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# THE BATON ROUGE

# AND

# DENHAM SPRINGS-SCOTLANDVILLE

# FAULTS

(Mapping and Damage Assessment)

by

Louisiana Geological Survey

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## Preface

Mapping and damage assessments of the "Baton Rouge" and "Scotlandville-Denham Springs" faults were initiated in early 1980 through Department of Natural Resources Contract Number 21576-80-01 and Parish Resolution Number 15982 and City Resolution Number 9572.

The Department of Natural Resources, represented by the Louisiana Geological Survey, initiated a subcontract for the actual mapping of the faults to Durham Geological Associates of Houston, Texas and Baton Rouge, Louisiana, with mapping done by Dr. C. O. Durham, Jr. and C. G. Smith, Geologists.

The purpose of this project has been to locate both faults as accurately as possible; to recommend a means of measuring the relative movement along each of the faults; and to assess the damage caused by movement associated with the faults.

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# THE BATON ROUGE AND DENHAM SPRINGS-SCOTLANDVILLE FAULTS: MAPPING AND DAMAGE ASSESSMENT

## Introduction

Structural damage to buildings, streets and sidewalks in Baton Rouge has caused grief to a number of citizens, problems in construction and maintenance to the City Parish Department of Public Works, and consternation to the administrators of the City-Parish government.

Some of this structural damage was undoubtedly caused by movement (over a period of time) along at least two geologically active faults in the Baton Rouge area: the "Baton Rouge fault" and the "Scotlandville-Denham Springs fault." Other damage could be, and probably is, attributable to other causes such as soil creep on slopes, subsidence, poor construction, effects of tree roots and shrinking and swelling of certain types of soils.

This project was designed and initiated to determine as precisely as possible the location of the two known active faults and to document and assess the damage near these faults. In addition an attempt was made to determine the location and width of the "fault hazard zone" and recommend location for precise benchmark elevation networks to determine more accurately future rate of movement along the faults.

The two active faults extend east-west through East Baton Rouge Parish. Both are gradually displacing the surface downward on the south through fault movement and consequently damaging man-made structures such as buildings and pavements that have been constructed across the surface position of the faults.

The positions of the faults are recognizable by south-facing escarpments or slopes where the faults traverse and displace the upland surface. These have been generally mapped in earlier studies. Where the faults cross modern flood plains, escarpments have not yet developed, and location of the faults is less certain. The present study has attempted to locate the surface position of the faults more exactly by detailed mapping, primarily by observing damage created by modern fault movement. This has permitted localization of the surface fault positions within a few feet or even inches where damage exists. Between such locations a better interpolation is provided than use and projection of the escarpments alone.

A corollary survey has investigated damage to houses and buildings in the general vicinity of the faults and elsewhere by interviews of residents and independent observations. This has been accomplished in order to determine any more widespread effects of the faulting and to identify damage resulting from other causes.

The objective of this study then, is to map the faults as accurately as possible, to obtain some knowledge as to the extent of damage directly and/or indirectly attributable to fault movement, to estimate a zone which can be considered as hazardous and to recommend procedures for measurement of movement along the faults.

It is hoped that the data presented in this report will aid in the determination of those restrictions and zoning laws necessary to minimize the destructive effects caused by movement along these faults.

Earlier Works

The first published report of the Baton Rouge fault in 1944 was an aerial photograph depicting it displacing an ancient abandoned Amite River channel in Livingston Parish. (1) The escarpments produced by the displacements associated with the several faults of the Baton Rouge system of faults were mapped in 1966. (2) This report documented the recurrent movement of the faults. It also correlated the surface position of the Baton Rouge fault with the subsurface position utilizing data from petroleum drill holes. This fault, considered typical, was shown to have a dip of $70^0$ to the south (nearly vertical) at the surface reduced gradually with depth to $50^0$ or lower at a depth of two miles. The displacement of the upland surface averaged 20 feet or less contrasted with a displacement of several hundred feet in the older subsurface beds, corroborating the fault's continued movement through time.

Its modern movement was subsequently documented by a catalog of damages to man-made structures in 1961 (3). A guidebook presented additional information in 1964 (4). The Baton Rouge fault was cited as a subsurface barrier to the movement of ground water in 1965 (5). In particular, it appeared to block or impede the northward intrusion of salt water into the fresh water aquifers of the Baton Rouge water supply. This significance led to several additional studies which more accurately defined the location and amount of displacement of the Baton Rouge fault in the subsurface (6, 7).

Meanwhile, additional information was also compiled regarding other faults of the Baton Rouge fault system and their relationships to terrace uplands (8, 9).

Damage to school buildings by the faults at Glen Oaks High School on the Scotlandville-Denham Springs fault in 1970-71 (10, 11) and at Woodlawn High School on the Baton Rouge fault in 1974 (12) plus damages to homes in the College Park (13) subdivision in 1976 led to publicity and public interest which ultimately resulted in the present study commissioned by the City-Parish Department of Public Works.

The relationship of surface subsidence, primarily caused by ground water withdrawal, and to a lesser extent fault movement, has been treated in recent studies (14, 15).

Present Study

The present study is designed to meet the need for a more accurate definition of the exact location of the faults, the areas vulnerable to their damage, and the type of damage that has resulted. This was accomplished by observing the damage or lack of it at every street or highway crossing of the faults and on pertinent buildings and other structures.

Using these observations, exact positions of the faults were marked on blue line copies of aerial photographs at a scale of 200 feet to the inch supplied by the City-Parish Department of Public Works. In addition, the heights of the escarpments were measured where appropriate and the vertical position of the fault or the total height of the escarpment at such points was determined. This information provides a guide for more precisely predicting the location of the faults where no damage can be observed and only the escarpment is discernible.

The fault position has been delineated on the maps accompanying the report as a thin line on street crossings where the fault position has been located accurately, as a broad line between the streets where its location is interpolated and as a dashed line where the faults are projected utilizing the escarpment trend alone.

Independently, a house to house survey was conducted in the vicinity of the faults to determine the extent of damage and its proximity to the faults. Damage locations are depicted on base maps, containing the fault locations.

Fault Locations

The Baton Rouge and Scotlandville-Denham Springs faults are two active faults in the Baton Rouge fault system. This system of surface faults extends generally east-west for 100 miles through the southern portion of the Florida parishes from the Mississippi to the Pearl River and eastward.

The Baton Rouge and Scotlandville-Denham Springs faults cross East Baton Rouge Parish and extend westward into West Baton Rouge Parish but have not been mapped on the surface. However, both have been mapped on the surface eastward into Livingston Parish where they die out and are replaced eastward by similar, but possibly inactive, faults. Another surface fault, the Zachary fault, believed inactive, extends through the northern part of East Baton Rouge Parish. The existence of the Baker fault, midway between the Zachary and Scotlandville-Denham Springs faults, is speculative.

Within East Baton Rouge Parish, the Baton Rouge fault extends fourteen miles from the Mississippi to the Amite River. Over most of this distance it is readily traceable by its escarpment. However, its western extent traverses the mile wide Mississippi flood plain between the river and the valley wall bluff, 1/4 of a mile east of Nicholson Drive. Its only evidence is displacement or damage due to modern movement. From the valley wall bluff eastward one mile to the east side of University Lake, the uplands have been considerably altered by erosion due to proximity to the Mississippi River so that the fault escarpment is so modified that it does not serve as a confident guide to the position of the fault.

The Scotlandville-Denham Springs fault extends twelve miles between the two rivers. Originally, the fault was mapped at Denham Springs and later it was recognized separately in Scotlandville. However, the present mapping indicates that these are actually one continuous fault, hence the hyphenated name. At its western surface position the Mississippi River impinges directly against the uplands valley wall so that the fault escarpment terminates at the river bluff without traversing a Mississippi flood plain. Midway across the parish, however, the Comite River and its flood plain extend east-west along the fault for approximately two miles. In that stretch west of the Greenwell Springs Road bridge the uplands and tell-tale escarpment have been removed by valley erosion so that the fault is not traceable.

