multi-seam and multi-panel extraction was quite evident in the observations. The subsidence profiles were in general asymmetrical. The subsidence movement profiles are likely to change due to further extraction of 1- West panel in Lower Yorkable seam and also due to time. Therefore, it has been suggested to continue the investigations.

The maximum subsidence in July 1985 due to extraction of panels C & D in Upper Yorkable and panel 2-West in Lower Yorkable seams was 1418 mm. which was 31.5 % of the combined extraction thickness of both the seams. The corresponding values of maximum slope and strains were

Maximum slope = 73.6 mm/m

Maximum strain

(a) Compressive = 5.5 mm/m
(b) Tensile = 9.9 mm/m.

Samanta Sharma Mukherjee

INTRODUCTION

Longwall caving system was introduced at Pathakhera Mine No.2 in Pathakhera area of Western Coalfields Limited in Upper Workable seam (Panel C). The CMRS studied feasibility of extraction of the panel and other panels in 1981 (a summary is given later). On the request of the colliery management the Central Mining Research Station (CMRS), Dhanbad started subsidence investigations over panel C in June 1982. The investigations were continued over the panel as also over adjacent panel D. Immediately after extraction of panels C and D extraction was also done in Lower Workable seam.

Discussed in the report are the observations taken over panels C and D in Upper Workable and corresponding panels in Lower Workable seams taken up to July 1985. The investigations are expected to continue.

(Refs:- Their letter No. PK/II/DCMR/CMRS/4/895 dated 27.6.1981 and PK-2/DCMR/14/CMRS/192 dated 14.4.1983).

FEASIBILITY STUDIES

As stated a study regarding

"Feasibility of Extraction of Upper Korkable seam at Pathakhera Mine No.2 Underneath Nallah by Longwall Caving System in Pathakhera Area of Western Coalfields Limited"

was made by the CMRS (Ref:RC/16/81) and the report was submitted in 1981. The summary of the report is reproduced below, which also includes the recommendations made :

"It is proposed to extract Upper Korkable seam at Pathakhera Mine No.2 in Pathakhera Area of Western Coalfields Limited by longwall caving system. The thickness of the seam is about 1.5m and the depth of proposed panels varies from about 100m to 178m. The length of the faces in the panels has been kept as 124.8m and a barrier of 20m width has been planned between the panels, which lie underneath a number of seasonal nallah. The problem involved theoretical estimation of surface movements due to extraction of the panels with caving and their possible influence on the possibilities of inrush of water from nallah on the surface, and precautions/measures to be taken in this regard. After an analysis of estimated surface movements and the conditions of the area the following recommendations have been made:

- 1 - During the extraction of panels C and D

  i - a barrier of about 30m width should be left in panel C against nallah N-1.

ii - before commencement of extraction the bed of nallah N-2 should be filled-up to a distance of about 25m from the periphery of the panel C so that there is practically no flow of water in it, and

iii - nallah N-3 should be diverted suitably so that there is no flow of water over the panels in this nallah.

" 2 - During the extraction of panels A and B

i - nallah N-4 should be diverted suitably so that there is no flow of water over the panels, or the bed should be filled up,

ii - the bed of nallah N-5 should be filled-up to a distance of about 25m from the perimeter of panel B,

iii - the beds of nallah N-6 and 7 should also be filled-up to a distance of about 25m from the perimeter of panel B,

iv - nallah N-8 should be diverted suitably, so that there is no flow of water over the panel, and

v - the extraction in panel A should be stopped about 50m away from the road leading to Tawa reservoir.

" 3 - For the extraction in panel E, the face should be stopped 50m away from the road leading to Tawa reservoir.

" 4 - During extraction in panels F and G

i - the face in panel F should be stopped at a distance of about 35m from nallah N-3, and

ii - the faces in both the panels should be stopped at a distance of about 40m from the road leading to Tawa reservoir.

- 5 - During extraction of the panels in the area it is advisable to scientifically monitor the subsidence behaviour of the ground, the results of which could be utilised in future.

- 6 - After the extraction of the first two panels, dams should be made in their outbye galleries. The dams should be fitted with devices to monitor the head against them and the rate of flow of water. These observations will be useful while working other panels in the area under review.

"The above recommendations have been made with the assumption that the details of the area under review supplied by the colliery are correct. The CMRS does not take any responsibility of any happening in the area under review."

The possibilities of extraction of panels C and D were discussed at the site (colliery) by the CMRS Scientists with the DGMS and Pathakhera area officials before the DGMS granted the permission for the extraction.

Details

Fig.1 is a plan showing panels C and D in Upper Forkable and corresponding workings in Lower Forkable seam. The details of the workings are given hereunder.

A. Details of panels in Upper Forkable seam

		C	D
1.	Panel	C	D
2.	Seam	Upper Forkable	Upper Forkable
3.	Coalfield	Pathakhera	Pathakhera
4.	Colliery	Pathakhera Mine No.2	Pathakhera Mine No.2
5.	Seam thickness	1.5 m	1.5 m
6.	Extraction thickness	1.5 m	1.5 m
7.	Dip of the seam	1 in 8	1 in 8
8.	Depth		
	a) Minimum	87 m	70 m
	b) Maximum	112 m	116 m
	c) Average	99.5 m	93 m
9.	Size of panel	104m X 580m	120m X 525m
10.	Method of working	Longwall	Longwall
11.	Roof support	Caving	Caving
12.	Geological disturbances	Practically no geological disturbances.	
13.	Previous workings around	No previous workings above the panels. No previous workings below the panels.	

An area on the dip side had been extracted by bord and pillar system with caving.

Panel C had been extracted with caving. The width of barrier between panels C and D was about 20m.

