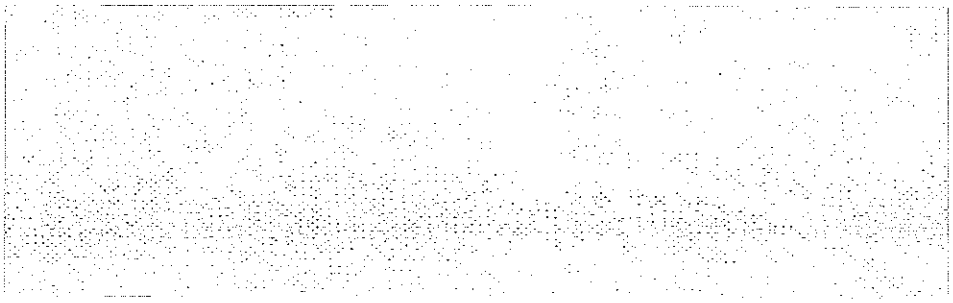
1202

# EVALUATION OF NOISE BARRIERS ON I 275 FOR STRUCTURAL AND VISUAL INTEGRITY

(I 96/I 275 Interchange, Northeast Quadrant and I 275 From Koppernick Rd to Edw. Hines Dr)


**TESTING AND RESEARCH DIVISION**
**RESEARCH LABORATORY SECTION**





TD 893.3 M5 H37 1982 c. 2
Evaluation of noise
barriers on I-275 for
structural visual integrity
(I96/I275 interchange,

# EVALUATION OF NOISE BARRIERS ON I 275 FOR STRUCTURAL AND VISUAL INTEGRITY
(I 96/I 275 Interchange, Northeast Quadrant and I 275 From Koppernick Rd to Edw. Hines Dr)

F. W. Harwood
K. S. Bancroft

Research Laboratory Section
Testing and Research Division
Research Project 82 TI-799
Research Report No. R-1202

Michigan Transportation Commission
Hannes Meyers, Jr., Chairman; Carl V. Pellonpaa,
Vice-Chairman; Weston E. Vivian, Rodger D. Young,
Lawrence C. Patrick, Jr., William C. Marshall
John P. Woodford, Director
Lansing, July 1982

## Introduction

Concrete noise barrier walls were built along I 275 in 1978 in eight areas:

1) Koppernick Rd to Joy Rd, west wall including overlap
2) Koppernick Rd to Joy Rd, east wall including overlap
3) Joy Rd to Ann Arbor Rd, west wall
4) Joy Rd to Ann Arbor Rd, east wall
5) Ann Arbor Rd to Ann Arbor Trail, east wall
6) Ann Arbor Trail to Edw. Hines Dr, west wall
7) Ann Arbor Trail to Edw. Hines Dr, east wall
8) I 275/I 96 Interchange, northeast quadrant; I 96 northbound Service Rd crossover to Five Mile Rd.

The walls were built of individual panels 20 ft long, 6 in. thick, and in widths of 1, 2, and 4 ft. The panels were made with one smooth side and one rough side. Vertical concrete 'H' posts were set in concrete foundations on 20-1/2-ft centers and the panels were slid down into place from the top.

Landscaping was done after construction of the noise barrier, approximately two years ago, to lessen the visual impact of the barrier on the freeway side as well as on adjacent residences. Because of limited space, vines were used adjacent to residences. Shade trees, ornamental plants, pine trees, and vines were planted on the freeway side of the barriers. Only vines were evaluated in this report.

This report was prepared to provide the Design Division with information on the current condition of the noise walls. Information in this report can also be used by the Maintenance Division to plan wall and footing repairs if needed, and for removal or covering of graffiti.

## Discussion

Field trips were made to the I 275 noise barrier sites by Research Laboratory personnel in March 1982. Both sides of the eight walls were inspected and the following items were noted:

1) cracks in the panels,
2) gaps between the panels or between panel ends and posts,
3) rust stains,
4) graffiti,
5) surface and corner spalls,

6) erosion or settlement of wall,
7) vine growth upon walls.

Other miscellaneous items that the technicians felt might affect the structural or visual integrity of the wall were also noted.

Tables 1 through 8 are summaries of the survey. The cracks in the concrete panels were fine or hairline cracks and were evident only on the smooth side of the panels. A majority of the cracks were found in top panels. Figure 1 shows typical cracking.

Gaps between the panels appear to be caused by improperly fitted panels or by improperly formed tongues or grooves, or both. Figure 2 shows examples of these gaps. Gaps also were found between panels and posts. Corners of some panels spalled away leaving holes in the wall as shown in Figure 3.

Nearly all of the rust stains were caused by iron-bearing materials used as aggregate in the concrete. The technicians found only three locations where the reinforcement was the probable cause of rust stains. Figure 4 shows rust stains caused by iron-bearing materials.

Notes on graffiti are given in Tables 1 through 8. Several areas with graffiti had already been covered with cement colored paint and were not included in the survey. There were very few cases where graffiti was found on the rough side of the panels. In these areas, large amounts of paint were simply splashed on the wall. Figure 5 shows examples of graffiti (the most vulgar examples not shown).

Surface spalls were found mostly on smooth panels along the edge of seams (Fig. 6).

Notes on erosion or settlement are included in Tables 1 through 8. Erosion under the wall and under a paved bicycle path (Fig. 7) has occurred in the east wall area between Ann Arbor Rd and Ann Arbor Trail. In this case, the bottom panel shows hairline cracking. Severe erosion found under the west wall between Ann Arbor Trail and Edw. Hines Dr is shown in Figure 8. The photographs, taken on the freeway side at the end of Gilbert St, show that the erosion has formed a tunnel several feet beneath the bottom of the wall. In this area, a resident has built his drive up to the wall as shown in Figure 9. A drain is needed to collect the water from the drive and yard area and transport it to the freeway ditch below. Figure 10 shows animal burrows under the wall.

