UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

REPORT ON RECOMMENDED LIST OF STRUCTURES FOR SEISMIC INSTRUMENTATION IN THE NEW MADRID REGION

The U.S. Geological Survey Strong-Motion Instrumentation of Structures
Advisory Committee for the New Madrid Region

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	Affiliation
M. Cassaro	University of Louisville, Louisville, KY
M. Celebi (Coordinator)	USGS, Menlo Park, CA
W. Durbin (Chairman)	Woodward–Clyde Consultants, St. Louis, MO
P. Gould	Washington University, St. Louis, MO
W. Graham	John Mathes & Associates, Columbia, IL
A. Johnston	TEIC, Memphis State University, Memphis, TENN
H. Karabinis	Monsanto Agricultural Co., St. Louis, MO
A. Lin	Kansas State University, Manhattan, KS
R. Maley	USGS, Menlo Park, CA
O. Nuttli	Saint Louis University, St. Louis, MO
G. Schwalbe	Russell & Axon, St. Louis, MO
J. Theiss	Theiss Engineers, St. Louis, MO
M. Walsh	City of St. Louis, MO
T. Winstead	Allen & Hoshall, Memphis, TENN

OUTLINE

I. INTRODUCTION

The New Madrid area—the location of the 1811–1812 New Madrid earthquakes—is a potentially seismically active region requiring earthquake hazard mitigation programs including those related to the investigation of strong shaking of structures. As part of its earthquake hazard reduction planning, the United States Geological Survey (USGS) identified the New Madrid area as one of the regions for the implementation of a structural instrumentation program to further these studies. Selection of structures for strong-motion instrumentation is accomplished by establishing advisory committees in the various seismic regions, including the New Madrid area.

This report outlines the efforts of the committee formed in St. Louis, Missouri, covering the New Madrid area.

II. THE STATUS OF STRUCTURAL INSTRUMENTATION PROGRAMS OF THE USGS

The main objective of any instrumentation program for structural systems is to improve the understanding of the behavior, and potential for damage, of structures under seismic loading. The acquisition of structural response data during earthquakes is essential to confirm and develop methodologies used for analysis and design of earthquake-resistant structural systems. This objective can best be realized by selectively instrumenting structural systems to acquire strong ground motion data, and the response of structural systems (buildings, components, lifeline structures, etc.) to the strong ground motion. As a long-term result one may expect design and construction practices to be modified to minimize future earthquake damage [1].

Various codes in effect in the United States, whether nationwide or local, recommend different quantities and schemes of instrumentation. The Uniform Building Code (UBC) [2] recommends for Seismic Zones 3 and 4 a minimum of three accelerographs be placed in every building over six stories in height with an aggregate floor area of 60,000 feet or more and in every building over 10 stories in height regardless of floor area. Experience from past earthquakes shows that the instrumentation guidelines given by the UBC code, for example, although providing sufficient data for the limited analyses projected at the time, do not provide sufficient data to perform the model verifications and structural analyses now demanded by the profession.

On the other hand, valuable lessons have been derived from the study of the data obtained from a well-instrumented structure, the Imperial County Services Building, during the moderate-sized Imperial Valley earthquake ($M_s = 6.5$) of October 15, 1979 [3].

To reiterate, it is expected that a well-instrumented structure for which a complete set of recordings has been obtained would provide useful information to:

- check the appropriateness of the design dynamic model (both lumped mass and finite element) in the elastic range;
- determine the importance of non-linear behavior on the overall and local response of the structure;
- follow the spreading of the non-linear behavior throughout the structure as the response increases and the effect of the non-linear behavior on frequency and damping;
- correlate the damage with anelastic behavior;
- determine ground motion parameters that correlate well with building response damage; and
- make recommendations to improve seismic codes.

To enhance the effort in instrumentation of structures, the USGS recently established an advisory committee program. The advisory committees are regional committees comprised of professionals from universities, state, federal, and local government agencies, and private companies. The advisory committees are formed in regions of seismic activity and are requested to develop recommended lists of structures for possible instrumentation. The first of these committees was formed in the San Francisco Bay Region [1]. The second committee was formed in San Bernardino County [4]. A newly formed Earthquake Engineering Committee of the St. Louis Section of the American Society of Civil Engineers was asked to double as the advisory committee for the New Madrid region. Other interested