VI.	Surface properties	Government forest and seasonal nallahs.	
VII.	Composition of overlying rock mass	Sandstone Shale	84.9 - 90.9 % 2.1 - 9.9 %
VIII.	Percentage of extraction in the panels (approximately)	100 %	100 %
IX.	Area of panel	60,320 m^2	63,000 m^2
X.	Volume of panel	90,480 m^3	94,500 m^3
XI.	Quantity of coal in the panel	117,600 tonne	122,800 tonne
XII.	Date of		
	a) Starting	1.9.1982	18.8.1983
	b) Completion	20.6.1983	7.8.1984

It has been stated earlier that corresponding panels in Lower Forkable Seam below C and D were extracted after extraction of panels C and D. Therefore, the subsidence movements on the surface were influenced by the workings in both the seams. The details of the workings in Lower Forkable seam were as given below :

Details of panels in Lower Forkable seam

I.	Seam	Lower Forkable	Lower Forkable
II.	Panel	2 West	1 West
III.	Depth		
	a) Minimum	90 m	93 m
	b) Maximum	127 m	112 m
	c) Average	108.5 m	102.5 m
IV.	Parting between Upper and Lower Forkable seams	15 m	15 m
V.	Seam thickness	3 m	3 m
VI.	Extraction thickness	3 m	3 m

7.	Shape of panel	Almost rectangular	Irregular
8.	Size of panel	170m X 550m	Width = 60 - 216 m Length = 480 m
9.	Dip of seam	1 in 8	1 in 8
10.	Method of Working	Bord and pillar	Bord and pillar
11.	Roof support	Caving	Caving
12.	Geological disturbances	Practically no geological disturbances.	
13.	Surface properties	Forest and seasonal nallah	
14.	Percentage of extraction in the panel	80 %	80 %
15.	Area of panel (approximately)	93,000 m^2	79,000 m^2
16.	Volume of panel (approximately)	279,000 m^3	237,000 m^3
17.	Quantity of coal in the panel (approximately)	362,700 tonne	308,100 tonne
18.	Quantity of coal extracted	290,000 tonne	246,500 tonne
19.	Date of		
	a) Starting	17.10.1983	July 1985
	b) Completion	1.7.1985	Dec. 1986

It may be noted that the extraction in panel 2-West in Lower Barkable seam was just completed when the last observation was taken in July 1985, while 1-West panel was started in July 1985, just after completion of extraction of 2-West panel. Extraction of the panels 2 and 3 in Upper Barkable seam was completed by Aug. 1984. Therefore, the subsidence observations on the surface would show influence of extraction of the two panels in Upper Barkable and panel 2-West in Lower Barkable seam.

LAYOUT OF MONITORING STATIONS

Fig.1 also shows the layout of monitoring stations on the surface over the panels whose details have been described earlier, in which one line of stations has been made almost in the centre of the panels and perpendicular to the face, two lines have been made parallel to the face and four diagonal lines. The layout was made to obtain comprehensive information of subsidence movements.

The general interval between the stations in different lines was about 10m, which was about 1/10 of the average depth. Due to uneven surface topography it was not possible to maintain uniform distance between the stations.

The stations in different lines were made in such a manner that it was possible to monitor three - dimensional movement of the points.

MONITORING PROCEDURE

1. Vertical Movement - of monitoring stations was monitored using self aligning level in conjunction with precision levelling staff of a least count ± 0.00005m. Modified levelling procedure incorporating spot-checking system was adopted to reduce/eliminate human and instrumental errors.

2. Horizontal Strains - were computed from the distances between the monitoring stations measured by using steel bands with a least count of 1 mm.

3. Lateral Displacements - of surface points/monitoring stations was measured by using an electronic distance measuring instrument.

OBSERVATIONS

1. Width-Depth Ratio - The average width and depth of the four panels (two in Upper Yorkable and two in Lower Yorkable) and thereby their width-depth ratio were as given below :

Seam	Panel	Avg. width m	Avg. depth m	Width-depth ratio
Upper Yorkable	C	104	99.5	1.05
	D	120	93	1.29
Lower Yorkable	2-Feet	170	108.5	1.56
	1-Feet	160*	102.5	1.56

* Average width

2. Non-Effective Width - The first signs of subsidence movements were noticed/observed on the surface in November 1982, at which time the width of extraction in panel C in Upper Yorkable seam was about 90m. Therefore, the non-effective width in this case was about 0.7 times the depth of the panel. The safe non-effective width can be taken as 0.7 times the depth. It was not possible to obtain non-effective width in case of panel D.

3. Visual - The visual observations taken over the panels upto July 1985 were as given below :

- While panel C in Upper Yorkable was worked from 1.9.1982 to 20.6.1983 there was practically no open crack on the surface till the corresponding panel in Lower Yorkable also advanced after October 1983.

- Panel D in Upper Workable seam was worked simultaneously with panel 2-West in Lower Workable seam and during this period wide cracks developed on the surface with stepping presumably due to effect of both the seams. The maximum width of cracks on the surface was of the order of 200 mm.

4. Subsidence and Time - Fig.2 and 3 show the subsidence observed over panels C and D (at a few stations (four) plotted against time respectively. The periods of extraction of the panels are also shown in the figures.

It can be seen in Fig.2 that for a time of about 170 days after extraction of panel C in Upper Workable seam there was a little increase in subsidence. But afterwards when Panel D in Upper Workable and Panel 2-West in Lower Workable were being worked simultaneously there was an abrupt increase in subsidence.

In Fig.3 the subsidence was due to combined influence of extraction in Panel D in Upper Workable and Panel 2-West in Lower Workable seam.

It may be mentioned here that panel 1-West in Lower Workable seam was worked after July 1985, therefore further observations over the area would reveal a clear picture.

5. Maximum Subsidence - The maximum subsidence observed at different stages was as given below :

- Maximum subsidence over panel# C immediately after completion of extraction was 239 mm, which was 15.2 per cent of extraction thickness of 1.5m.

- After extraction of panels C and D in Upper Workable and panel 2-West in Lower Workable seams the maximum subsidence over panels C and D in July 1985 was as given below :

Panel C	=	1418 mm	= 31.5 %
Panel D	=	1329 mm	= 29.5 %

The maximum subsidence over the workings is likely to further increase after extraction of panel 1-West in Lower Workable seam and afterwards due to time effect.