Notes concerning frequency of vine growth are listed in Tables 1 through 8. Figure 11 shows examples of vines growing on the walls. Vines, when well established, seem to have the earliest and greatest impact in softening the barriers and blending them into the surrounding landscape. Plantings other than vines do provide some softening effect but their impact will not be fully realized until they begin to mature over a period of years.

Notes included in Tables 1 through 8 also describe the use of the land on the resident's side of the wall between the wall and right-of-way. In residential areas, where landscaping was completed before a wall was constructed, the property between the wall and right-of-way fence is not being used.

## Summary of Findings

Cracks were visible on 7 and 5 percent of all the panels on freeway and property sides, respectively (Table 9). All cracks were being held tightly together by reinforcing steel.

Gaps in the wall were found in 13 percent of the sections. Many of these gaps seriously affect the noise attenuation characteristics of the walls. Gaps as large as 35 sq in. were found in the walls. This is 2 percent of the area of a section that is 10 ft high. If the expected attenuation of the wall section was 17 dbA, 5 ft from the wall, 4 dbA of attenuation would be lost. Some gaps had been filled and were not counted in this evaluation. If gaps larger than 9 sq in. were filled, remaining gaps would not significantly affect noise attenuation.

Rust stains affect the appearance of the wall. There were rust stains on 17 percent of the panels on both freeway and property sides, and 4 and 5 percent of the posts on freeway and property sides, respectively. Of these rust stains, only three were caused by reinforcing rods. The rest of the stains were caused by iron-bearing materials used as aggregate in the concrete.

Graffiti was found on 3 and 5 percent of the panels on the freeway and the property sides, respectively. Posts were defaced on 1 and 2 percent of their number on the freeway and property sides, respectively. Three wall locations had 1 percent or fewer panels with graffiti. Those locations were Koppernick Rd to Joy Rd, west wall, and Joy Rd to Ann Arbor Rd, both west and east walls. The Ann Arbor Trail to Edw. Hines Dr, west wall had no graffiti on the freeway side but had seven panels with graffiti on the property side. Only one of these panels was near a residence. The Ann Arbor Trail to Edw. Hines Dr, east wall was a situation similar to that of

the Ann Arbor Trail to Edw. Hines Dr, west wall, with a bicycle trail on the residence side. The remaining three walls had 2 to 13 percent of the panels or posts having graffiti.

Surface and corner spalls could have been caused by rough handling of the panels and posts during manufacture, transportation, and construction. Surface spalls were found on 3 and 2 percent of the panels on the freeway and property sides, respectively. Posts exhibited less than 1 percent spalling on the property side. No surface spalls were found on posts on the freeway side. Corner spalls were not counted but were included as gaps when a piece had broken away from the main panel.

Locations of soil erosion were found at 2 and 1 percent of the bottom panels on the freeway and property sides, respectively. Most of the erosion was caused by animals (probably woodchucks) digging under the wall.

Vines are growing on 5 and 12 percent of the sections on the freeway and the property sides, respectively. As would be expected, vines that were planted on the property side and cared for by residents are much larger than the other vines.

## Recommendations

The walls should be periodically inspected for spalling. If spalls occur, they should be patched.

Gaps in the wall larger than 9 sq in. should be filled. Holes larger than 9 sq in. in the wall reduce the wall's noise attenuation a measurable amount.

In future noise barrier walls, formed out of concrete, specifications should be revised to reduce the amount of iron-bearing materials permitted in the aggregate.

Graffiti on walls is a continuing problem, especially where the wall surface isn't close to a residential area. Noise barrier walls in the future should have rough surfaces. A rough surface seems to discourage vandals from painting graffiti on walls. The walls on I 275 presently have several areas of graffiti needing cover.

Surface and corner spalls can be minimized by better concrete forming methods, more care in transporting and handling, and closer inspection of the finished wall.

Two locations mentioned on page 2 should have foundation improvements and repairs made in the near future. Other erosion or holes caused by animals are not currently reducing the effectiveness of the wall's noise attenuation or reducing the visual integrity of the wall.

Greater effort should be made to establish vines on both sides of this type of barrier on future projects. The time it takes for plants to be effective in reducing the visual impact of the noise barrier, makes it important that landscaping be done immediately after barrier construction. Ideally, landscaping should be a part of the noise barrier contract.

# TABLE 1
## NOISE WALL SURVEY SUMMARY
## Koppernick Rd to Joy Rd, West Wall, Checkerboard Design

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 31 | 6 | 72 | 14 | 0 | 0 | 7 | 1 | 5 | 3 | 3 | 2 | 2 | 1 |
| Posts, freeway side | 0 | 0 | 6 | 4 | 0 | 0 | - | - | - | - | - | - | - | - |
| Panels, property side | 47 | 9 | 124 | 24 | 0 | 0 | 7 | 1 | 5 | 3 | 0 | 0 | 5 | 3 |
| Posts, property side | 0 | 0 | 1 | <1 | 0 | 0 | - | - | - | - | - | - | - | - |
| Bottom panels only, freeway or property side | 11 | 7.5 | --- | -- | - | - | - | - | - | - | - | - | - | - |

NOTES: No graffiti.
Minimal vines, freeway side only.
Some settlement (minimal) on the property side. Most are holes under wall dug by woodchucks. Right-of-way fence runs parallel about 3 ft from wall.