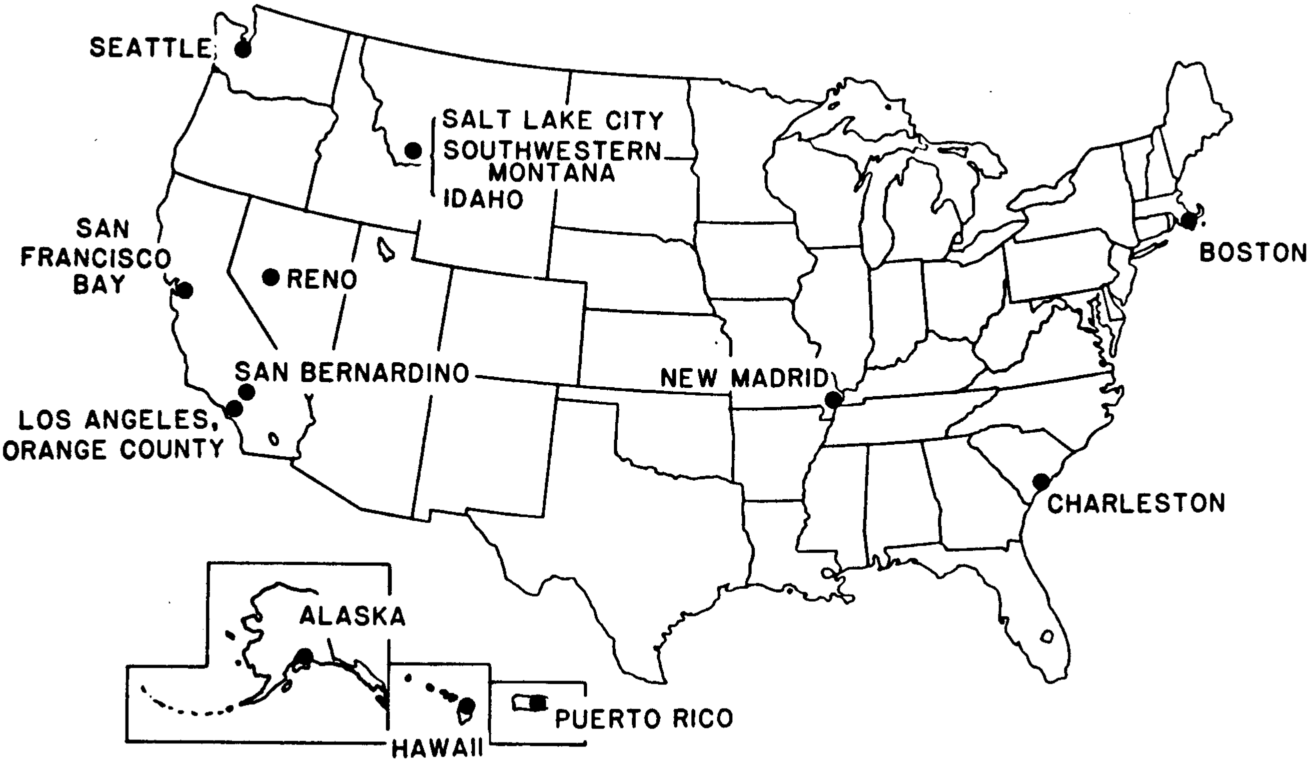
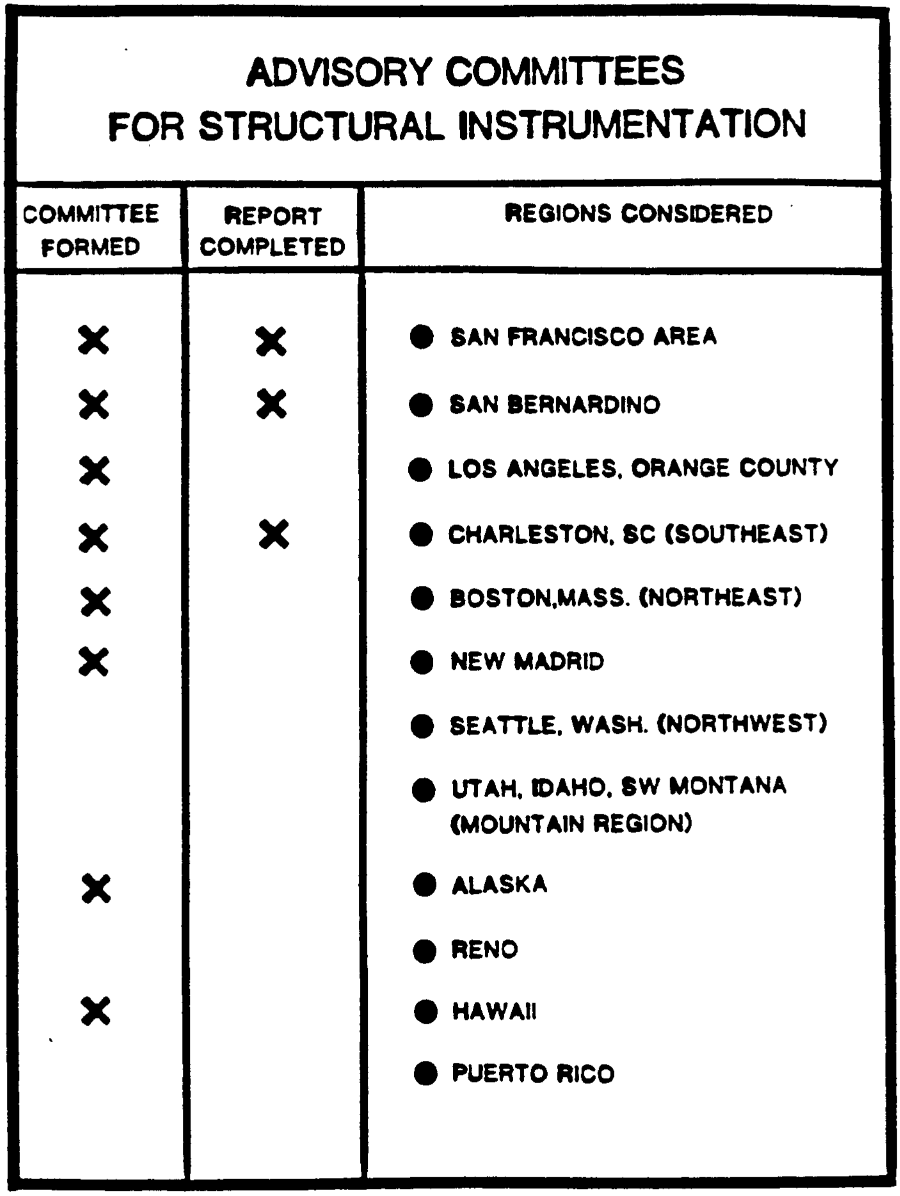


Figure 1. Target regions for USGS—Strong-Motion Instrumentation of Structures Program.



ADVISORY COMMITTEES
FOR STRUCTURAL INSTRUMENTATION

COMMITTEE FORMED	REPORT COMPLETED	REGIONS CONSIDERED
✕	✕	● SAN FRANCISCO AREA
✕	✕	● SAN BERNARDINO
✕		● LOS ANGELES, ORANGE COUNTY
✕	✕	● CHARLESTON, SC (SOUTHEAST)
✕		● BOSTON,MASS. (NORTHEAST)
✕		● NEW MADRID
		● SEATTLE, WASH. (NORTHWEST)
		● UTAH, IDAHO, SW MONTANA (MOUNTAIN REGION)
✕		● ALASKA
		● RENO
✕		● HAWAII
		● PUERTO RICO

Figure 2. Status of USGS Advisory Committees for Strong-Motion Instrumentation of Structures.

professionals were added to the committee for their particular expertise and to have broader geographical representation.

A general description of the targeted regions for structural instrumentation is shown in the map in Figure 1. In a number of regions, committees have been formed and some reports were issued as summarized in Figure 2.

III. SEISMICITY OF THE REGION

The studies related to the seismicity of the New Madrid region have always referred to the 1811 and 1812 New Madrid earthquakes as the largest earthquakes known to have occurred in the Mississippi Valley. A general historical seismicity map of the New Madrid seismic zone and surrounding areas is provided in Figure 3, as adopted from Hopper [5].

The Mississippi Valley seismicity is summarized by Nuttli in APPENDIX A. The probability of large earthquakes in the Mississippi Valley has been summarized by Algermissen [6] and is provided in this report as APPENDIX B. Figure 4 provides a probabilistic contour map of the Mississippi Valley (based on 10% probability of exceedence in 100 years). As deduced from this figure, substantial peak accelerations can be expected in the Mississippi Valley. Recently, additional recurrence rates and probability estimates of large earthquakes of the area have been developed by Johnston and Nava [7].

IV. STRUCTURES CONSIDERED FOR INSTRUMENTATION

The New Madrid seismic region contains several states and urban centers with a significant number of important structures constructed on a variety of subsurface conditions. Therefore, in order to reach a workable list of structures, initially, the following subregions were initially considered within the scope of work of the committee's agenda:

1. St. Louis (Missouri)
2. Memphis (Tennessee)
3. Louisville (Kentucky)
4. Kansas City (Missouri)
5. Others

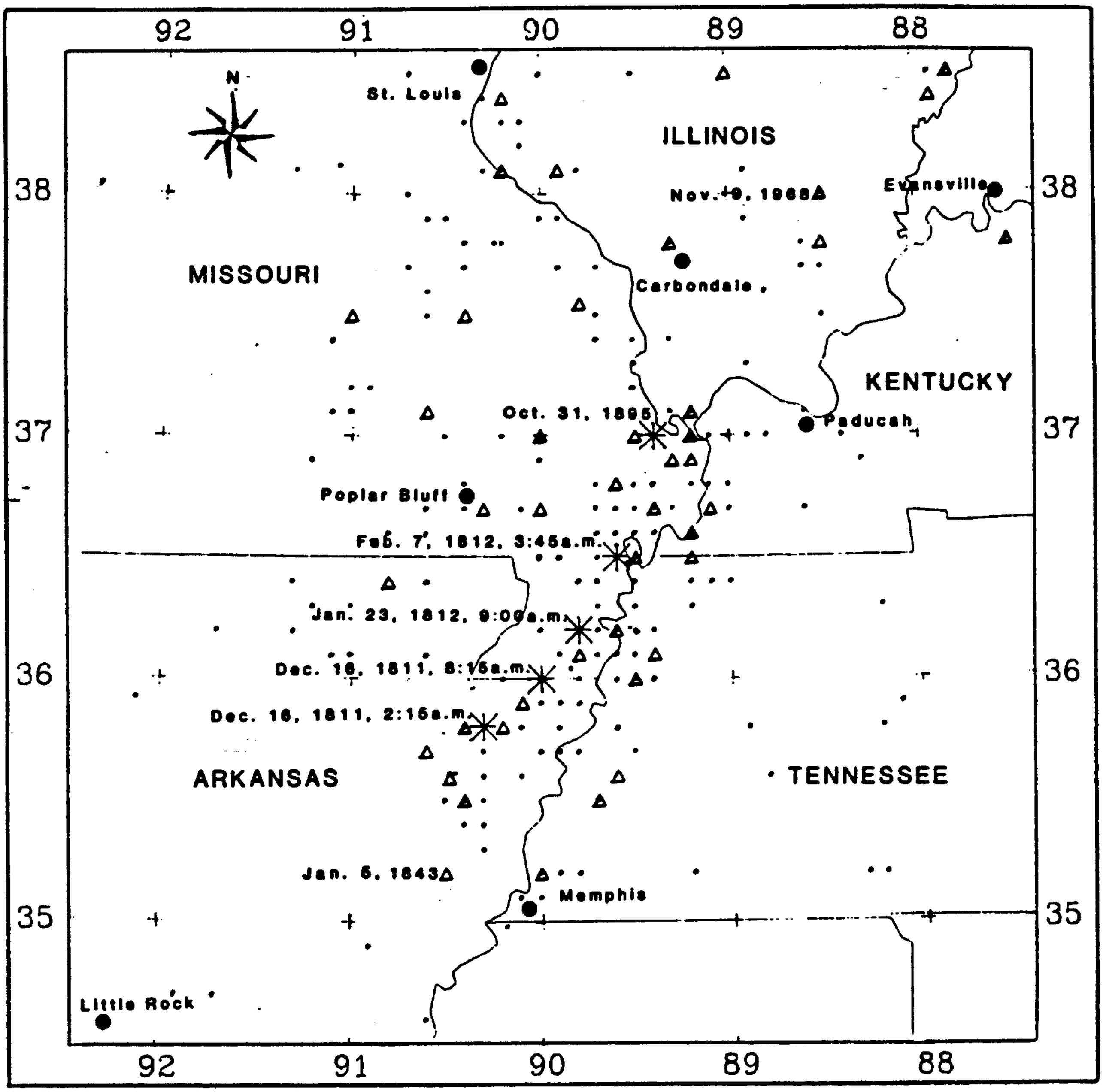


Figure 3. (Adopted from Hopper, 1985.) Historical seismicity of the New Madrid seismic zone and surrounding areas, 1800–1982. Plotted from Algermissen and Askew, unpublished listings. Epicenters for intensities IX and above are indicated by asterisks; VI–VII, VII, and VIII by triangles; and VI and below by small dots.

The detailed list of structures for each one of the subregions considered in the Mississippi Valley are provided in APPENDIX C. Certain selection criteria were applied for all of the listed structures in each subregion.

IV.1. SELECTION CRITERIA

The structures in each subregion presented were compiled by members of the committee living in the particular subregions. However, each of the listed structures in each region, whenever details were available, was subjected to ranking criteria formulated by a subcommittee consisting of P. Gould, H. Karabinis, O. Nuttli, G. Schwalbe, and A. Lin. The following is a summary of the formulation developed by the subcommittee.

The overall index (I) by which the structures are ranked is:

$$I = [C_1 \times \Sigma F_{\text{site}}] + [C_2 \times \Sigma F_{\text{structure}}] + [C_3 \times \Sigma F_{\text{other}}]$$

where C_1, C_2, and C_3 are arbitrary coefficients (in general equal to unity) adopted by the committee to reflect the various interests of the committee in the structure being subjected to the ranking process. The weighting factors (F) used for each summation in the index, I, are provided in Table 1.

For purposes of this study, the site conditions have been characterized as either shallow- or deep-soil profiles. A shallow-soil profile is defined as one that is less than 100 feet in thickness. A deep site is one in which the depth to bedrock is greater than 100 feet. In general, the Mississippi embayment is the only large area of interest to this study where the depth to rock is much greater than 100 feet. The northern limits of the embayment are shown in Figure 4. Memphis is located within the embayment.

There are isolated areas outside the embayment where the depth to bedrock is somewhat in excess of 100 feet. For example, in several zones of the commercial downtown St. Louis area, the bedrock is at a depth of 140± feet. The depth to bedrock was reflected in the calculation of an index number by assigning a factor of 1.0 for deep sites and a factor of 0.5 for shallow sites.