6. Maximum Subsidence, Slope and Strains - observed over the panels C and D in Upper Workable and 2-West in Lower Workable seam in July 1985 were as given below :

Panel C

Maximum subsidence	=	1418 mm	= 31.5 %
Maximum slope	=	46.4 mm/m	
Maximum strain			
- Compressive	=	5.5 mm/m	
- Tensile	=	6.0 mm/m	

Panel D

Maximum subsidence	=	1329 mm	= 29.5 %
Maximum slope	=	73.6 mm/m	
Maximum strain			
- Compressive	=	4.2 mm/m	
- Tensile	=	9.9 mm/m	

The above values are likely to change due to effect of extraction of panel 1-West in Lower Forkable seam and also with time. Therefore, it would not be advisible to arrive at any conclusion at this stage.

7. Subsidence Contours - Fig.4 shows subsidence contours plotted over panel C (Upper Forkable seam) on the basis of observations taken in March 1983, about three months before completion of extraction of the panel. In Fig.5 are shown the contours based on observations taken in July 1983 about a month after completion of extraction in the panel. The difference in the shape of contours is evident. It is also evident that density of contours was more on the starting side as compared to the finishing side. The maximum subsidence was also more nearer to the starting sitting side.

Fig.6 shows the subsidence contours plotted on the basis of observations taken in July 1985 when extraction had been completed in panels C and D in Upper Forkable and panel 2-West in Lower Forkable seam. The density of contours was more on the starting side of the panels as compared to the finishing side.

The panel 1-West in Lower Forkable seam was to be worked after extraction 2-West panel. Therefore, the shape of the contours is likely to change after its extraction and also due to time, which would be evident in subsequent observations.

8. Effect of Subsidence on Surface Profiles - Fig.7 to 9 show the effect of subsidence on surface profiles along different lines of monitoring stations over the panels. It is clear that the subsidence movements had a tendency to modify surface profiles. Since, more subsidence is anticipated in the area, is likely to take place due to extraction 1-West panel in Lower Forkable seam and this further changes in surface profiles can be anticipated in future.

9. Angle of Draw - Due to multi-seam and multi-panel extraction in the area under review it was not poss to ascertain angle of draw on all the sides of the panels. The angle of draw ascertained along differe lines, as seen in Fig.7 to 12, varied from 7° to 3

Along C-line over panel C in Upper Workable seam th angle of draw on the starting side was 30° and it w 7° on the finishing side on the basis of observatio taken in July 1983, about one month after completio of extraction in the panel. Along the same line it 27° on the starting side of panel 2-West in Lower Workable seam on the basis of observations taken in July 1985.

Along D and F lines over panel C in Upper Workable seam the angle of on the rise side was 19° and 25° respectively on the basis of observations in July 1985.

Along C line over panel D in Upper Workable seam t angle of draw was 20° on the finishing side on the basis of observation in June 1984. Along D and F l over this panel the draw was 20° and 14° respectiv on the basis of the observation in June 1984.

From the above observations it is clear that in undisturbed condition the angle of draw on the sta side was more than that on the finishing side alon line over panel C.

10. Subsidence Movement Profiles - The subsidence mov profiles shown plotted in Fig.7 to 12 are discusse below :

4. C Line over Panel C in Upper Workable seam - Three subsidence profiles corresponding to observations tak in March 1983, July 1983 and July 1985 are shown in Fig.7. The profiled of March 1983 corresponds to the time when the face in panel C in Upper Workable was about to be completed while profile of July 1985 shows subsidence just after completion of extraction in the panel. In both the profiles asymmetry is evident. The subsidence profile of July 1985 shows the effect of extraction of panels C and D in Upper Workable and 2-Feet in Lower Workable seam and in this case also asymmetry was evident. The effect of 2-Feet panel is quite clear from the shape of the three profiles.

5. D and N lines over Panel C in Upper Workable seam - Tw subsidence profiles corresponding to the observations taken in July 1983 and July 1985 are shown in Fig.8 an 9. The profile of July 1983 shows the subsidence due t extraction of panel C in Upper Workable seam only while that of July 1985 shows the effect of extraction in both the Upper Workable and Lower Workable (2-Feet pane seams.

6. [illegible] over Panel D in Upper Workable seam - Two subsidence profile corresponding to observations in June 1984 and July 1985 are shown in Fig.10. While June 1984 profile gives the subsidence due to extraction of panels C and D while that of July 1985 has additional influence of panel 2-Feet also.

7. D and E Lines over Panel D in Upper Workable seam - Fig.11 and 12 show subsidence profiles similar to those along C line over the panel. Effect of multi-panel and multi-seam extraction is evident.

The subsidence profile along almost all the lines are expected to change from those shown plotted in Fig.7 to 12, as 1-Feet panel Lower Workable seam was extracted after July 1985 and also due to time effect.

5. Slope and Strain Profiles - It can be seen in Fig. 7 to 12 that slope profiles almost along all the lines in the area under review in accordance with subsidence profiles while strain profiles were erratic.

The profiles are likely to change after extraction of panel 1-West and also due to time.

CONCLUDING REMARKS

On the basis of various observations discussed earlier it can only be said at this stage that further observations after extraction of panel 1-West in Lower Kurkable seam and with time would reveal the real and clear picture of subsidence movements in the area. Therefore, it could be advisible to continue monitoring of subsidence movements.

Overleaf.