Total panels = 519
Total sections = 160
Total posts = 161

# TABLE 2
## NOISE WALL SURVEY SUMMARY
## I 275, Koppernick Rd to Joy Rd, East Wall, Checkerboard Design

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 32 | 6 | 67 | 12 | 8 | 1 | 14 | 2 | 15 | 9 | 3 | 1 | 0 | 0 |
| Posts, freeway side | 1 | <1 | 3 | 2 | 3 | 2 | -- | - | -- | - | - | - | - | -- |
| Panels, property side | 32 | 6 | 114 | 20 | 21 | 4 | 19 | 3 | 15 | 9 | 0 | 0 | 1 | <1 |
| Posts, property side | 1 | <1 | 8 | 5 | 3 | 2 | -- | - | -- | - | - | - | - | -- |
| Bottom panels only, freeway or property side | 5 | 2.9 | --- | -- | -- | - | -- | - | -- | - | - | - | - | -- |

NOTES: Minimal graffiti with most occurring on the property side.
Minimal vines. Apartment complex parking lot and drive adjacent to wall on property side. Bicycle path on freeway side.
Very little settlement. One hole under wall.

Total panels = 566
Total sections = 174
Total posts = 175

# TABLE 3
## NOISE WALL SURVEY SUMMARY
## I 275, Joy Rd to Ann Arbor Rd, West Wall

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 22 | 6 | 90 | 27 | 1 | <1 | 15 | 4 | 29 | 26 | 2 | 2 | 2 | 2 |
| Posts, freeway side | 1 | <1 | 10 | 3 | 0 | 0 | -- | - | -- | -- | - | - | - | - |
| Panels, property side | 9 | 3 | 56 | 17 | 0 | 0 | 3 | 1 | 29 | 26 | 0 | 0 | 3 | 3 |
| Posts, property side | 2 | <1 | 2 | <1 | 0 | 0 | -- | - | -- | -- | - | - | - | - |
| Bottom panels only, freeway or property side | 2 | 1.8 | -- | -- | - | -- | -- | - | -- | -- | - | - | - | - |

NOTES: Minimal graffiti.
A few vines on the freeway side
A number of sections had holes dug under the wall, probably caused by a combination of animals (woodchuck) and settlement.

Total panels = 339
Total sections = 113
Total posts = 113

# TABLE 4
## NOISE WALL SURVEY SUMMARY
## I 275, Joy Rd to Ann Arbor Rd, East Wall

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 17 | 4 | 54 | 13 | 5 | 1 | 16 | 4 | 19 | 15 | 2 | 2 | 0 | 0 |
| Posts, freeway side | 0 | 0 | 5 | 1 | 2 | <1 | -- | -- | -- | -- | -- | -- | - | - |
| Panels, property side | 5 | 1 | 22 | 5 | 2 | <1 | 1 | <1 | 19 | 15 | 27 | 21 | 5 | 4 |
| Posts, property side | 1 | <1 | 4 | <1 | 5 | 1 | -- | -- | -- | -- | -- | -- | - | - |
| Bottom panels only, freeway or property side | 1 | 0.8 | -- | -- | - | -- | -- | -- | -- | -- | -- | -- | - | - |

NOTES: Minimal graffiti.
A few vines on the freeway side. Majority of vines, shrubs, tree, are on the property side. In most cases, the residents property butts up against the wall. They use the wall right-of-way for extra yard, garden, wood piles, storage and/or junk. Many residences use wall for vine trellis.
Bicycle path on the freeway side results in the grade being higher; therefore, fewer exposed panels on the freeway side than on the property side. Some settlement on the property side but appears to be minimal.

Total panels = 423 freeway side, 450 property side
Total sections = 126
Total posts = 130 (three double posts)

# TABLE 5
## NOISE WALL SURVEY SUMMARY
## I 275, Ann Arbor Rd to Ann Arbor Trail, East Wall

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 27 | 11 | 52 | 22 | 13 | 5 | 3 | 1 | 10 | 13 | 5 | 6 | 8 | 10 |
| Posts, freeway side | 0 | 0 | 3 | 1 | 2 | 1 | - | - | -- | -- | - | - | - | -- |
| Panels, property side | 9 | 4 | 74 | 31 | 18 | 8 | 8 | 3 | 10 | 13 | 0 | 0 | - | -- |
| Posts, property side | 0 | 0 | 5 | 6 | 5 | 6 | 2 | 2 | -- | -- | - | - | - | -- |
| Bottom panels only, freeway or property side | 1 | 1.3 | -- | -- | -- | - | - | - | -- | -- | - | - | - | -- |

NOTES: Graffiti found on both sides of wall.
A few vines along the freeway side.
Bicycle path along property side of wall. Drains from the bicycle path to the freeway side of the wall creates potential sound paths through the barrier. The drains on the freeway side have also caused considerable erosion and undermining along the wall.

Total panels = 238
Total sections = 80
Total posts = 81

# TABLE 6
## NOISE WALL SURVEY SUMMARY
## I 275, Ann Arbor Trail to Edw. Hines Dr, West Wall

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 16 | 6 | 65 | 26 | 0 | 0 | 24 | 10 | 20 | 23 | 4 | 5 | 8 | 9 |
| Posts, freeway side | 0 | 0 | 4 | 5 | 0 | 0 | -- | -- | -- | -- | - | - | - | - |
| Panels, property side | 14 | 6 | 55 | 22 | 7 | 3 | 14 | 6 | 20 | 23 | 2 | 2 | - | - |
| Posts, property side | 0 | 0 | 5 | 6 | 0 | 0 | -- | -- | -- | -- | - | - | - | - |
| Bottom panels only, freeway or property side | 4 | 4.7 | -- | -- | - | - | -- | -- | -- | -- | - | - | - | - |

NOTES: Graffiti found on property side only.
Vines consisted of some ivy planted by property owners and some vines of unknown origin.
Settlement seemed to be more evident along the freeway side. Settlements consist of washout, woodchuck holes, and ground settlement.
There was no right-of-way area between the property and noise wall. Fence between properties were butted against wall. Property owners used wall for storage of wood, junk, etc. Some driveways butted against wall. Wall was used to grow ivy, vines, etc.