Detailed mapping has revealed relatively irregular or sinuous patterns of the faults on the surface, rather than the straight line pattern usually drawn on small-scale maps. Because of its large size, the abrupt northward convex course of the Baton Rouge fault in the Airline Highway vicinity has long been recognized. The highway crosses the fault at three places as a result. Although good evidence to support this finding can be seen on the frontage road east of Airline, only the southernmost crossing on Airline (just northwest of the Tiger Bend Road intersection) damages that highway.

On a minor scale many similar orientation changes have been mapped. While such patterns are well known in mapping of faults, both on the surface and in the subsurface, their existence on a small scale on such major faults was not anticipated.

Relationship of Faults to Topography

An upland terrace comprises most of the surface of East Baton Rouge Parish. Except where incised by stream valleys or offset by the fault escarpments, the surface is generally flat, preserving its original depositional character.

This surface, termed the Coastwise Prairie or Port Hickey terrace, is believed to represent a deltaic plain of the Mississippi deposited prior to the most recent ice age, the Wisconsin. The Sangamon interglacial stage during which it was deposited, terminated approximately 80,000 years ago.

Subsequently, during the Wisconsin glacial period which terminated about 5,000 years ago, fluctuating continental ice sheets resulted in oscillating lowered sea levels with entrenchment of the Mississippi River and other streams in the area into the older depositional surface.

Although, intra-glacial and post-glacial deposition has partially filled the entrenched valleys, the older depositional surface remains at a higher level to form the present terrace. It has undergone coastward tilting so that its present southward slope averages 2 feet per mile. In addition, escarpments have been produced by faulting.

The height of the escarpments is a measure of the amount of fault displacement since the deposition of the terrace surface 80,000 or more years ago. Measurements along the Baton Rouge fault range from 22 to 12 feet, with generally the lower amounts occurring east of Airline Highway. The Scotlandville-Denham Springs fault ranges from 7 to 3 feet, with the lower amounts again in the eastern portion of the parish.

Subsurface and surface fault positions indicate a near vertical orientation for the fault plane at the surface (actually a dip of $70^{o}$ from horizontal to the south). This was confirmed in an exposure of the fault plane observed south of Interstate 12 in a newly dug drainage ditch in the sixties, but now overgrown (4). Thus, if the escarpments were solely the product of faulting, they should rise nearly vertical with a width of a few feet rather than slope at a few degrees with a width of tens to hundreds of feet as they now have, depending on their heights.

Their present subdued slope is the result of continued erosion of the high side and deposition on the low side operative by slope wash and soil creep.

This process also reduces the escarpment height and thus affects the measurements cited above, particularly by deposition at the base of the escarpment. In spite of this process, the foot of the escarpment is low and poorly drained and in places occupied by a stream, such as Clay Cut Bayou along Tiger Bend Road on the south side of the Baton Rouge fault.

The exact position of the active fault above the base of the escarpment has been variously measured at 30 to 60% of the total height with the 25 to 40% predominating. Varying patterns of erosion and deposition on the escarpment may determine this result. This range provides an appropriate guide to predicting fault location where the escarpment is the only tangible evidence of the fault. The fault position within the slope may also be marked by localized steepening of the escarpment, presumably because erosion has not yet smoothed the effects of the most recent movement of the fault.

Amount and Rate of Movement

There are few precise measurements of the modern rate of fault movement. At the time in 1970 that damage was noted at Building H of the Glen Oaks High School campus, an offset of the floor slab of 4 inches was measured which would have occurred in the 10 years previously since that building had been constructed (10).

On the Baton Rouge fault damage to the Woodlawn High School buildings was investigated in 1975. Surveys indicated a displacement of "3 inches over 15 years," an average of 0.2 inches per year. Nearby benchmarks surveyed in July 1973 and July 1975 showed movement of 0.3 inches per year (12). Displacement along the Scotlandville-Denham Springs fault has been slightly more pronounced than along Baton Rouge fault at least at these two localities. However, the present observations have revealed many comparable instances of pavement displacements and other damage along both faults, that seem to indicate a displacement at the rate of a few inches per decade on each of them. Whether rate of movement along the faults has accelerated is not known.

Conversely, there are places on each fault where no damage has been observed. Whether this is due to temporary resistance of the overlying buildings or resistance of pavement to movement is not known.

On the Baton Rouge fault the damage and displacement obvious at the Nicholson Drive crossing is of particular interest because it signifies displacement in Mississippi flood plain material. Conversely, no damage was observed in the public housing structures 1/4 mile east on the terrace although damage and displacement is noted further east at Highland Road also on the terrace.

On both faults damage and displacement evidence can be seen in the eastern part of the parish beyond the area of intense building and urban development.

As previously cited, the progressive movement during the geologic past has displaced the terrace surface by as much as 22 feet on the Baton Rouge fault and 7 feet on the Scotlandville-Denham Springs fault based on escarpment heights in each case. The terrace thus displaced is believed to have been deposited 80,000 or more years ago. Hence, a displacement of 22 feet on the Baton Rouge fault indicates an average rate of displacement of one inch per $400^{\pm}$ years, and a displacement of 7 feet on the Scotlandville-Denham Springs fault of one inch per $1000^{\pm}$ years.

Subsurface formations of older age aquifers are displaced by greater amounts. For example, the 400 foot and 600 foot aquifers are displaced approximately 200 to 250 feet by the Baton Rouge fault. Inasmuch as these formations are generally regarded as having been deposited 1,000,000 years ago prior to the onset of Pleistocene glaciation, an average displacement rate of one inch per $400^{\pm}$ years appears to have occurred through a long interval of time.

These rates are much smaller than those observed today. One cause of increased modern rates may be due to artificial improvement of surface drainage thus causing soil compaction particularly in the low-lying areas south of the fault escarpments.

An additional factor may be ground water withdrawal which is definitely causing subsidence in the Baton Rouge area. Subsidence due to ground water withdrawal as well as subsidence due to downward movement on the south side of the faults has been documented by Smith and Kazmann (15). Maximum rates of 9 mm/yr (0.35 inches/year) have been measured.

These authors showed that land subsidence associated with ground water use effects an area extending several miles outward from the maximum occurring in the industrial center of Baton Rouge. The maximum amount of subsidence measured between 1935 and 1976 - representing both the earliest and the most recent precise surveys of benchmark networks in the Baton Rouge area - was 1.67 feet, of which 0.41 feet was assumed to be due to the natural regional subsidence.

Smith and Kazmann (15) also noted that precise leveling surveys revealing anomalously high rates of subsidence occurred immediately south of the Scotlandville and the Baton Rouge faults. Survey lines used in their report crossed the faults only at two locations, and benchmarks were not adequately located to measure the maximum displacement across the faults. However, the data indicates that the surface south of the Baton Rouge fault along River Road had dropped at least 0.017 feet per year during the period 1964 to 1976. This rate is about half the maximum rate of subsidence attributed to ground water pumpage and would amount to about 2 inches of movement in 10 years.

Since subsidence due to ground water is mainly occurring north of the Baton

Rouge fault, it might be expected to counter the effect of fault movement. Conversely, since it is mainly occurring south of the Scotlandville-Denham Springs fault, it might be expected to reinforce the movement of that fault, particularly if aquifers are blocked by offset at the fault.

A subsequent section recommends establishment of a network of benchmarks in order to provide data to help solve these problems.

# DAMAGE ASSESSMENT

## Overview

The types of damage noted in this study may be attributable to one or more of the following causes (not necessarily in order): Subsidence due to ground water withdrawal; faulting; soil types; large trees and shrubs; poor construction; accidents; combination of above.

Damage assessment was accomplished by investigations of the buildings, streets, sidewalks, and other structures within an area of approximately 1,000 feet on either side of the suspected fault trace. Additionally, some areas where structural damage is known to have occurred were investigated even though these areas were located at some distance from the main fault trace.

## Methodology

The objective of the damage assessment portion of the study was to seek evidence on how wide a zone adjacent to the fault is susceptable to damage. The Louisiana Geological Survey used a four step approach to accomplish the assessment objectives of the study.

The first step in the study was the preparation of an operational plan. A literature search was conducted, prior studies were identified, copies were obtained, and a review of pertinent information was performed. Also at this time, the generalized study area was determined. The topographic high side of the fault was delineated as the top of the escarpment and the topographic low side of the fault delineated as the bottom of the escarpment. The area between the top and bottom escarpments became the generalized study area.