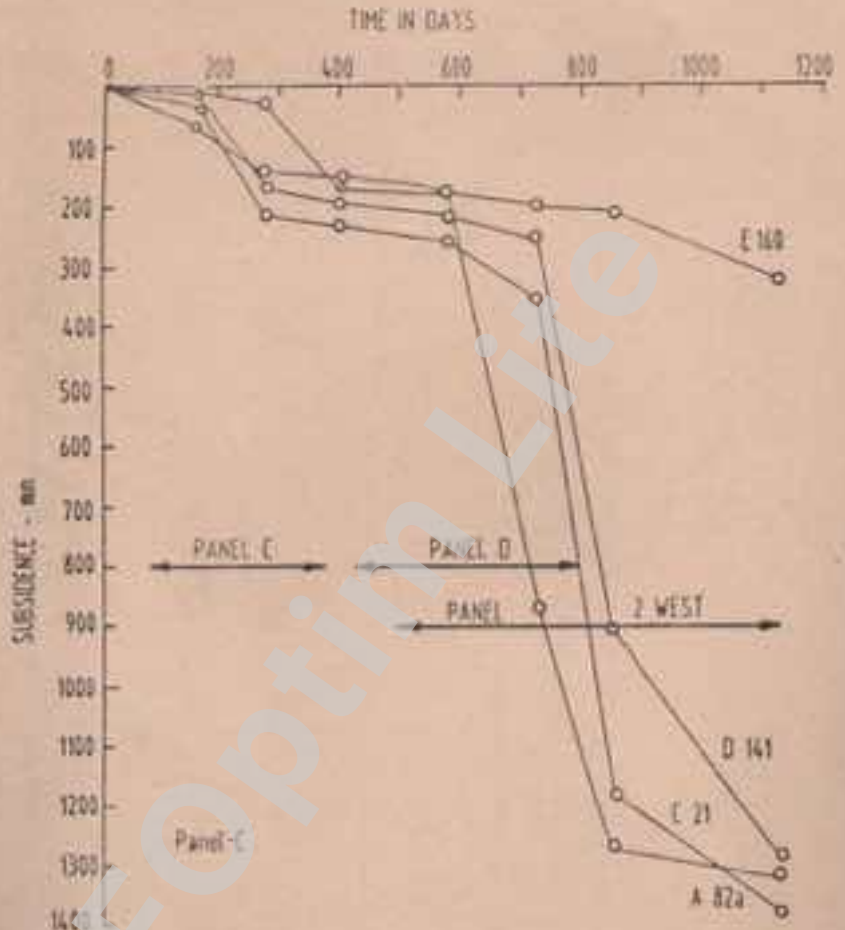
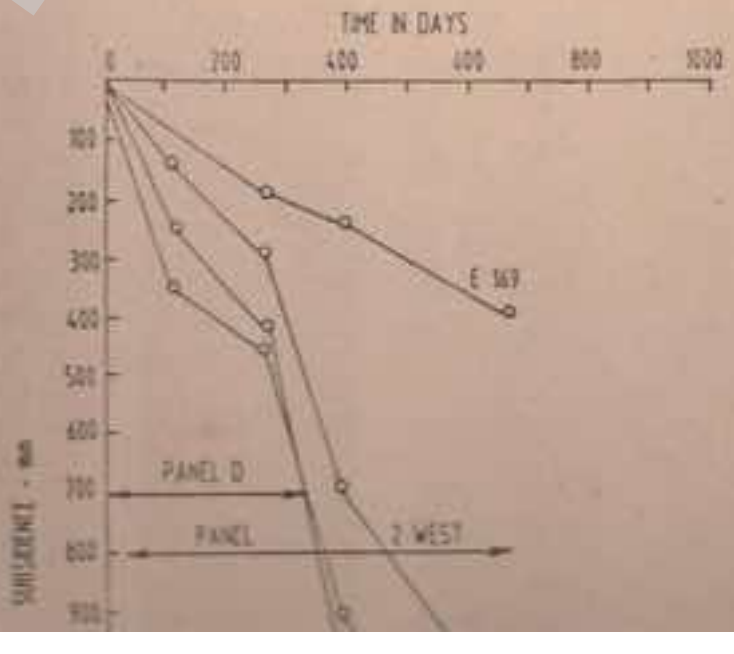
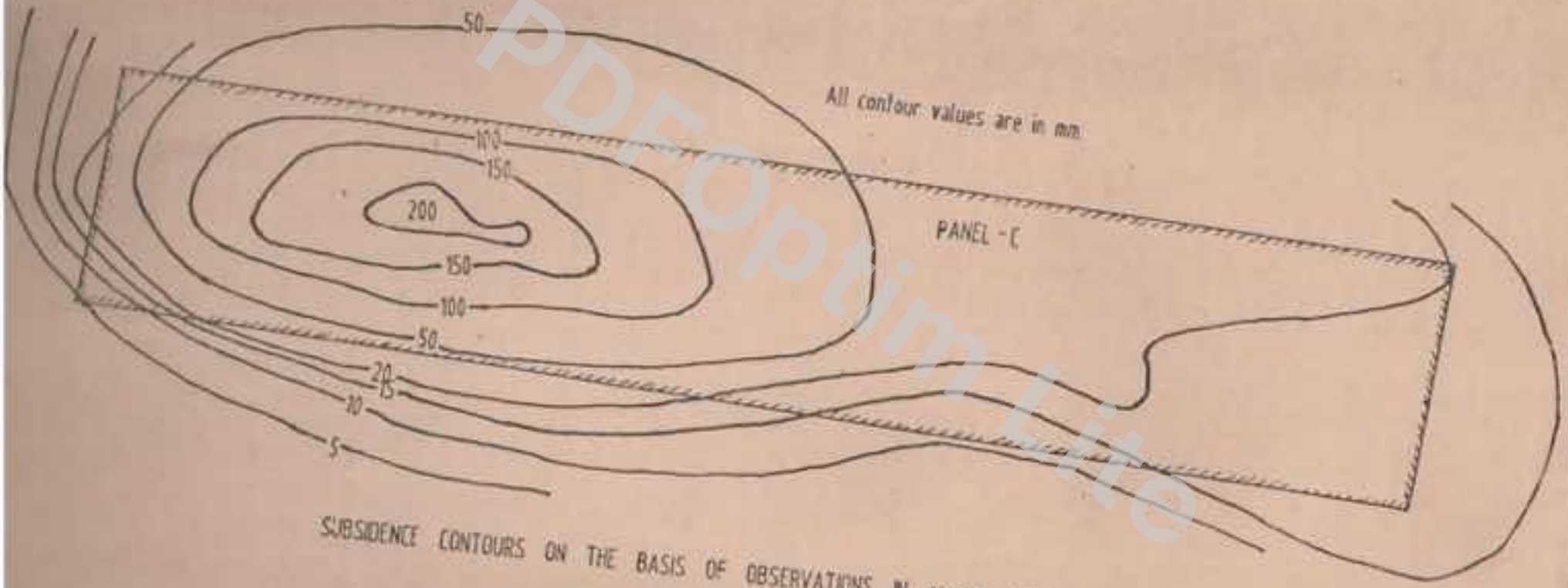