Total panels = 251
Total sections = 86
Total posts = 87

## TABLE 7
## NOISE WALL SURVEY SUMMARY
## I 275, Ann Arbor Trail to Edw. Hines Dr, East Wall

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 23 | 10 | 69 | 29 | 0 | 0 | 7 | 3 | 15 | 17 | 6 | 7 | 0 | 0 |
| Posts, freeway side | 0 | 0 | 4 | 2 | 1 | <1 | - | - | --- | --- | - | - | - | - |
| Panels, property side | 9 | 3 | 34 | 14 | 17 | 7 | 6 | 3 | 15 | 17 | 0 | 0 | 0 | 0 |
| Posts, property side | 0 | 0 | 1 | <1 | 6 | 3 | - | - | --- | --- | - | - | - | - |
| Bottom panels only, freeway or property side | 6 | 7 | --- | --- | --- | --- | - | - | --- | --- | - | - | - | - |

NOTES: Graffiti found mostly on the property side.
A few vines on the freeway side.
Bicycle path on the property side of wall.

Total panels = 240
Total sections = 86
Total posts = 87

## TABLE 8
## NOISE WALL SURVEY SUMMARY
## I 96 Westbound to I 275 Northbound, North-East Wall

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 77 | 8 | 149 | 16 | 70 | 7 | 10 | 3 | 35 | 11 | 35 | 11 | 3 | 1 |
| Posts, freeway side | 0 | 0 | 6 | 2 | 19 | 2 | --- | --- | --- | --- | --- | --- | - | --- |
| Panels, property side | 41 | 4 | 130 | 13 | 124 | 13 | 5 | <1 | 35 | 11 | 110 | 36 | 2 | <1 |
| Posts, property side | 0 | 0 | 30 | 10 | 30 | 10 | --- | --- | --- | --- | --- | --- | - | --- |
| Bottom panels only, freeway or property side | 6 | 1.9 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | - | --- |

NOTES: Graffiti was most evident on the property side smooth panels.
Vines growing on the freeway side were of an unknown origin. The property side had many cultivated vines and vines of unknown origin.
There was very little settlement or erosion along this wall.
The right-of-way area running parallel to the wall was used by the property owners in most cases. It was used as lawn, garden, storage, junk storage, etc. The fence between residences usually butted up against the noise wall. One area resident did not use the right-of-way area; those residences were on Summer St.

Total panels = 967
Total sections = 309
Total posts = 310

## TABLE 9
## NOISE WALL SURVEY SUMMARY
## I 275, Eight Walls

| Location of Items | Number and Percent of Panels or Posts | | | | | | | | Number and Percent of Sections | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cracks | | Stains | | Graffiti | | Surface Spall | | Gaps | | Vines | | Settlement | |
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Panels, freeway side | 245 | 7 | 618 | 17 | 97 | 3 | 96 | 3 | 148 | 13 | 60 | 5 | 23 | 2 |
| Posts, freeway side | 2 | 1 | 41 | 4 | 8 | 1 | --- | - | --- | --- | --- | --- | --- | - |
| Panels, property side | 166 | 5 | 609 | 17 | 189 | 5 | 63 | 2 | 148 | 13 | 139 | 12 | 16 | 1 |
| Posts, property side | 4 | 1 | 56 | 5 | 19 | 2 | 2 | 1 | --- | --- | --- | --- | --- | - |
| Bottom panels only, freeway or property side | 36 | 3.2 | --- | --- | --- | - | --- | - | --- | --- | --- | --- | --- | - |