The second step in the study was an unconfined data collection phase. Investigators drove through the generalized study area checking homesites for damage which was visible from the road. When possible, the investigators took photographs of noticeably damaged structures. The photographs were reviewed and compared in order to ascertain the presence of reoccurring damage patterns. The location of visually damaged homesites were plotted on maps and were reviewed for "trends" of damage or areas of concentrated damage. The information derived from the "second step" of the project, particularly the nature and density of encountered damage, allowed the Louisiana Geological Survey to identify a concentrated study area.

The third step, the collection of detailed data, was performed within the concentrated study area. Investigators conducted door to door interviews. The interview questions sought information concerning the age and type of structure, the length of current occupation, what (if any) damage the resident has noticed and when damage was first noticed. Detailed photographs were taken of all identified damage. At homes where an interview could not be obtained, the investigators were instructed to secure as much photographic evidence as possible without intrusion onto the property. The locations of damaged structures were plotted on subdivision maps.

Step four, the analysis phase of the project, provided an assessment approach which:

A) Identified structural damage as a diacritical feature.

B) Related damage features to known or potential causes.

C) Evaluated the likelihood of damage being fault related.

Soil Types

A review of the East Baton Rouge Parish soil survey shows thirteen soil types appearing in the Baton Rouge fault zone. The two soil characteristics which most affect building stability are bearing capacity and shrink-swell values. Each of these characteristics can influence building integrity and damage susceptibility. Two soil types were found to have poor to fair bearing capacity, they were the

Calhoun Silt Loam and the Frost Silt Loam. The balance of the soils in the fault zone rated fair (6 types) or good (5 types). The Jeanerette silt loam has the most undesirable range for shrink-swell characteristics being rated at moderate to low. The shrink-swell rates for all other types are listed as low.

Damage Observations

Visible evidence of the faults consists of a crack or cracks in pavement strips, curbs and sidewalks that traverse the faults. The cracks are oriented generally with the trend of the fault. Parallel cracks may occupy a zone up to 10 or more feet wide. In many instances, the downward offset to the south can also be observed. From a distance, the offset can be observed by the effect on vehicles as they cross the fault or felt if within the vehicle. This is true even in many places where the pavement has been newly patched or topped to correct the bump caused by fault displacement.

On buildings, cracks in the slab and cracks in brick walls occur. In the latter the cracks slope northward usually at about $45^{o}$ to horizontal because of the horizontal tension produced as the south portion of the building settles, with the fault, thus pulling away from the north side. Warping of the roofline and the originally horizontal bricklines can also be observed. Porches and carports may also sag at different angles. These are diagnostic characteristics that can usually be observed from the street.

Visual structural damage is evidenced in the following series of selected photographs. Masonry structures built on slab tend to be more readily identified as damaged than do wooden structures. Because wood has the capacity to flex, displacement forces are more easily distributed throughout structure and therefore damage is often imperceptable. That is not to say that wooden structures are not affected by fault movement. The damage is manifested in more subtle forms:

windows and doors may stick, flooring may buckle, side walls may shift from plumb. However, the scope of this study did not permit a complete inventory of all structural alternations and the observable damages were most visible in brick homes.

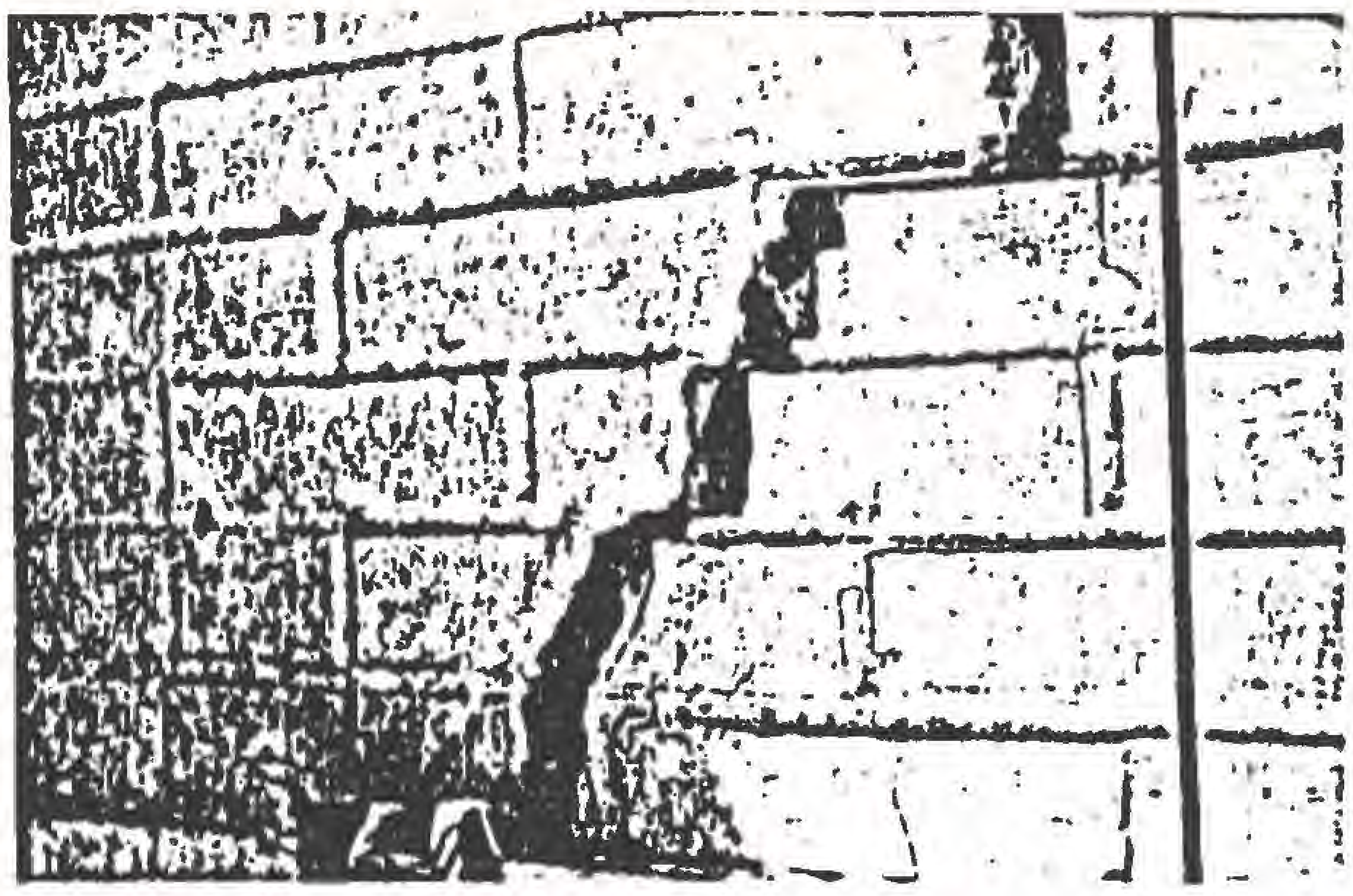
Forms of Damage

Wall failure was one of the three general forms of damage observed during field investigation. Figures 1 and 2 show "Block Shear." This type of damage indicates structural stress of sufficient magnitude to split the parent brick. Figures 3 and 4 exhibit joining plane separation where the structural strain pulls the brick apart at the mortar joints. In many instances both "block shear" and "Joining plane separation" was associated with weak architectural features such as windows or doors. Most wall cracks are formed in a diagonal stair step pattern. It may be possible to analyze the crack patterns and determine the direction and amount of force required to form the pattern. However, no attempt was made to do so during this study.

The second general form of damage was "appurtenant separation." This term is used to describe the damage which occurs when "Add-on" structures such as carports, added rooms, porches, steps, etc., break away from the main building. The causes for appurtenant separation are highly dependent on construction methods and techniques. Poorly designed and constructed attachments will show separation with a minimum application of stress forces. Figures 5 and 6 provide examples of appurtenant separation.