FIG. 2

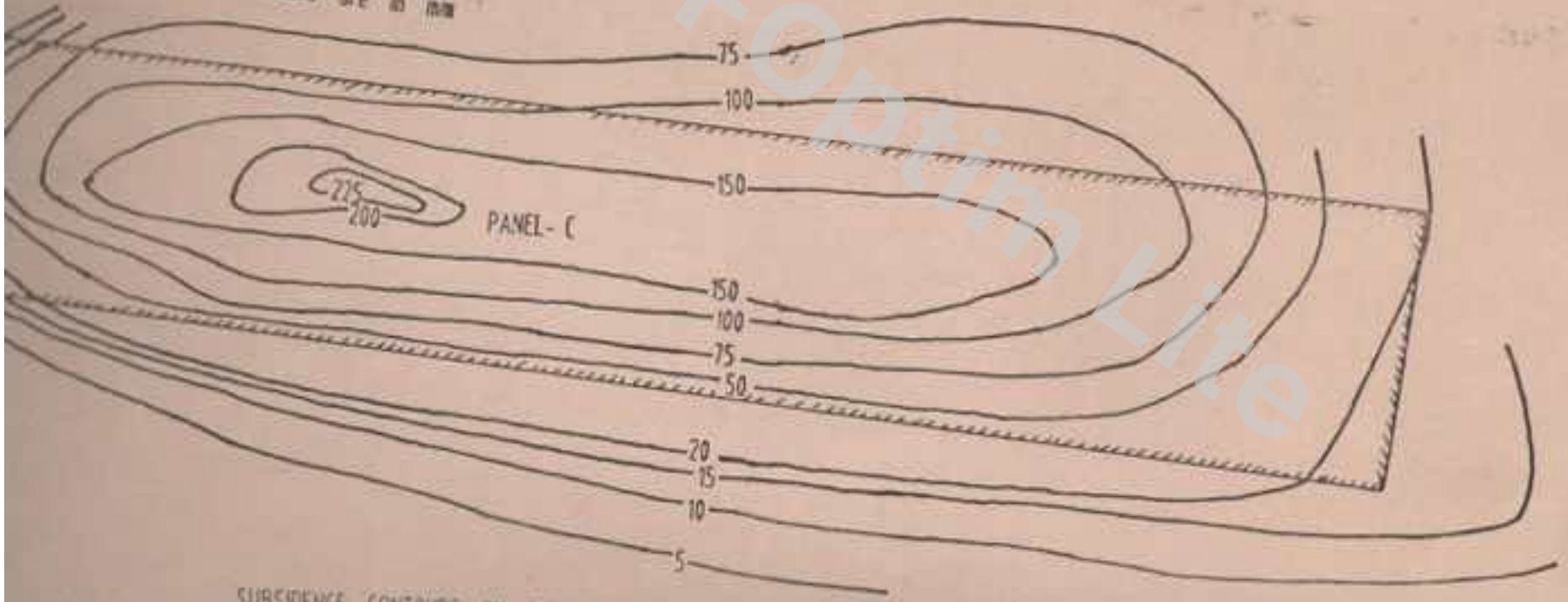




SUBSIDENCE CONTOURS ON THE BASIS OF OBSERVATIONS IN MARCH 1983

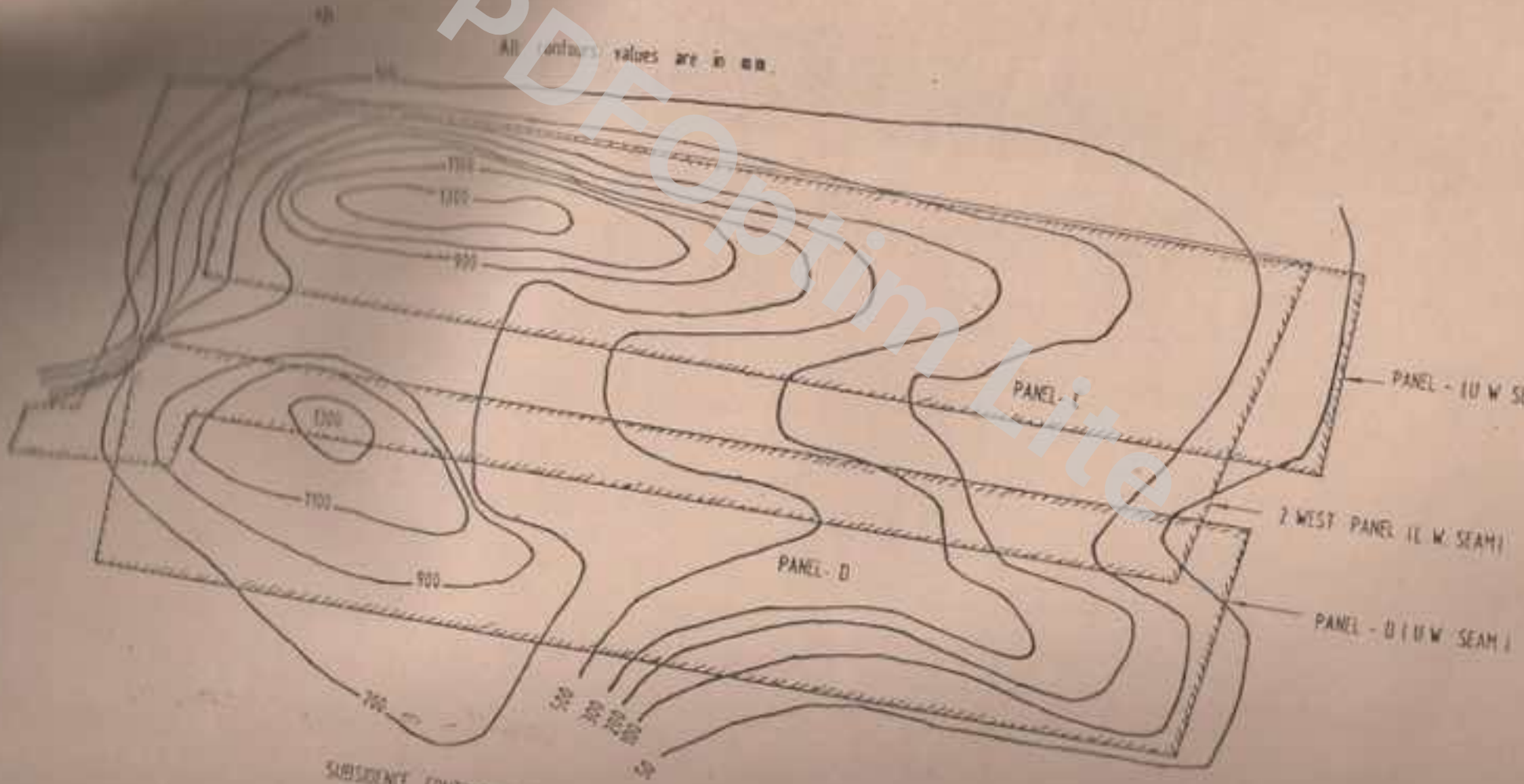