NOTES: Total panels = 3,570
Total sections = 1,134
Total posts = 1,144

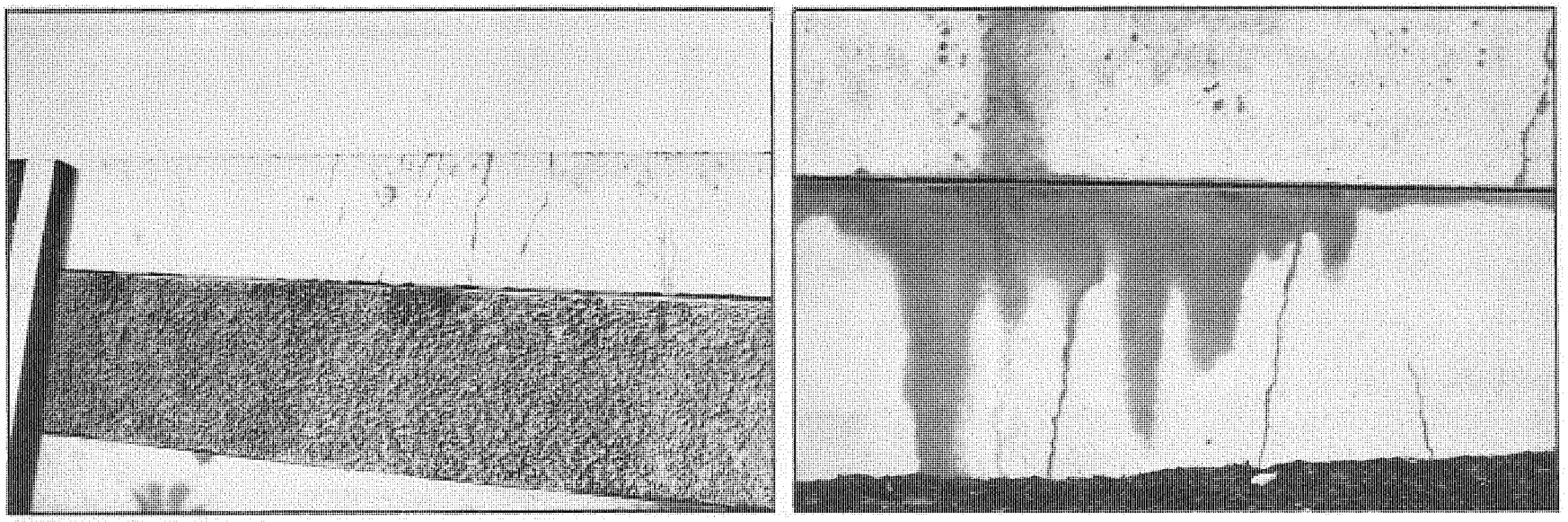


Figure 1. Typical cracks in an upper (left) and bottom (right) panel.

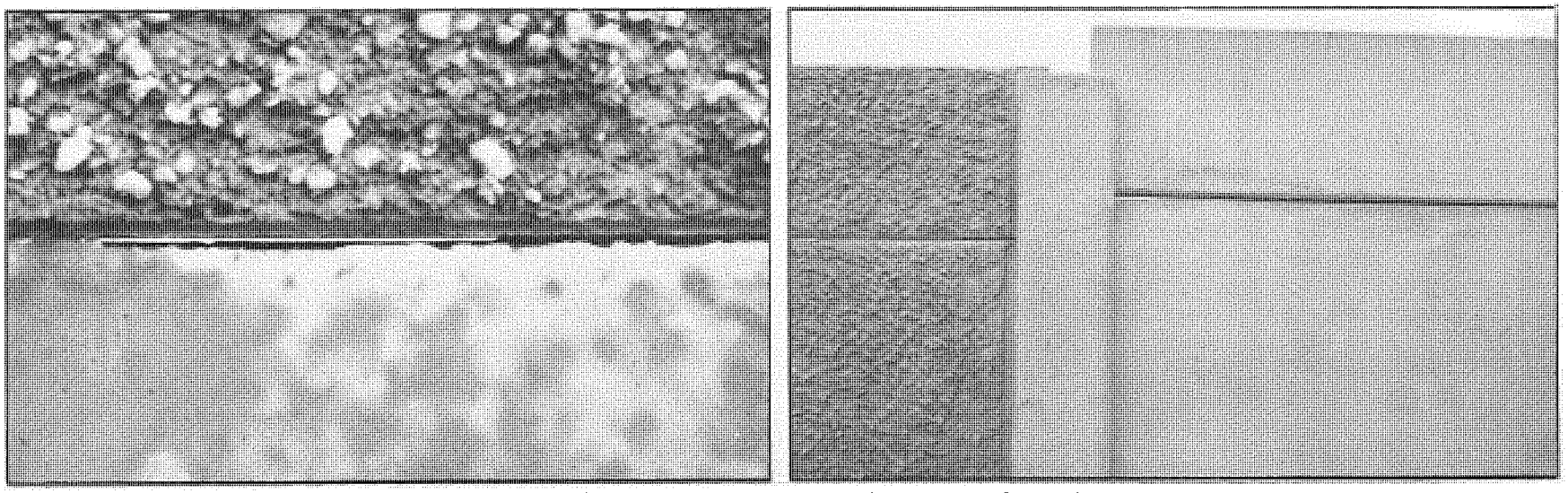


Figure 2. Typical gaps between panels; at mid-panel (left) and near post (right).

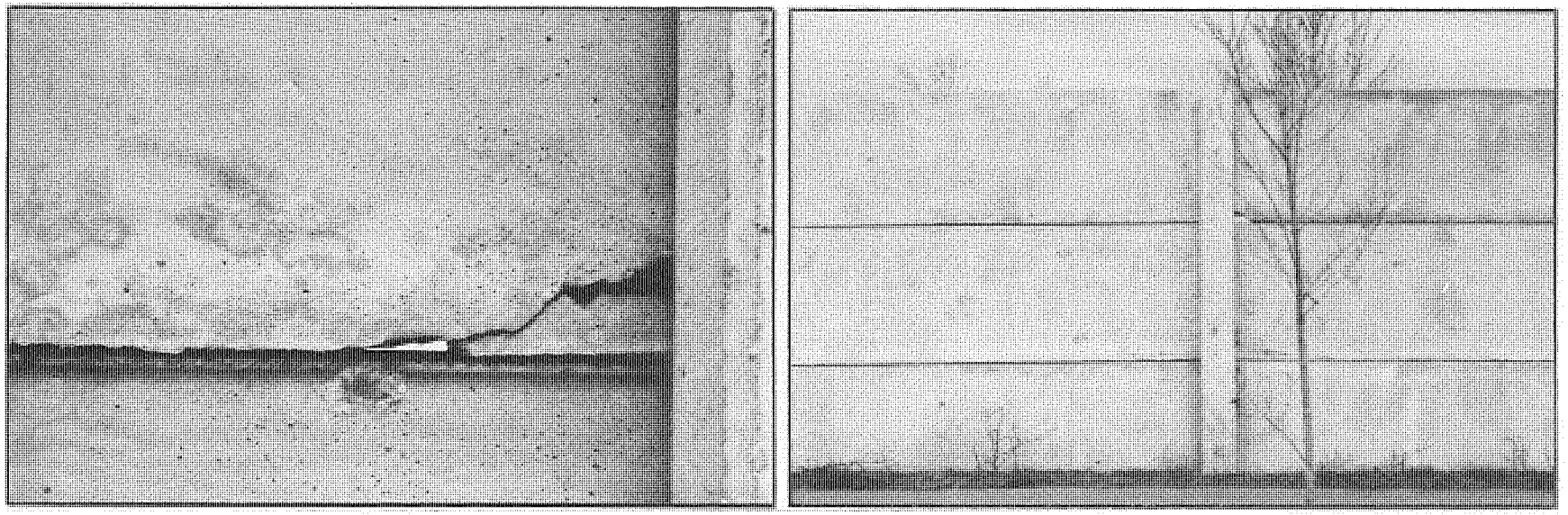


Figure 3. Corner spalling, causing openings in wall.