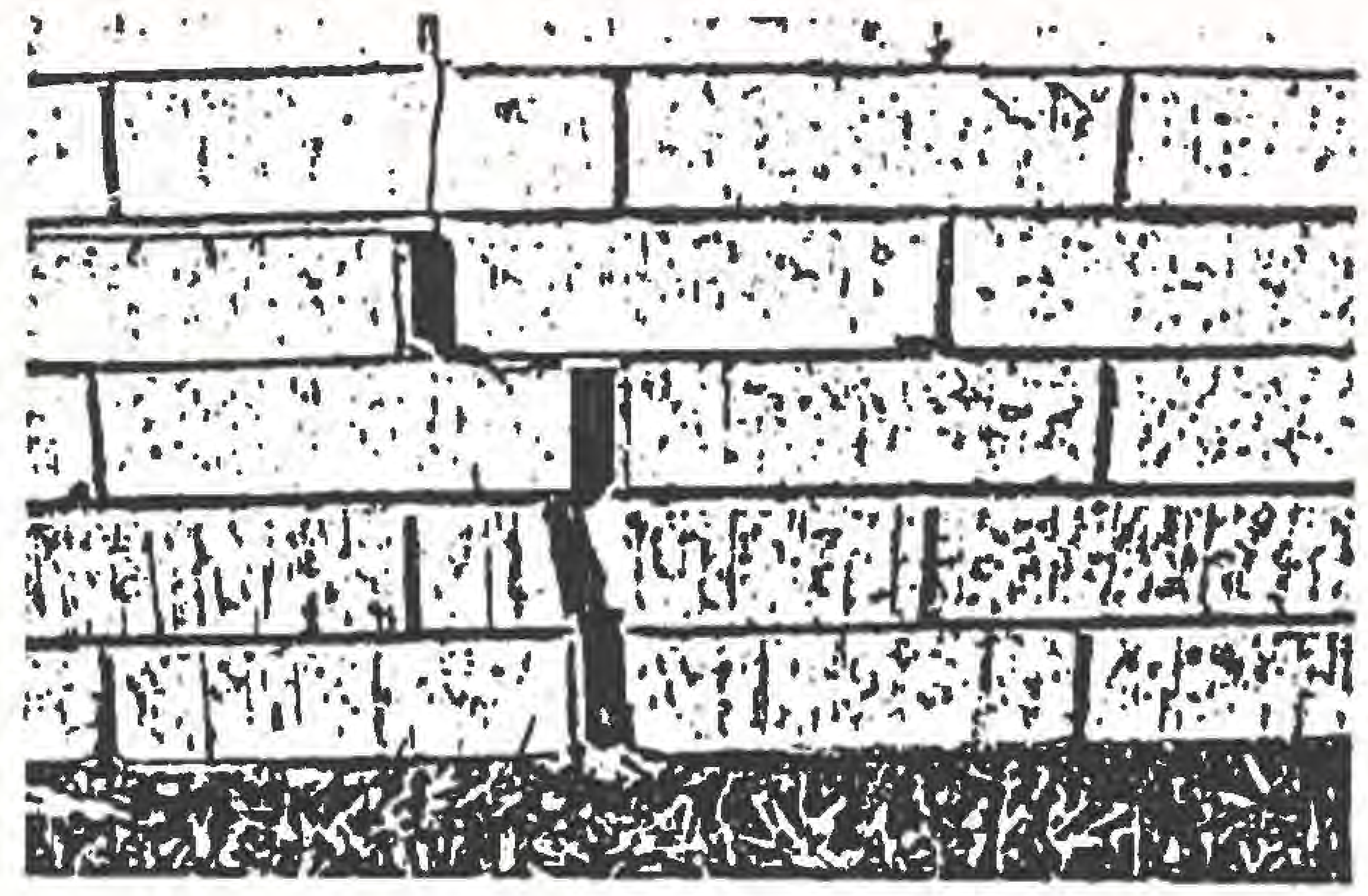
The third form of identified damage was "pavement cracks." This form includes driveways, carports, patios, and surface streets. Pavement cracks are a useful feature in terms of fault location. By following a line of pavement cracks leading to a damaged structure a clear connection between damage and fault movement can be made. Figures 7 to 10 illustrate several types of pavement cracks.

Figure 1



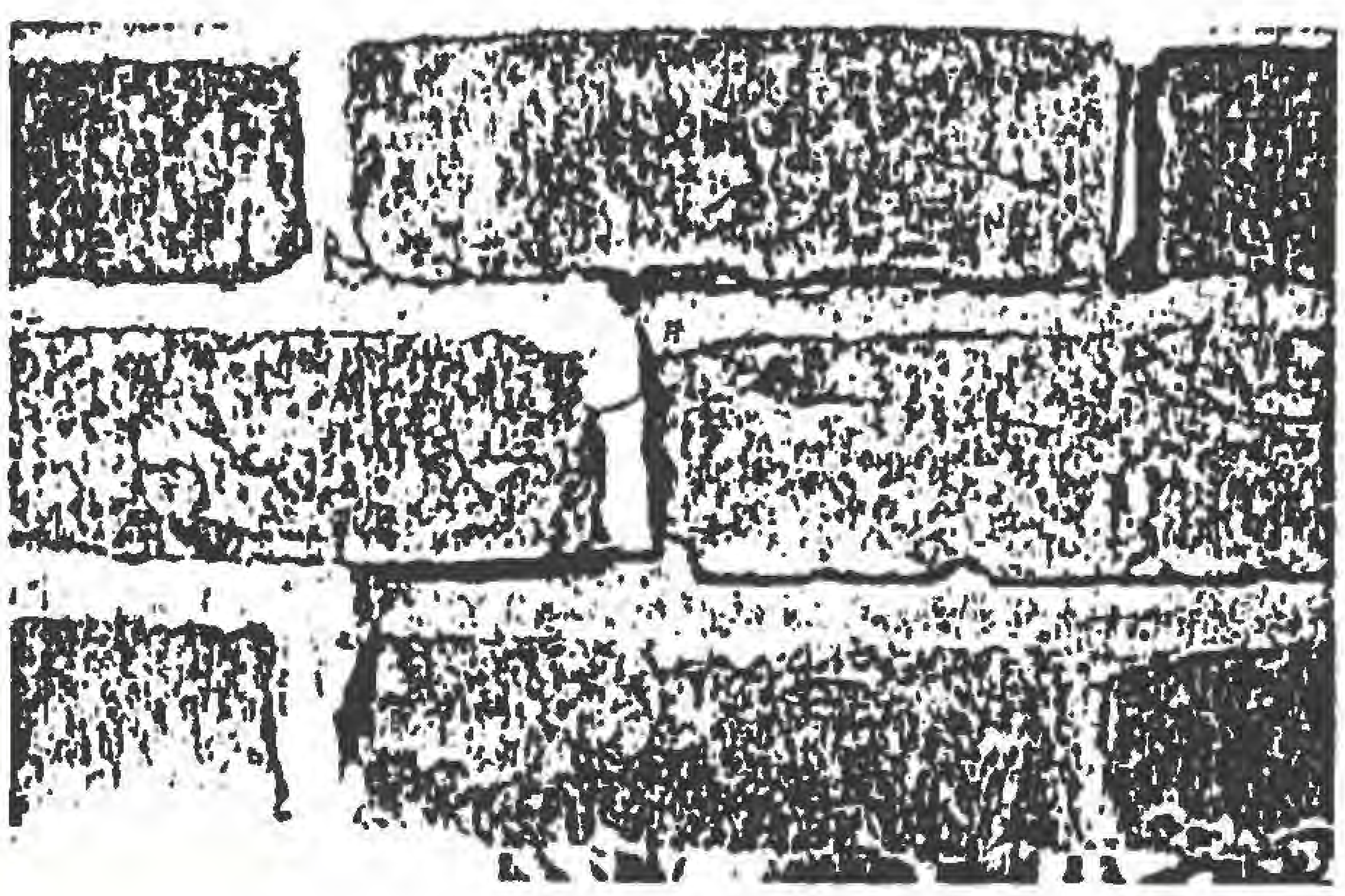
BLOCK SHEAR-2236 Cottonwood
This damage appears to be caused by tree growth.