FIG. 4

All the contours are in mm



SUBSIDENCE CONTOURS ON THE BASIS OF OBSERVATIONS IN JULY 1983

FIG. 5



SUBSIDENCE CONTOURS ON THE BASIS OF OBSERVATIONS IN JULY 1981

FIG. 6

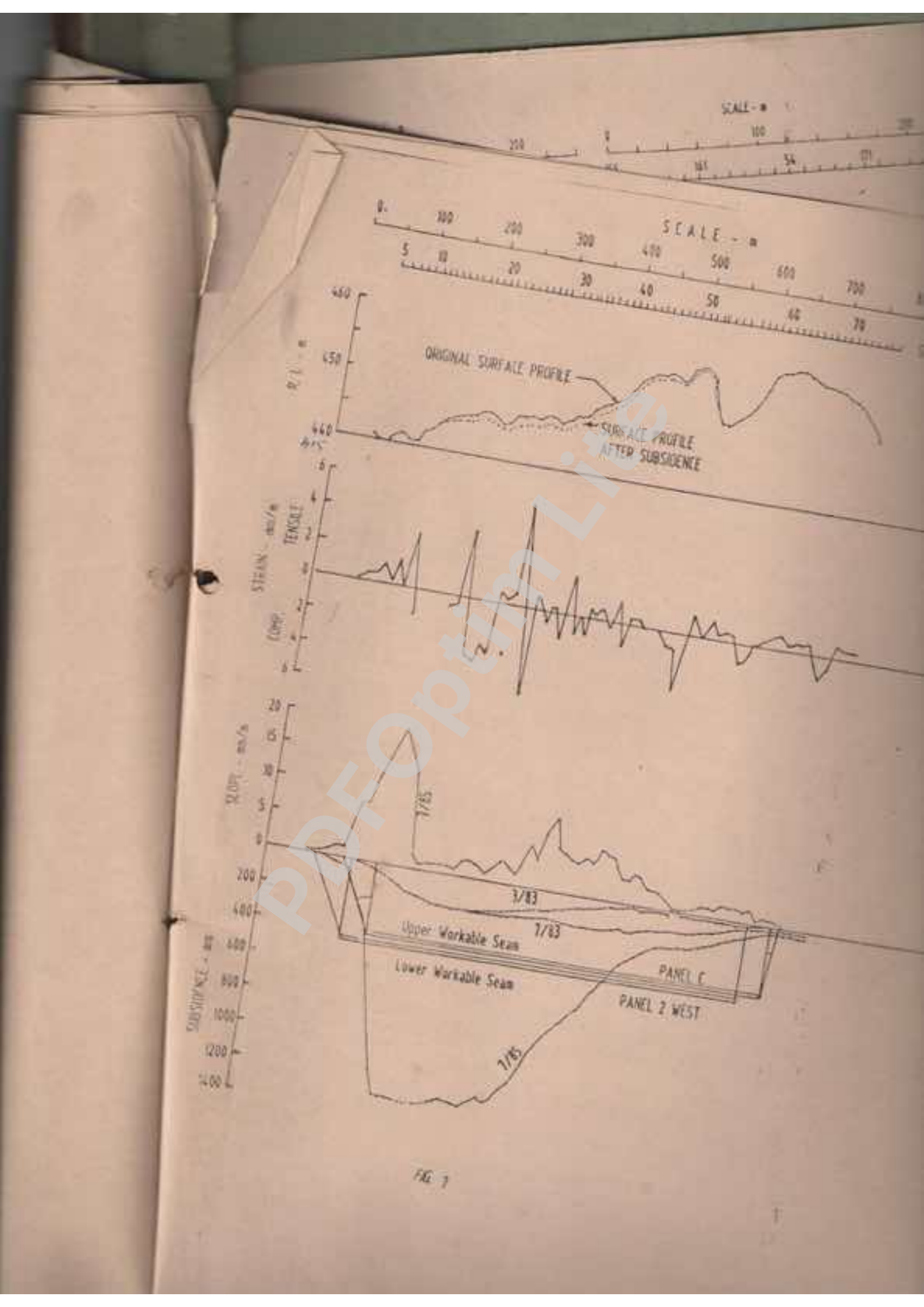


FIG 7

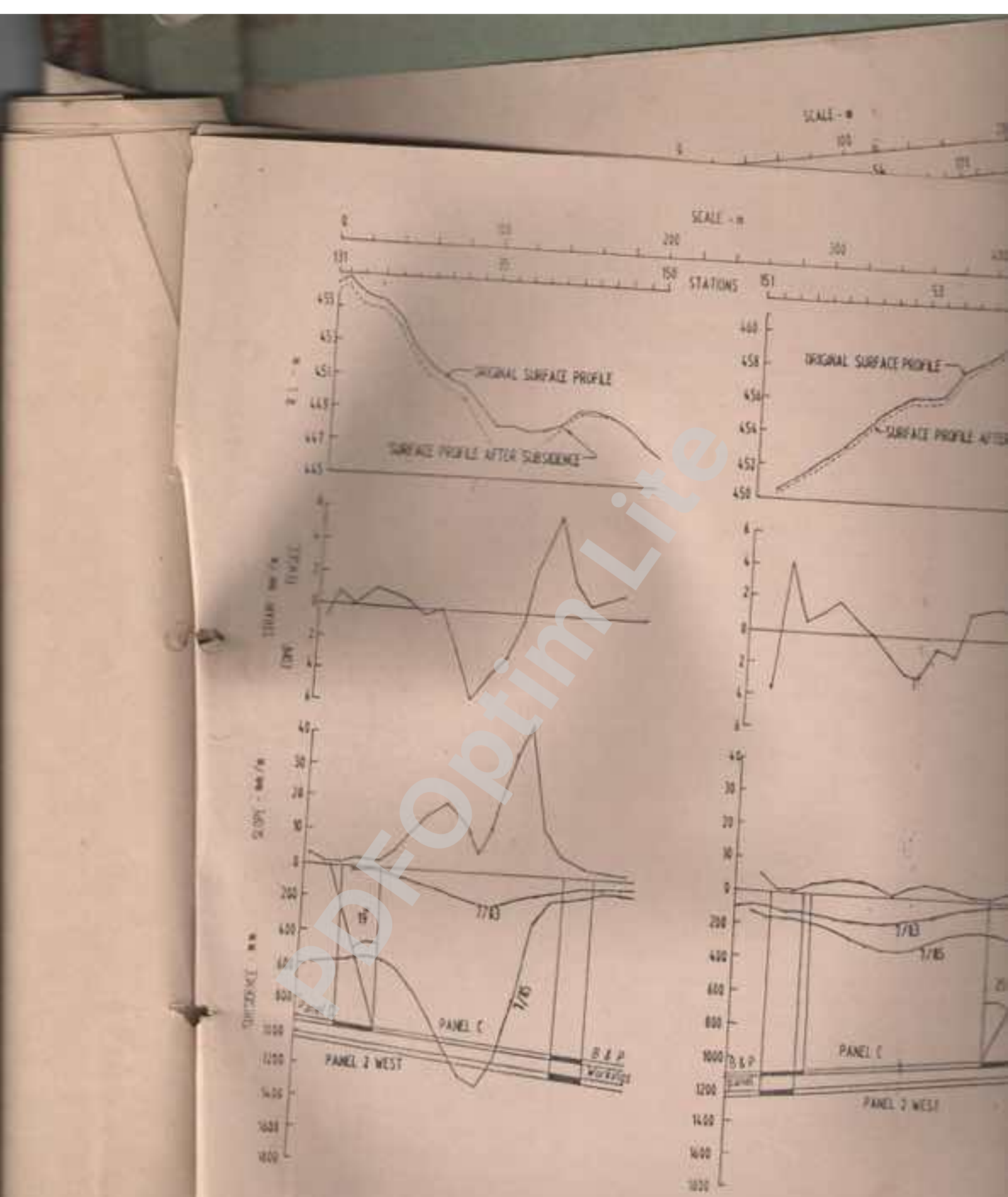
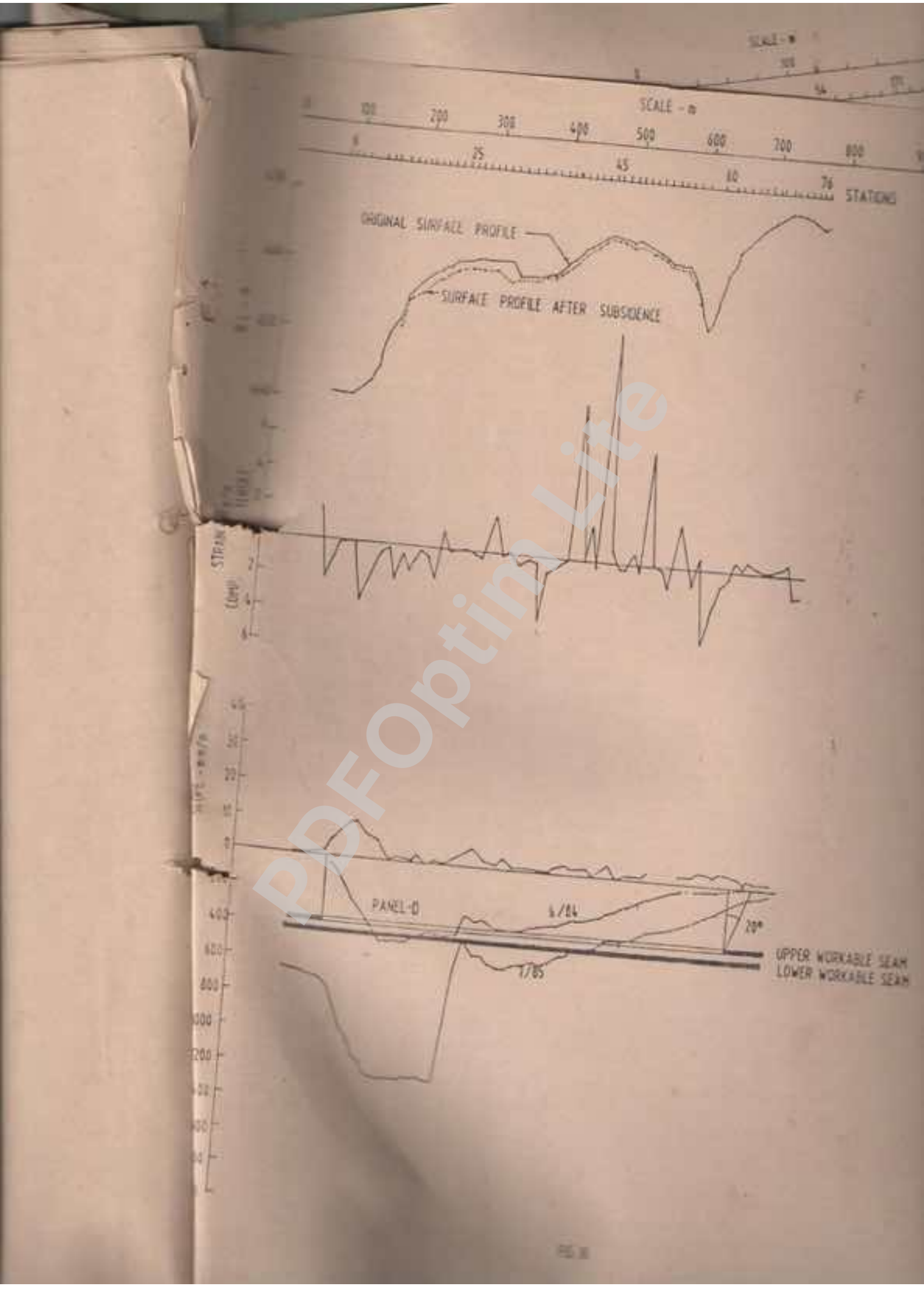