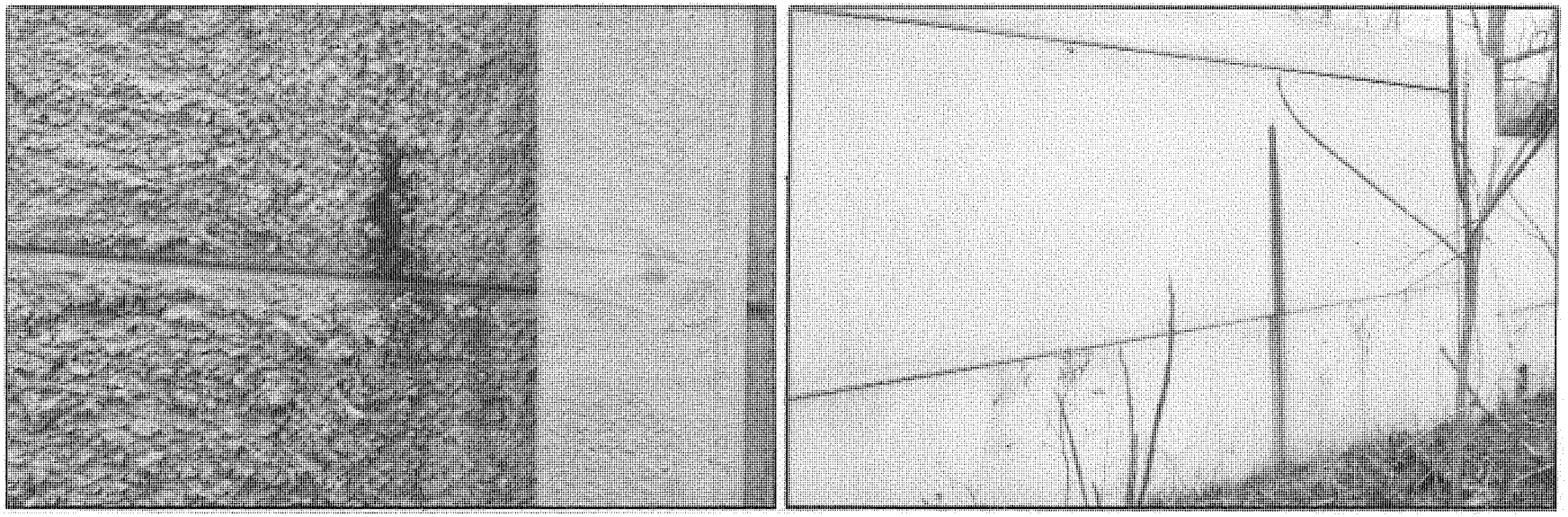


Figure 4. Typical rust staining from iron-bearing aggregate on the rough (left) and smooth surfaces.

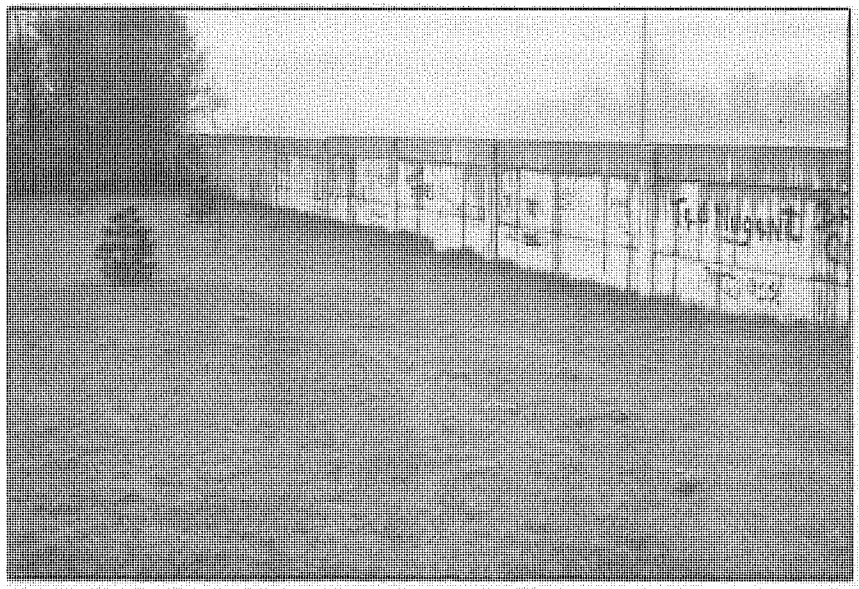


Figure 5. Typical graffiti on wall.