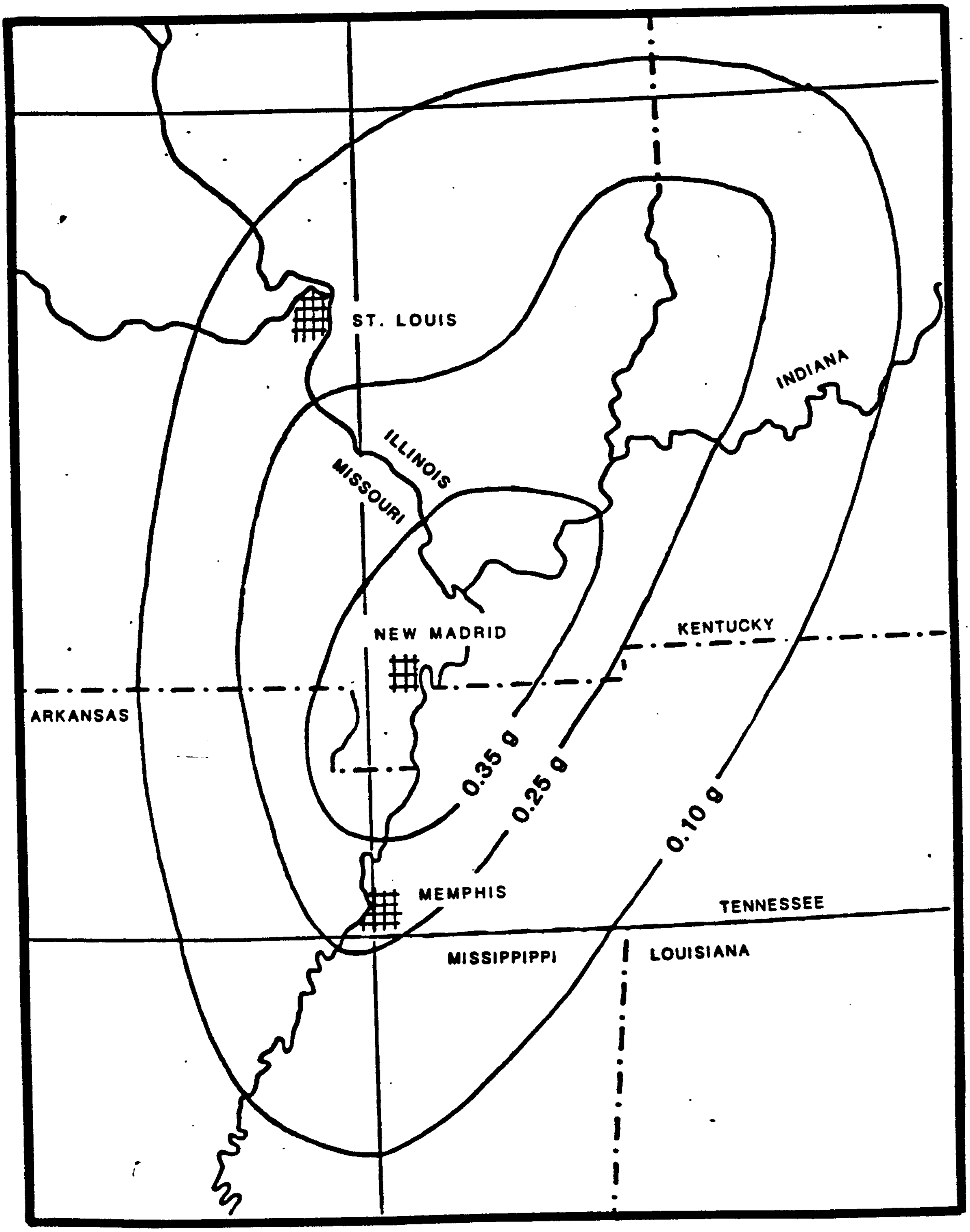


Figure 4. Probabilistic contour map of Mississippi Valley (based on 10% probability of exceedence in 100 years). (Figure courtesy of O. Nuttli.)

In addition to accounting for the effects of depth to bedrock, factors were also used to distinguish between "soft" sites and "hard" sites. This was done by assigning a factor of 1.0 for alluvial sites and a factor of 0.5 for non-alluvial sites. It is recognized that this is only a rough way to account for soil conditions since there could be non-alluvial sites that are softer than some alluvial sites. Higher factors for deep and soft sites have been assigned because it is likely that ground motions will be amplified for these sites; therefore, increasing the probability of measuring significant vibrations.

IV.2. STRUCTURES GIVEN TOP RANKING FOR STRONG-MOTION INSTRUMENTATION

As a result of ranking of structures that are provided in the tables of APPENDIX C, the structures with highest ranking in each area are identified. Based on this ranking process the immediate list of structures recommended by the committee for strong-motion instrumentation is summarized in Table 2.

V. CONCLUSIONS

This report represents the efforts of the USGS–New Madrid area advisory committee for strong-motion instrumentation of structures. The committee worked over a period of two years and compiled the list of structures and developed criteria for ranking them. The committee does not claim that the list or the areas covered within the Mississippi Valley is by any means complete. However, the recommendations are a beginning and it is hoped that in the future other structures in the region of the Mississippi Valley that were not covered in this report can also be considered as funds become available.

TABLE 1

WEIGHTING FACTORS USED IN THE RANKING OF STRUCTURES

I.	SITE/FOUNDATION FACTORS		
	A.	Alluvial vs. rock sites	
		Alluvial	1.0
		Rock	0.5
	B.	Shallow vs. Deep Foundations	
		Deep	1.0
		Shallow	0.5
II.	STRUCTURE FACTORS		
	A.	Materials of Construction	
		Masonry	1.0
		Reinforced concrete	0.8
		Steel	0.6
		Timber	0.5
	B.	Structural System	
		Hybrid	1.0
		Moment resisting	0.8
		Bearing wall	0.7
		Concrete shear wall	0.6
		Braced frame	0.5
		Other	0.4
	C.	Geometry	
		Regular	1.0
		Irregular	0.5
	D.	Long- vs. Short-Period	
		Long (>2 sec)	1.0
		Short	0.5
	E.	Existence and Availability of Calculation/Drawings	
		Calculations/Drawings	
		Including dynamic analysis	1.0
		No dynamic analysis	0.5
		No Calculations/Drawings	0.1
III.	Other Factors		
	A.	Lifeline or Special Interest	
		Yes	1.0
		No	0.7
	B.	Proximity to New Madrid Fault	
		Memphis	1.0
		St. Louis and Louisville	0.8
		Kansas City	0.5

TABLE 2
STRUCTURES WITH TOP RANKING

		INDEX
St. Louis Area	1. Gateway Arch	8.4
	2. Poplar St. Bridge	8.1
	3. Barnes Hospital Complex	8.0
	4. Southwestern Bell	7.4
Memphis, TN	1. One Memphis Place	7.8
	2. Clark Tower	7.6
	3. First Tennessee Bank	7.6
	4. National Bank of Commerce	7.6
	5. Union Planters National Bank	7.6
	6. White Station Tower	7.6
Louisville, KY	1. Humana Tower Hospital	7.7
	2. Galt House	7.4
	3. First National Bank	7.1
Kansas City, MO	1. AT&T Bldg.	7.4
	2. Mutual Benefit Life	7.3
	3. Mercantile Bank	7.1
Others	1. Baptist Medical Center (Little Rock)	7.3
	2. Lourdes Hospital (Paducah)	7.3
	3. Memorial Hospital (Carbondale)	7.3

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APPENDIX A

SEISMICITY OF THE MISSISSIPPI VALLEY

by O. Nuttli

During historical times the seismicity of the Mississippi Valley is dominated by that of the New Madrid fault zone. From December 16, 1811 through February 7, 1812 there were four catastrophic earthquakes of M_s (surface-wave magnitude) between 8.0 and 8.7. Taken together these five earthquakes released fifty times as much energy as all the earthquakes that occurred since 1812 between the Rocky and Appalachian Mountains. Since 1812 the New Madrid fault zone is the only one in the central United States to produce earthquakes of M_s larger than 6, namely one in 1843 in Arkansas, near Memphis, and one in 1895 in Missouri, near Cairo, Illinois.

Figure A–1 shows the extent of the New Madrid fault. Like all the active earthquake regions of the Central United States, the New Madrid region does not have fault rupture visible at the earth's surface. Vertical offsets of as large as one kilometer, however, have been mapped in the deeper rock layers by seismic subsurface exploration techniques. The contours drawn in the figure are Modified Mercalli intensity values for an earthquake assumed to occur at the center of the fault with an M_s of 7.6, which would relieve all the strain energy accumulated from 1812 through 1985. Intensity VIII or larger corresponds to structural damage, and of VI and VII to architectural damage. The map is generalized, assuming average soil conditions. Intensities one to two units higher might occur in river valleys or places of poor soil conditions. Where hard rock outcrops at the surface the actual intensities may be one to two units lower than those indicated in the figure.