FIG. 8

FIG. 9



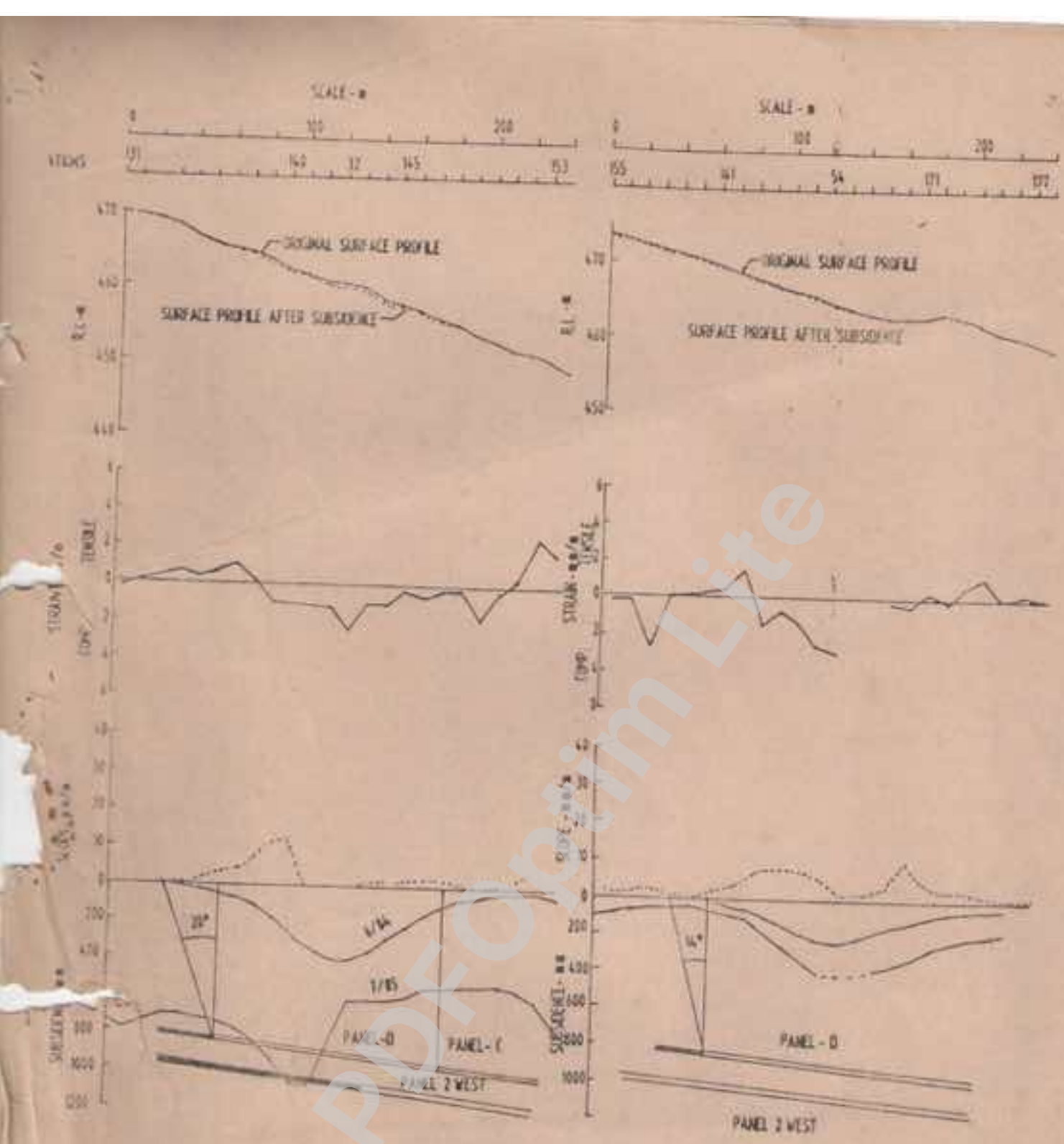


FIG. 11

FIG. 12