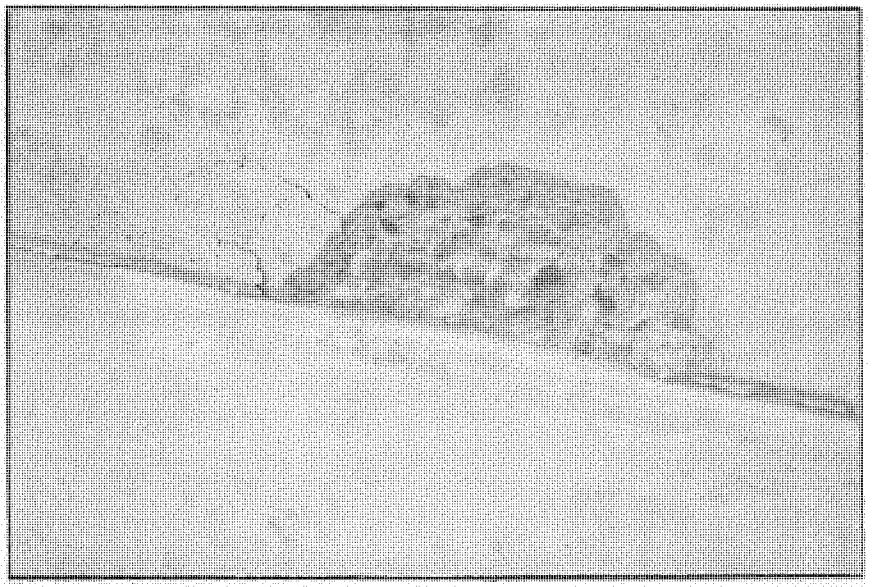


Figure 6. Surface spall (about 6 in. long).

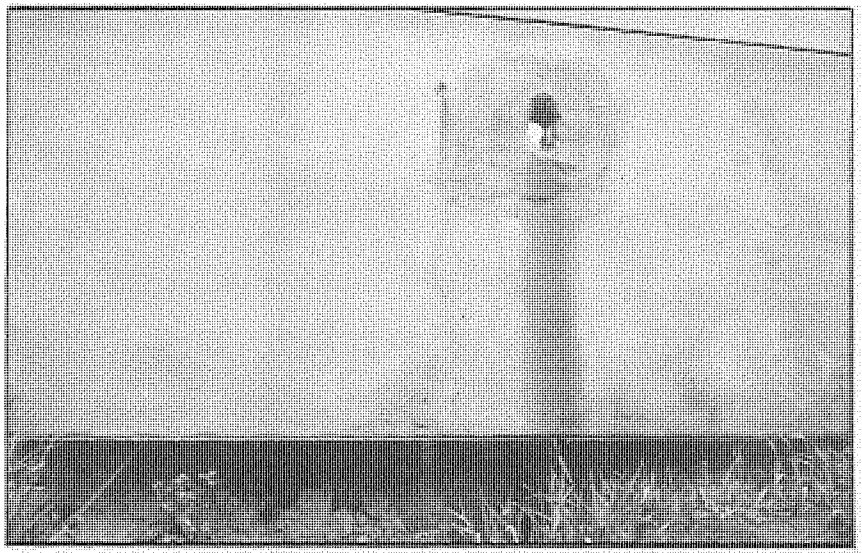


Figure 7. Erosion under wall (hole in wall is for bicycle path drainage).

Figure 8. Erosion near end of Gilbert St.

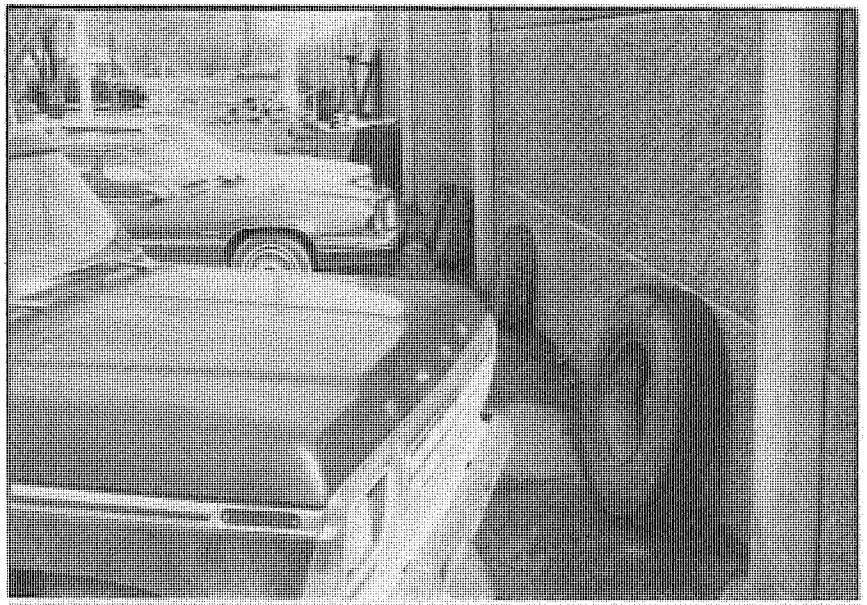


Figure 9. South drive at end of Gilbert St.