Figure A–2 shows the approximate boundaries of all the earthquake source zones in the Central United States. The number within each zone is the M_s value of an earthquake with a recurrence time of 1000 years. Earthquakes of $M_s = 7.7$ can be very damaging. For example, the 1976 Tangshan, China, earthquake of $M_s = 7.8$ caused at least 240,000 deaths as well as great economic loss. The smaller San Fernando valley earthquake of 1971, of $M_s = 6.6$, caused approximately 60 deaths and \$700,000,000 of property damage

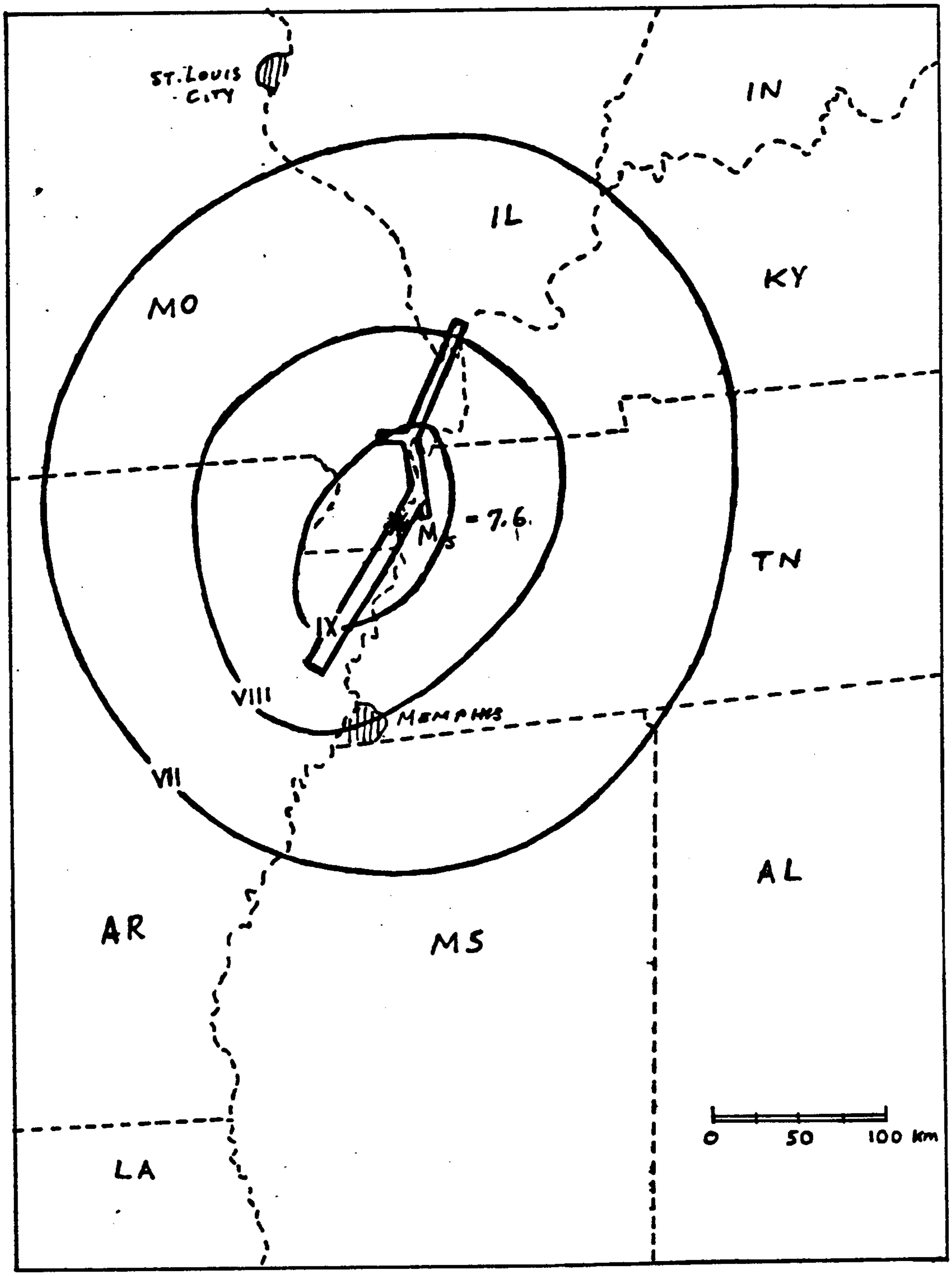

Figure A–1. Extent of the New Madrid fault. The contours drawn are MM intensity values for an earthquake assumed to occur at the center of the fault with an M_s of 7.6.