Figure 2



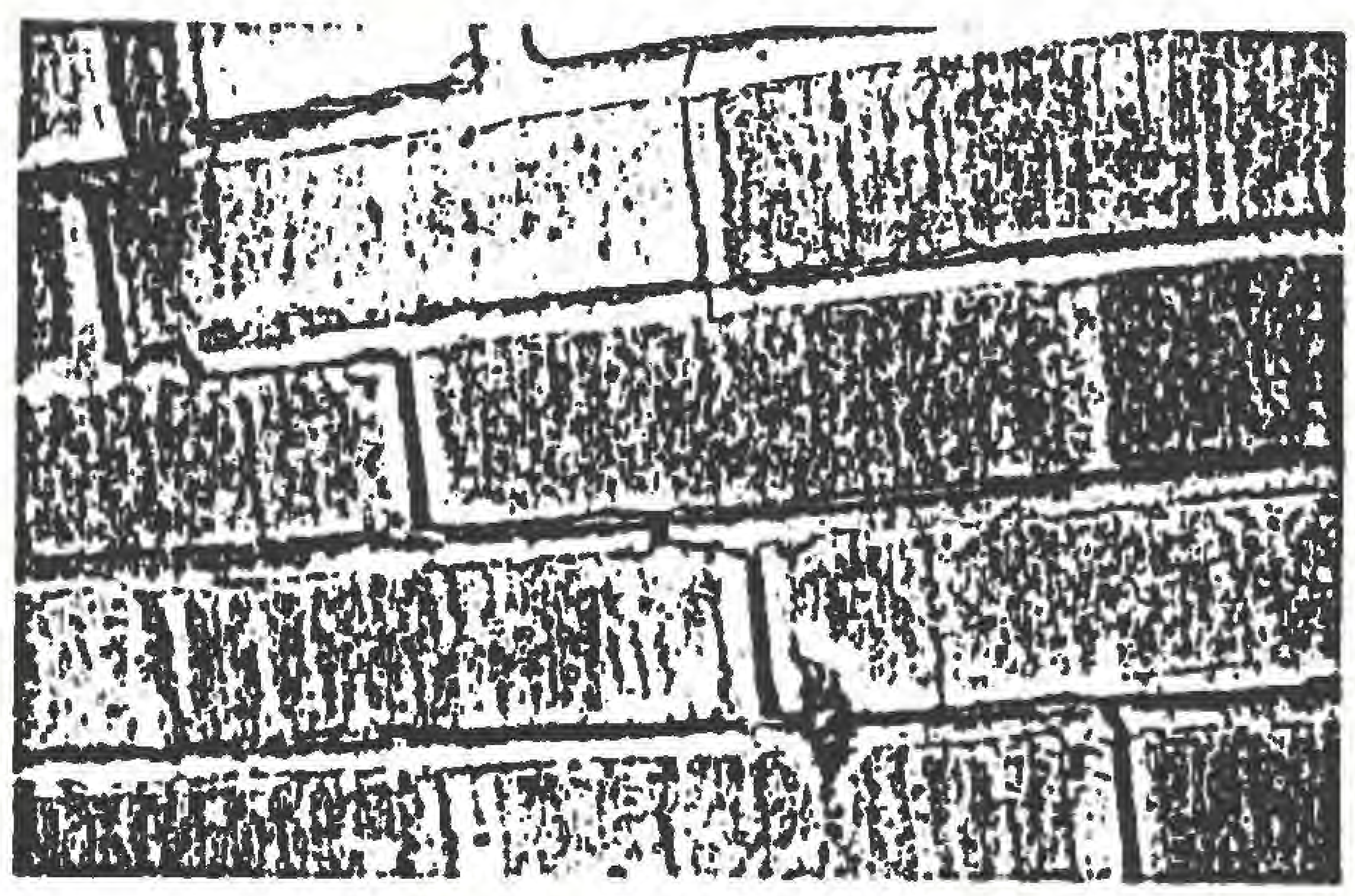
BLOCK SHEAR - 8727 Jefferson Hwy
(not fault associated)

Figure 3



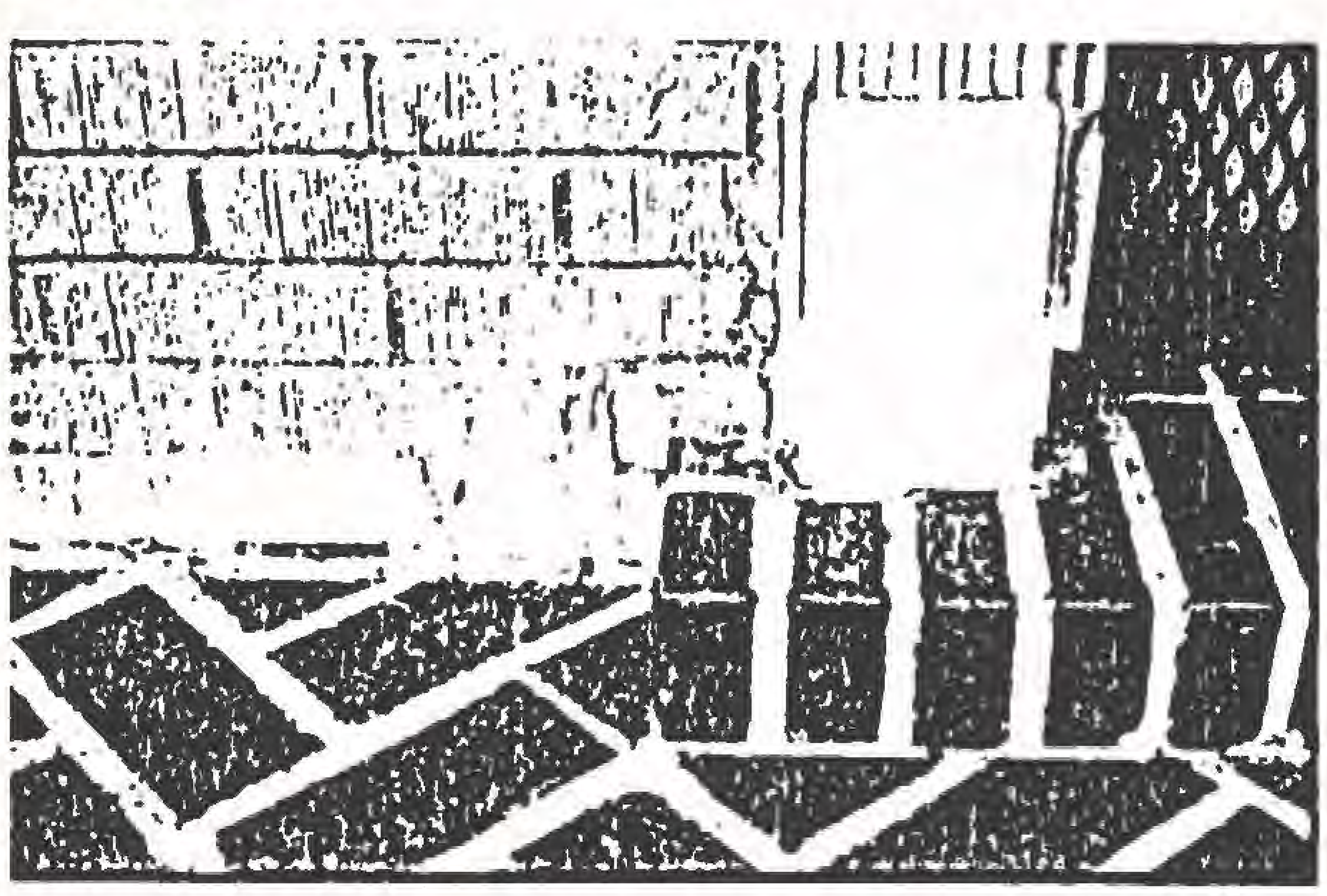
JOINING PLANE SEPARATION-2051
E. Ramsey (not fault associated)