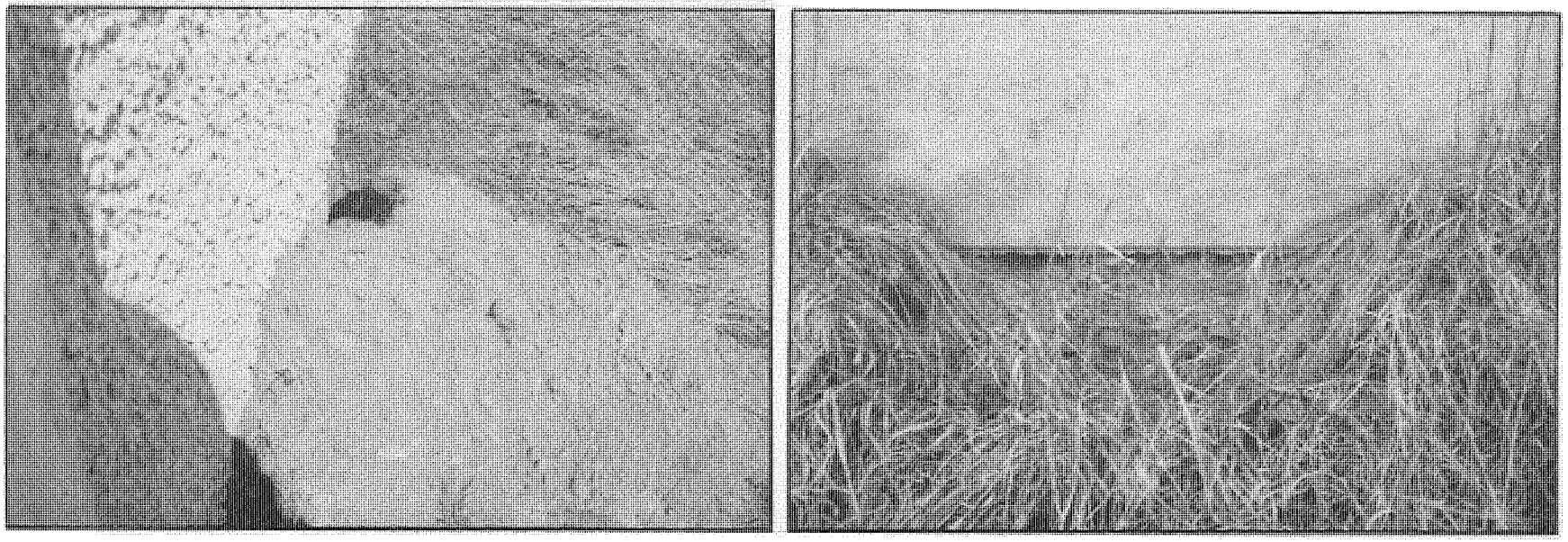


Figure 10. Woodchuck hole (left) and another animal excavation.

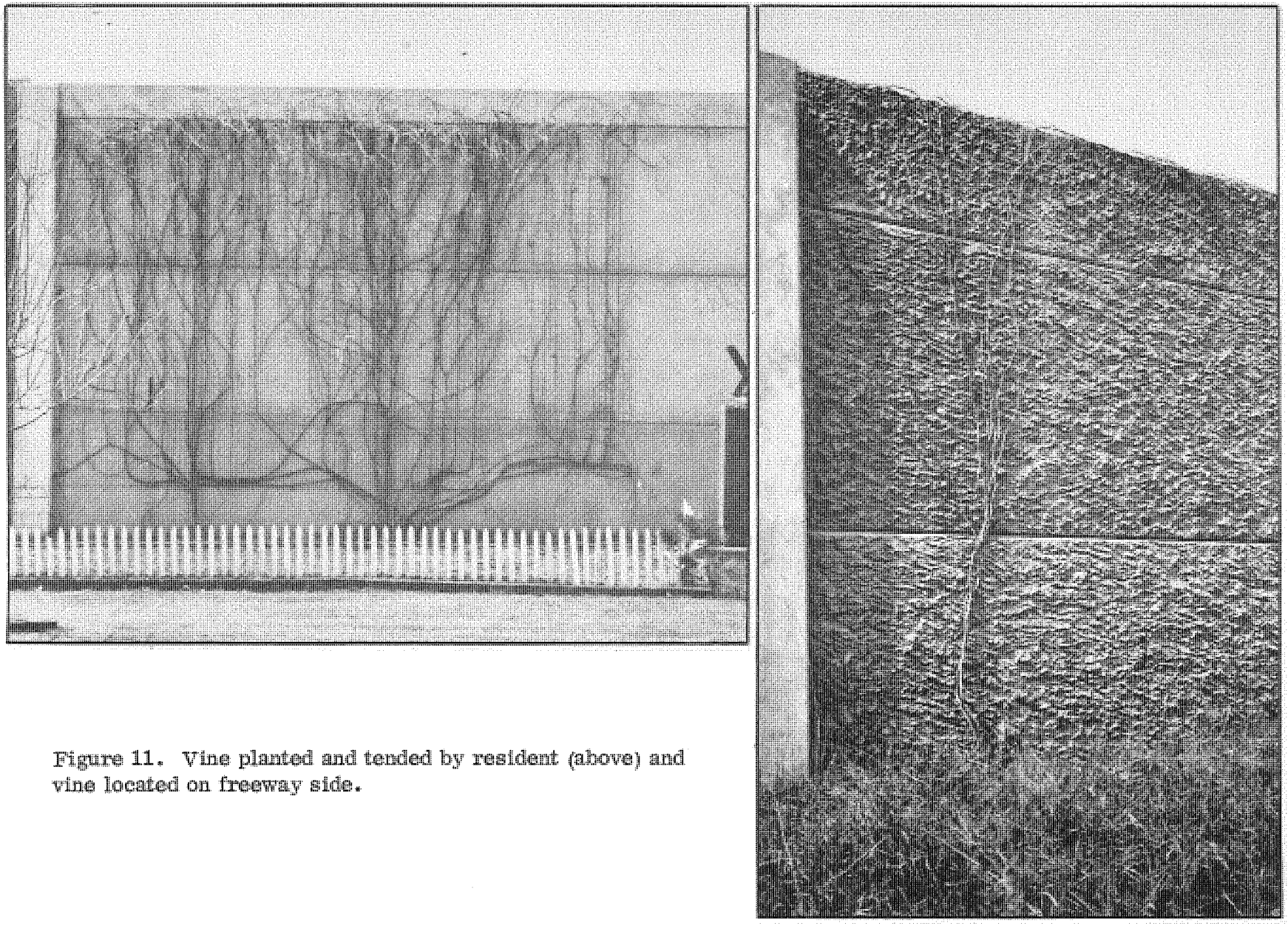


Figure 11. Vine planted and tended by resident (above) and vine located on freeway side.