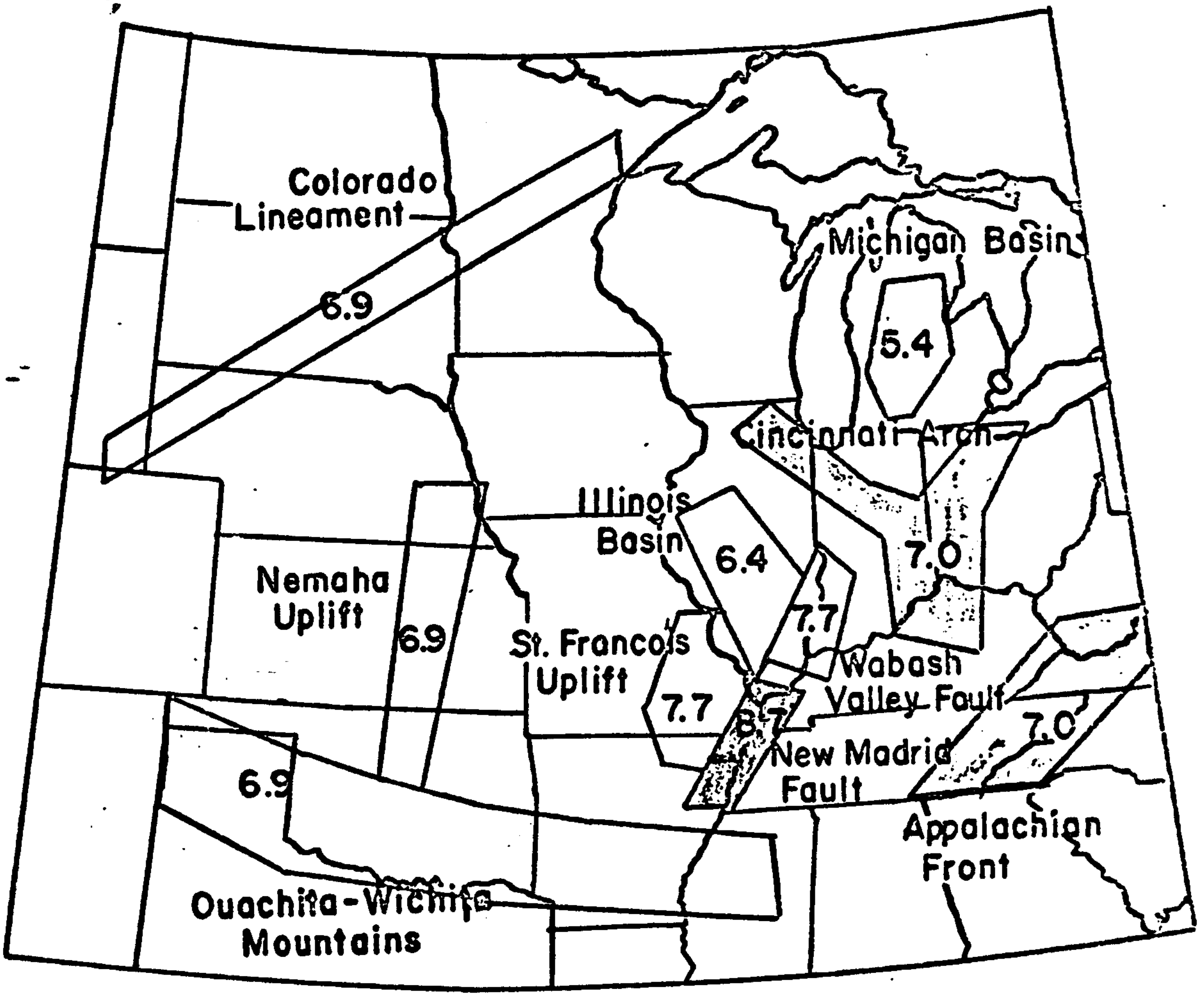

Figure A–2. Approximate boundaries of all the earthquake zones in the Central United States. The number in each zone is the M_s value of an earthquake with a recurrence interval of 1000 years.

in the Los Angeles area. During the last 200 years none of the Central United States source zones except the New Madrid has produced its maximum-magnitude earthquake. However, there have been five moderately large earthquakes in the Wabash Valley zone in the past 100 years, with epicentral intensities of VII or VIII.

Although large earthquakes occur about ten times less frequently in the Central United States than in California and adjacent states, the damage areas of the former are as much as 10 to 20 times larger because of differences in anelastic attenuation in the rock layers to depths of 20 km. In general, major damage from California earthquakes occurs only at distances less than 50 km from the fault, whereas in the Central United States it can happen at distances of hundreds of kilometers.

Damage to high-rise structures in Mexico City, 400 km distant from the epicenter of the $M_s = 8.1$ earthquake of September 1985, was a dramatic illustration of the effects of long-duration, low-frequency ground shaking. Structures built on the old lake bed sediments within the city were subjected to maximum ground acceleration of 150 to 200 cm/sec^2 at periods of 1 to 3 sec for 40 sec or more duration. In the adjacent areas, at firm ground sites, the measured peak accelerations were 40 to 50 cm/sec^2, the periods also were 1 to 3 sec (but less harmonic or pure sinusoidal in character) and the duration also was about 40 sec.

Long-duration, sinusoidal ground motion, of the type seen in the area of principal damage in Mexico City, is commonly seen in the Central United States. Figure A–3 shows examples of portions of two vertical-component seismograms of the Saint Louis University network for the northeastern Ohio earthquake of January 1986. The *P*- and *S*-wave motion, seen at the beginning of the broadband SLM (Saint Louis, Mo) record, is small. However, around 2 minutes after the onset of the *P* wave there is a 40-sec train of 1-sec period surface waves, which is soon followed by a 60-sec sinusoidal train of 2–3 sec period surface waves. The FVM (French Village,Mo) narrow-band record shows over 100 sec of large-amplitude 1-sec period waves.

The seismograms of Figure A–3 demonstrate that long-duration, sinusoidal wave motion of periods 1 to 3 sec can be seen at large epicentral distances for Central United States earthquakes. The remaining question, to complete the analogy to Mexico City, is: Can this peak acceleration be as large as 150 to 200 cm/sec^2? Figure A–4 is a map obtained by probabilistic analysis. It shows that peak accelerations of 150 cm/sec^2 have a 10% probability of being equaled or exceeded as far away as St. Louis, over a large area of the central Mississippi Valley, in a 100-year time period. The conclusion to be drawn is that high-rise structures at distances of at least 500 km are potentially vulnerable to earthquake damage in the Mississippi Valley.

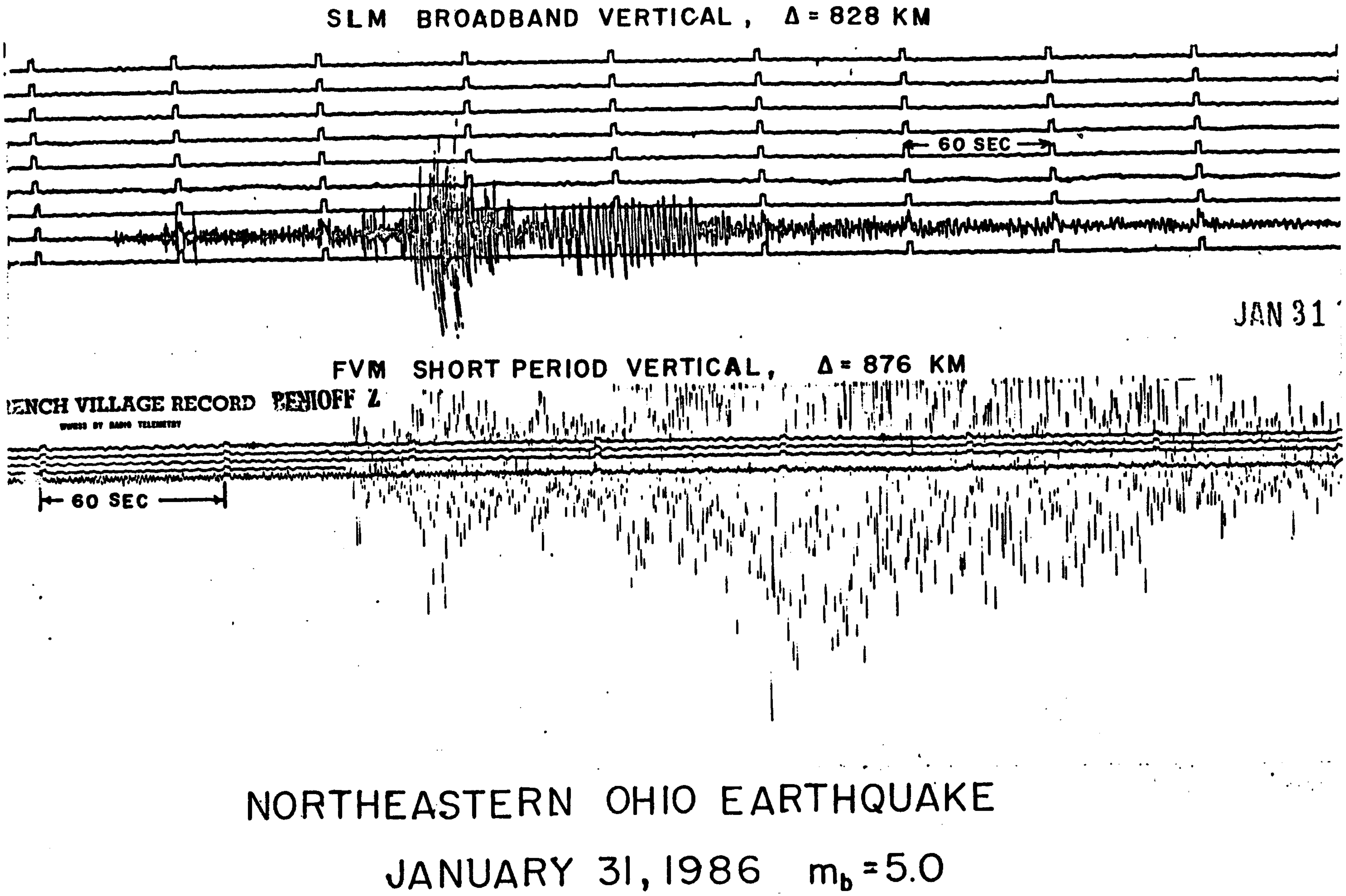

Figure A–3. Two of the vertical component seismograms of the northeastern Ohio earthquake of January 1986 (obtained by Saint Louis University network).