Figure 4



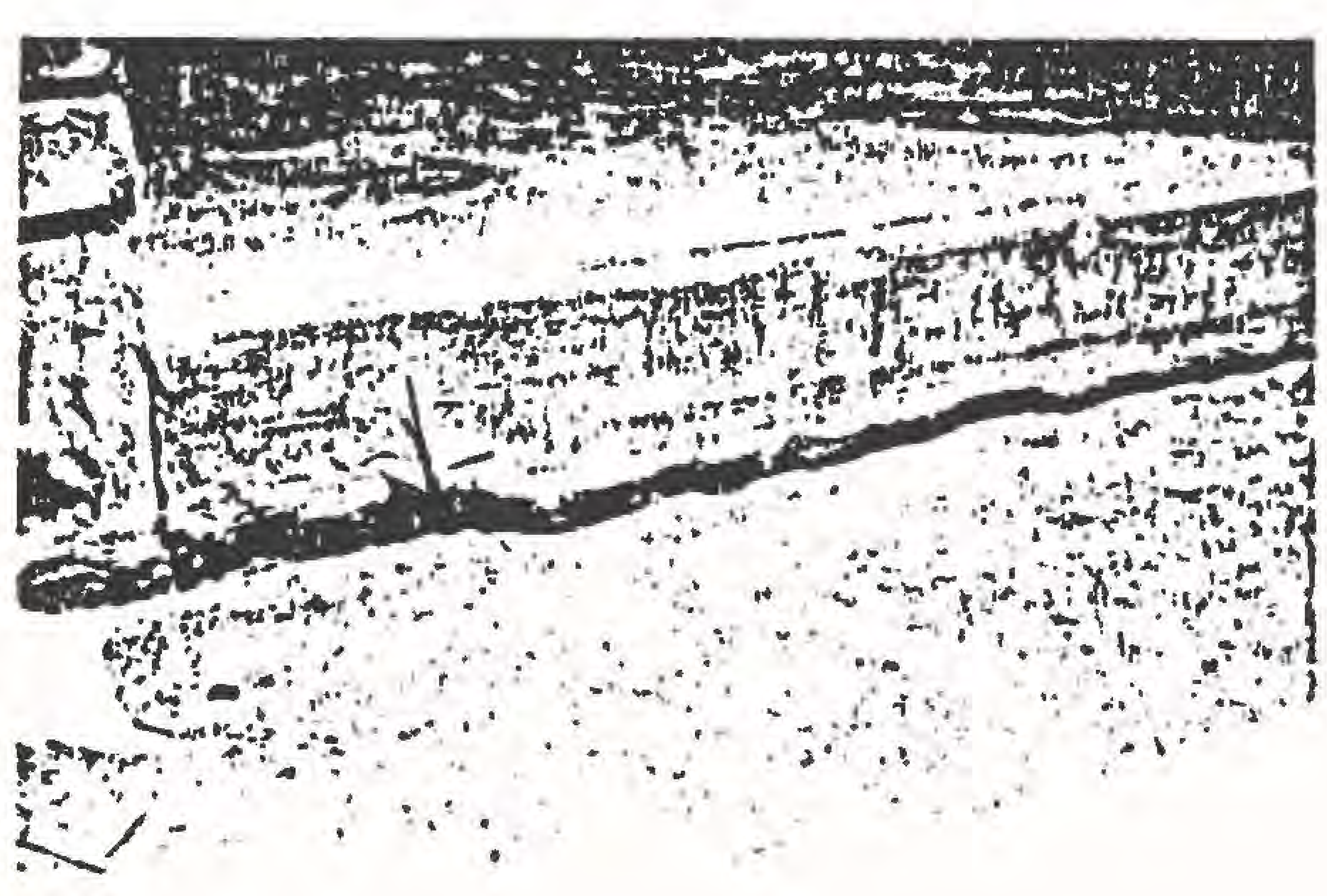
JOINING PLANE SEPARATION - 2460
Dogwood (Fault associated)

Figure 5



APPURTENANT SEPARATION - 2015
Lake hills (not fault associated)

Figure 6

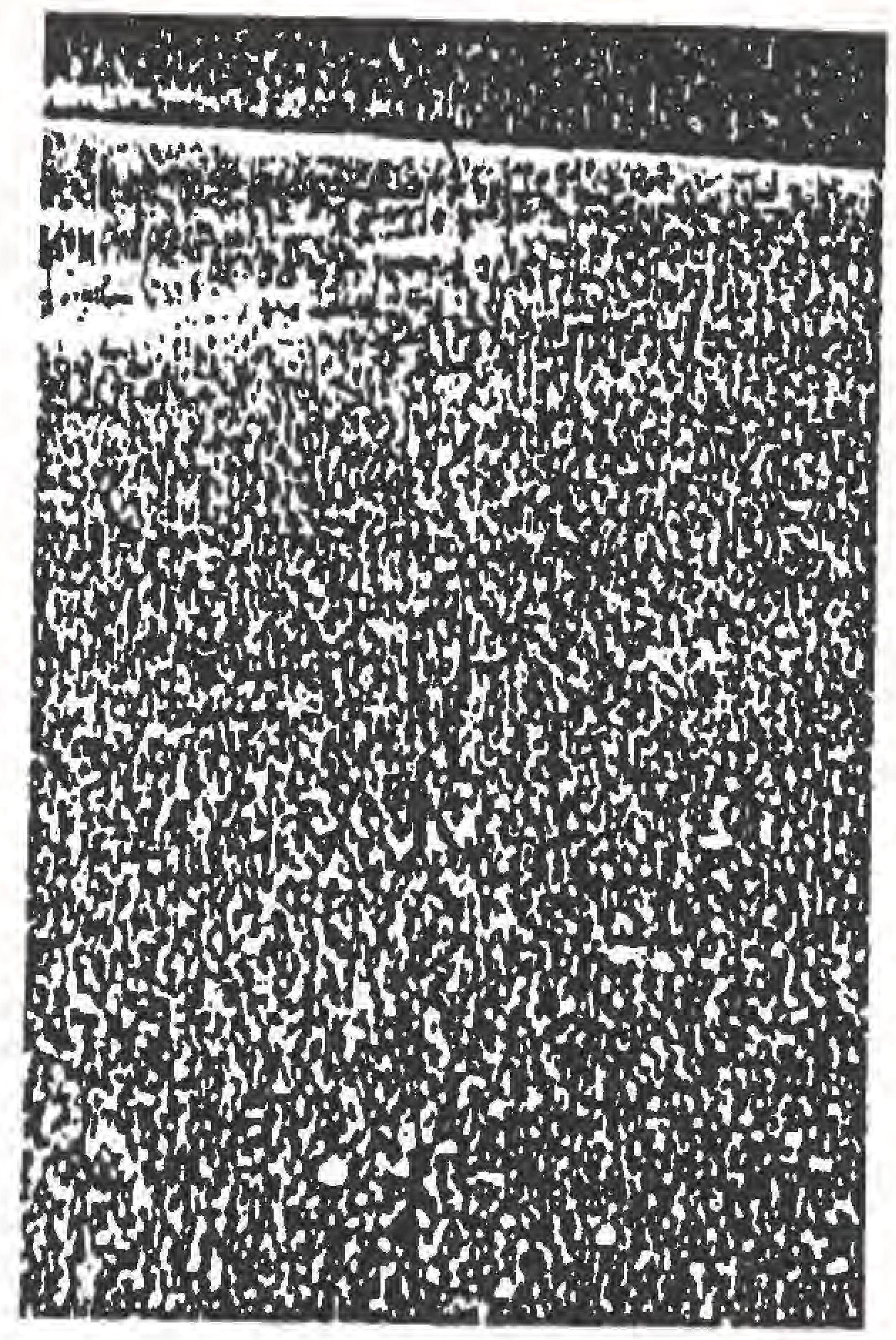


APPURTENANT SEPARATION - 3134
Fritchie (fault associated)