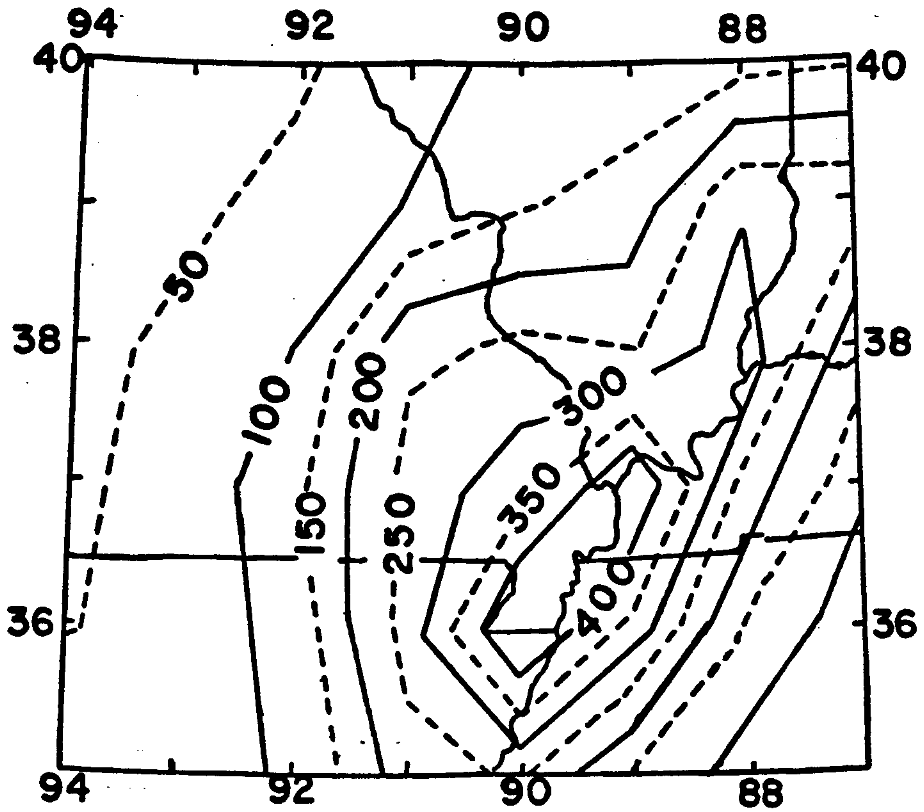

Figure A–4. Peak horizontal acceleration (cm/sec^2) with a 10% probability of being equaled or exceeded in 100 years.

APPENDIX B

(Adopted from USGS Open-file Report 85–457)

PROBABILITY OF LARGE EARTHQUAKES IN THE MISSISSIPPI VALLEY

by S.T. Algermissen

EARTHQUAKE OF MAXIMUM MAGNITUDE

Nuttli (1981) has assigned the largest shock of the 1811–1812 a M_s (surface wave magnitude) of 8.7, equivalent to an m_b (body-wave magnitude) of 7.3. These magnitudes are at the upper limits of both magnitude scales, which means, from a practical point of view, that the M_s and m_b magnitude scales saturate at these levels. Saturation of the scales means that the amplitudes of P waves and surface waves with periods of 1 second and 20 seconds respectively reach limiting amplitudes for body-wave magnitudes of about 7.5 and surface-wave magnitudes of about 8.7. The m_b magnitude is derived from the amplitude of P waves at about one second period. The M_s magnitude is derived from the amplitude of surface waves with periods of 20 seconds. Larger earthquakes (earthquakes releasing more energy than earthquakes with $m_b \sim 7.3$ and $M_s \sim 8.7$) are known to have occurred (for example, in Alaska in 1964) and their magnitude can be scaled by use of the moment magnitude M_w (Kanamori, 1977). Earthquakes with large moment magnitudes for which both the M_s and m_b scales are saturated are not likely to produce significantly larger amplitude ground motions than $M_s = 8.7 (m_b = 7.3)$ earthquakes out to distances of the order of 100 km. At greater distances, earthquakes with large moment magnitudes may produce significantly larger amplitude ground motion at longer periods. Earthquakes will shake increasingly larger areas (as M_w increases) at damaging levels.

The entire length of the New Madrid zone is only about 240 km which suggests that the stress drop in the 1811–1812 earthquakes may have been higher than for earthquakes along plate boundaries such as occur in California.

A number of investigations have developed magnitude-fault-rupture-length relationships using various data sets (for a summary see Slemmons, 1977). Based upon a length of about 240 km for the New Madrid zone, most of these relationships would predict smaller maximum magnitudes than are known to have occurred in the zone although the dispersion of the data sets is very large.

Because of the uncertainty in the stress drop associated with earthquakes in the midwest and the large dispersion of the magnitude-fault-length data sets, fault length does not offer a very high-resolution method of estimating maximum magnitude events in the midwest.

Because of the large magnitudes of the four principal shocks of the 1811–1812 sequence and since these are the largest shocks known to have occurred in historical times in North America (exclusive of Alaska), it is at least reasonable to assume that repetition of the 1811–1812 series in the Mississippi Valley represents an adequately conservative model for disaster planning and response. This assumption is made in the present study.

RECURRENCE OF LARGE SHOCKS

The average recurrence rates of large earthquakes can be estimated reasonably well from the historical record of earthquake occurrence provided that the area is not too small, that is, the area is sufficiently large that a number of large shocks have been known to have occurred historically. The seismicity of the midwestern United States is relatively low and the 1811–1812 series of large shocks is unique although some archeological evidence and certain native American legends suggest earlier large earthquake occurrence. A number of estimates have been made of the average recurrence rate for large earthquakes in the Mississippi Valley. Since significant seismogenic faults (and consequently fault slips) have not been positively identified in the Mississippi Valley, estimates of the recurrence times of large shocks have been based on the historical earthquake data. Table B–1 summarizes some of the estimates. The important conclusion from Table B–1 is that there is general agreement among a wide range of investigators on the average recurrence interval for large shocks when the recurrence rate is estimated from the historical seismicity. In the absence of geologic (fault slip) or other confirmatory data, it is not easy to estimate the reliability of the estimates of the recurrence rates of large shocks based on the historical data.