Figure 7

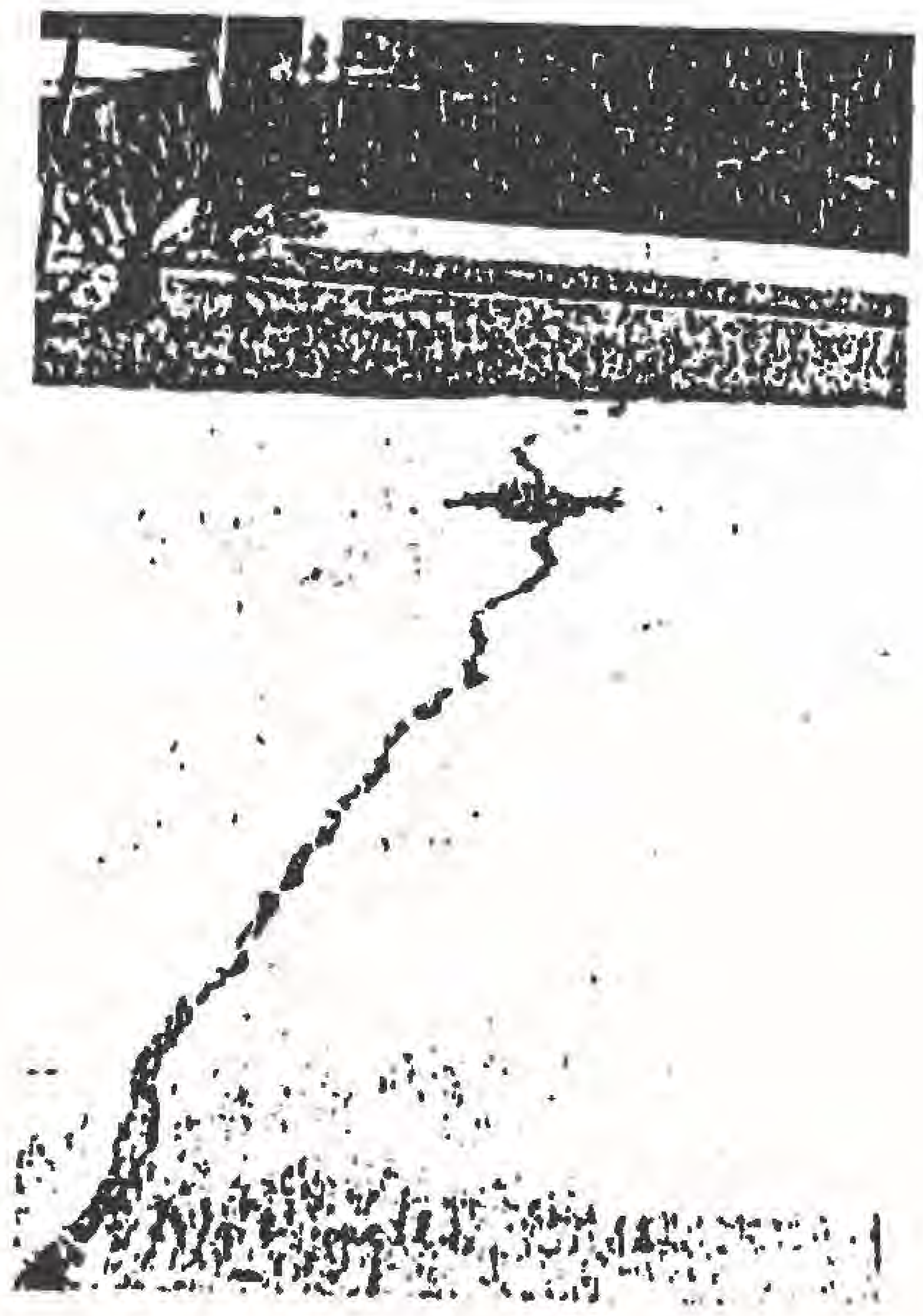
PAVEMENT CRACKS - 5115 Crown (fault associated)

Figure 8



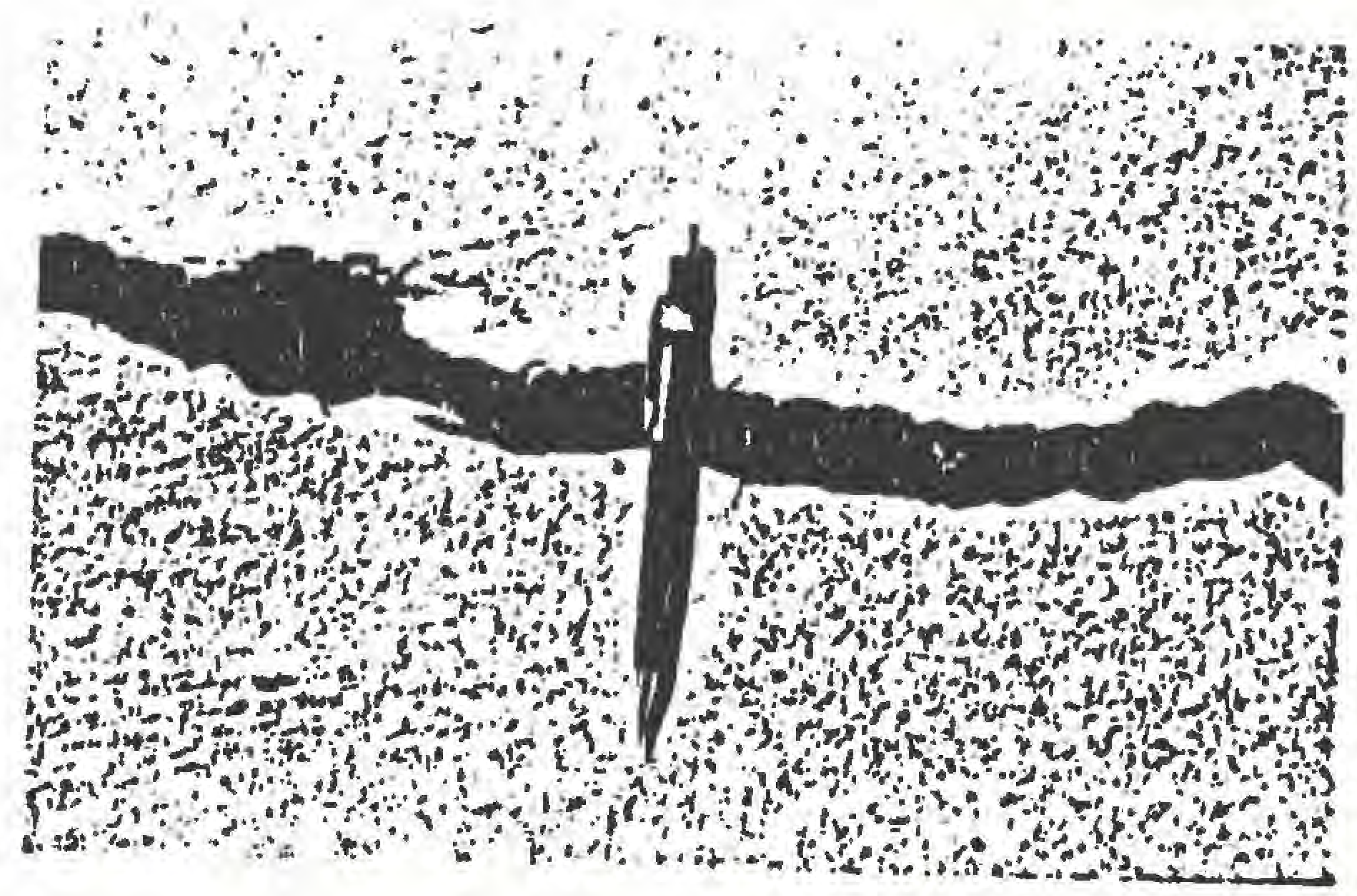
PAVEMENT CRACKS - Beachwood St. (Fault associated)

Figure 9



PAVEMENT CRACKS - 6187 LACEY ((fault associated)

Figure 10



PAVEMENT CRACKS - 6187 Lacey - Close up - (Fault associated)

## BATON ROUGE FAULT

### Damage Assessment

One hundred thirty nine buildings and/or houses are delineated on the accompanying maps as having structural damage ranging from slight to severe. It is believed that only those structures located in the very near proximity of the fault line as shown on the maps have probable fault related damage.

However, because the field investigators found damage in structures at distances greater than anticipated and because the damage was physically indistinguishable from the damage found directly on the fault, these locations are included on the maps. Most of the damage locations shown in the Lake Crest, Lake Hills, Hillsdale and Walnut Hills Subdivisions fall into this low probability category.

Unlike the Scotlandville-Denham Springs Fault where damage follows a clear linear pattern of pavement damage, the Baton Rouge Fault is less continuous and linked damage from house to house or driveway to driveway is less apparent.

Field investigations, starting at the Mississippi River and proceeding east found three commercial buildings with damage located near Nicholson Drive between Oklahoma Street and Garner Street.

Proceeding eastward, the fault meanders through an area where due to the generally poor state of the housing stock it was impossible to separate fault damage from plain disrepair and neglect. Continuing onto the Lake Crest Subdivision three houses on March Street appear to be candidates (by proximity) for fault related damage.

Crossing City Park Lake, ten damaged houses in the Hillside Subdivision are located close enough to this fault to be considered fault probable. Traveling eastward across Perkins Road, into the Hundred Oaks Park Subdivision, three houses on Tyrone Street are located in the probability zone.

The fault continues into the Walnut Hills Subdivision where eight damage sites occur near the fault. Moving into Hillside, Wells Place, and College Drive Heights, seven damage locations are found within the near area of the fault.

Continuing eastward from College Drive, damage, other than pavement cracks, is not observable until Jefferson Place Subdivision where fifteen damaged sites are situated in close proximity to the fault. Five damaged sites are considered probable in the Westminster Area. One damaged structure along North Bluebonnet Road is probably exhibiting fault caused damage. The damage to Woodlawn High School has been thoroughly identified and documented in earlier studies.

The eastward limit of observed damage occurs along Tiger Bend Road where three houses have apparent fault damage.

College Park

An extensive area, mainly south of the Baton Rouge fault in southwestern Baton Rouge, was formerly a swamp (4). Much of the area has been dammed to raise the water level and create University Lake. However, a portion of this lowland extends westward, in a broad valley, on the north side of the L. S. U. campus and merges westward into the Mississippi floodplain in the Nicholson Drive area. Much of this area formerly and into historic times was a cypress swamp. Some of those portions, now urbanized, overlie buried stumps and logs that are capable of causing differential localized surface subsidence, particularly as the water table has been lowered due to artificial drainage. An additional factor is the fluctuating water table influenced by the stage changes of the adjacent Mississippi River.

The area of most concentrated structural damage is the College Park subdivision and the surrounding area (13). Some of the damage noticed appears to be similar to that observed on the Baton Rouge fault trace, east of University Lakes. This relationship raised the question of whether the College Park damage was related to the Baton Rouge fault, which had not been precisely mapped in this area. However, in the College Park area, there is an absence of many diagnostic characteristics that were observed in the fault-affected areas. Road damage is minor, consisting only of scattered patches along the side of the road. No continuous cracks (displacements) have been noticed along the streets or walkways. Cracks in driveways are very irregular and no definite alignment of the cracks can be seen. Many front lawns have a hummocky appearance, suggesting an unstable soil. Houses along the fault zone do not exhibit interior damage resembling the type reported in College Park. Of the homes observed along the fault, interior damage (cracks) is restricted to floors, and walls have a tendency to separate in corners rather than cracking vertically or horizontally. The non-uniform pattern of damage leads to the conclusion that the damage in the College Park area is not fault related.

Damage cited in the College Park area (15) appears to be related to ground water table fluctuations and local soil characteristics but additional data is required for corroboration. At any rate, the Baton Rouge fault, as a result of mapping in this study, has been confirmed to be located approximately 3/4 mile to the north of the area cited, and hence is not a factor in the structural damage noted in the College Park area.

## SCOTLANDVILLE-DENHAM SPRINGS FAULT

### Damage Assessment

Thirty-eight sites are identified as being probably damaged by the movement of the Scotlandville-Denham Springs fault. Most of the damage was of the pavement type with some appurtenant separation and a few incidents of joining plane separation. Of the houses that were damaged, the effects were more severe than those found along the Baton Rouge fault. There was greater displacement, greater separation and a clearer relationship to fault proximity.

The observations for fault related damage along the Scotlandville-Denham Springs fault were initiated at the intersection of Plank Road and Crown Avenue. From this point the investigators followed the trace traveling from West to East. The fault appears to run through several houses on the South side of Crown Avenue west of Beechwood Drive. After crossing Beechwood Drive, damage is noticeable again in the driveways on the south side of Crown Avenue to about midway in the block where it crosses the street and is apparent again in the driveways on the north side of the street. The damage is mainly confined to driveways and a few carports until the fault reaches Winchester Avenue where the residence at 7025 Winchester is visibly damaged.

No damage to the property or buildings was found at the Glen Oaks Elementary or Junior High Schools.

The damage found along Sumrall Drive was generally confined to driveways. Two owners appeared to have sustained damage on Myrtlewood Drive. The fault continues through Glen Oaks High School causing so much damage to Building H that it has been abandoned. The fault follows a path through the driveway of the house located at 6647 Oakside Drive.

The next casualities of the fault are found in a cluster of three houses on Glen Oaks Drive between Pontotoc and Dalark Drive; again the damage is mostly to driveways.

The final cluster of fault disturbances is located where Bluefield Drive, Winterset Drive and Mapleton Drive intertwine. The fault trace is very distinct in this area and movement appears to be still taking place. Although most of the houses in this group look to be offset from the trace. The types of damage observed seem to be related to fault activity.

There are areas along the fault trace which are now being developed as residences. Great care should be taken in the placing of structures along the trace. Although the fault is not visible, particular attention should be given to Hanier Drive south of Mickens Road. The road here has many cracks and with close inspection an area of probable damage might be delineated.

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## RECOMMENDATIONS

In an effort to learn more about the rate of movement of the faults, to determine whether or not movement varies with location and time, and to help define more precisely the location of the fault trace on the surface in areas where it is poorly defined (Mickens Road area) the following recommendations are made:

1. Establish a closely-spaced line of benchmark monuments at the ten locations indicated on the accompanying maps. These locations were selected to take advantage of existing benchmarks. Place new benchmarks on either side of the fault trace, as close to the actual surface trace as possible. Continue placing monuments north and south of the fault, achieving a density of as much as one benchmark every 20 feet within 100 feet of the fault trace. Beyond 100 feet, place monuments at 300 feet intervals. The line of survey monuments should run at least 1000 feet north of the fault and 5000 feet south of the fault.
2. Select three traverses on each fault and survey (relevel) every three months initially. Relevel the remaining monument lines annually. After one year, analyze data and determine whether changes in survey frequency or location are needed.
3. Evaluate survey results to determine rates of fault movement, extent of surface displacement north and south of fault trace, areas of maximum and minimum movement. Ultimately, results of this study should provide basis for evaluating risks involved with construction on and near the fault trace.
4. Select appropriate buildings and other structures (e.g. bridges, roadways) located on faults and at selected distances from faults for detailed monitoring to observe and measure effects of fault adjustments with time. Consider

effects of differences in materials and type of construction (e.g. concrete vs. asphalt road surfaces).

In addition numerous city-parish streets, roads, subdivisions, and structures recommended for study are:

Baton Rouge Fault:

1. Mississippi River Levee
2. I-10 east of University Lake bridge
3. Perkins Road overpass
4. I-10 between Essen Overpass and Drusilla Drive
5. Airline Highway at Nesser Overpass area and at Tiger Bend Road intersection
6. Woodlawn School

Scotlandville-Denham Springs Fault:

1. Scenic Highway at Mongel Road
2. I-12, going north toward Ryan Airport at 42nd Ave.
3. Glen Oaks Schools
4. Mickens Road
5. Greenwell Springs Road, between Comite River and Frenchtown Road.

In addition, a reconnaissance survey of the Zachary fault is recommended in order to corroborate the assumption that it is inactive.

This report has been concerned primarily with the effects of surface faulting in East Baton Rouge Parish. Ultimately, a full report on the total aspects of the Baton Rouge fault system is desirable. Ideally, such a report should be published as a bulletin of the Louisiana Geological Survey.

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