Table B–1

Estimates of Average Recurrence Times for Large Earthquakes in the Mississippi Valley

(Leaders (—) indicate no available data)

Source	Magnitude or Maximin MM Intensity	Estimated Recurrence (years)	Method Used
Nuttli (1974)	7.0–7.4 (m_b) 7.0–7.4 (m_b)	510 710	Maximum likelihood Weighted least squares
Algermissen (1973)	XI ($m_b \sim 7.2$)	500	Least squares (1811–1812 events included)
McClain and Myers (1970)	X	175	—
Mann and Howe (1973)	7.7 (M_s) X	600–700	—
Algermissen (1972)	XI ($m_b \sim 7.2$)	500–600	Extreme value analysis

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APPENDIX C

DETAILED LIST OF STRUCTURES AND SELECTION

In this APPENDIX, all structures considered in the New Madrid (St. Louis) area for strong-motion instrumentation are listed with the ranking criteria applied to them.

The list of structures considered in this report are in the following tables:

Table C–1 Description of Structures in St. Louis, MO for Ranking Purposes

Table C–2 Ranking of Structures in St. Luis, MO

Table C–3 Ranking of Structures in Memphis, TN

Table C–4 Description of Structures in Louisville, KY for Ranking Purposes

Table C–5 Ranking of Structures in Louisville, KY

Table C–6 Description of Structures in Kansas City, Missouri for Ranking Purposes

Table C–7 Ranking of Structures in Kansas City, Missouri

Table C–8 Ranking of Structures in Other Areas

Table C-1 Description of Structures in St. Louis for Ranking Purposes.

Structure CITY OF ST. LOUIS	Location	Soil Conditions	Foundation Type	Proximity To Source	Structure Type	No. of Stories	Availability of Drawings & Calculations	Estimated Index No.	Other Comments
Mercantile Center	# 1 Mercantile Center	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	Steel Frame (.6)	35	Likely— S & P	6.8	485 Ft. High Elongated Octagon Plan 3-Story K Braces take Lateral Loads *favored by committee
Southwestern Bell	909 Chestnut (#1 Bell Center)	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	Steel Frame (.6)	44+28	Likely—HOK	7.4	600 Ft. High, Zone 2 Earthquake Design BOCA
St. Louis Place	200 N. Broadway	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	P.G. Reinf Conc Off. Steel Frame (.7)	20	Likely—PGAV	7.2	220 Ft. Below-Level Parking Garage Masonry Const.; Steel Frame
Pet, Inc. Headquarters	400 S. 4th	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	Reinf. Conc. (.8)	15	?	7.1	Scuptored Tower (Unusual Shape) Rises from plaza. Precast Concrete Columns
Federal Courts and Customs Bldg.	1114 Market	Loess/Fill (0.7)	Unknown (0.7)	St. Louis (.8)	Reinf. Conc. & Bearing Wall (.7)	10	?	6.4	Rock Cut Sepulcher; Built 1935
Shell Building	1221 Locust	Loess/Fill (0.7)	Unknown (0.7)	St. Louis (.8)	Reinf. Conc. (.8)	13	?	7.1	Rounded facade follows Locust. Built 1925-26 Tile and Curtain Wall *favored by committee
Ralston Purina	835 S. 8th (#1 Checkerboard Sq.)	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	High Rise-R.C. Shear Wall (.6)	16	Likely—HOK	7.0	Built 1965; 4-story atrium, unusual shape
Sheraton St. Louis Hotel	910 N 7th	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	Reinf. Conc. (.8)	19	Likely—S & P	7.3	Unusual shape; Three story triangular lobby 2-18 story wings at angle
Clarion Hotel (formerly Stoffers)	200(high) & 300 S. 4th	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	High Rise-R.C. Shear Wall (.6)	30/11	?	6.5	one circular tower with 3-story cabana wings (S-shape); 11-story eliptical tower
Marriot Pavilion Hotel	#1 S. Broadway	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	Reinf. Conc. & Steel Frame	25/19/lowrise	?	7.0	3-buildings including Spanish Pavilion from 1964-65 Worlds Fair
Mayfair Hotel	806 St. Charles	Loess/Fill (0.7)	Unknown (0.7)	St. Louis (.8)	Reinf. Conc. (.8)	18	?	6.6	Built 1925-26; 12-inch br curtain walls
Chase Park Plaza	212 N-Kingshighway 230-32 N. Kingshighway	Surf./soils (0.7)	Unknown (0.7)	St. Louis (.8)	Reinf. Conc. & Steel Frame (.7)	10/27	?	6.6	Chase - 1921; Park Plaza - 1929-30; 12-inch br curtain walls
Railway Exchange Building (Famous Barr, Downtown)	Locust-Olive-6th-7th	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	Reinf. Conc. & Steel Frame (.7)	23	?	6.8	Built 1914-17; Terra Cotta facing
Cervantes Convention & Exhibit Center	801 Convention Plaza	Loess/Fill (0.7)	Unknown (0.7)	St. Louis (.8)	Steel Space Fram (.6)	2	Likely-HOK/SWP	6.2	
Southwestern Bell parking garage	Pine-Chestnut-10th-11th	Loess/Fill (0.7)	Deep (1.0)	St. Louis (.8)	post-tensioned Reinf-Conc. (.7)	7/8	?	6.8	Recent vintage downtown parking garage
Piere Choteau Building	4440 Lindell	Surf./soils (0.7)	?	St. Louis (.8)	Steel Frame (.6)	Check	?	6.9	
Gateway Mall	Development through Mid downtown	Loess/Fill (1.0)	Deep (1.0)	St. Louis (.8)	Mixed (0.5)	Check	?	7.4	Current Development-Buildings and Mall *favored by committee
Metropolitan Life Bldg.	Under construction Olive-Pine-6th-Broadway	Loess/Fill (1.0)	Deep (1.0)	St. Louis (.8)	Reinf. Conc. & Steel Frame (.7)	Check	Likely	7.5	new high rise under construction; tallest building in St. Louis *favored by committee

Table C-1 Description of Structures in St. Louis for Ranking Purposes.

(CONTINUED)

Structure	Location	Soil Conditions	Foundation Type	Proximity To Source	Structure Type	No. of Stories	Availability of Drawings & Calculations	Estimated Index No.	Other Comments
ST. LOUIS COUNTY									
St. Louis County Government Center	7900 Forsyth	Surf./soils (0.7)	Deep (1.0)	St. Louis (.8)	Reinf-Conc. (.8)	Check Approx 13	Likely-County	7.6	*favored by committee
University Club Towers	1034 S. Brentwood	Surf./soils (0.7)	Deep (1.0)	Deep (1.0)	Steel Frame (.6)	Check	Likely	7.1	
Apex Oil Headquarters (Clayton Point Building)	Forsyth & Maryland	Surf./soils (0.7)	Deep (1.0)	St. Louis (.8)	Reinf-Conc. (.8)	check approx 14	Likely-Theiss	7.3	Recently completed high rise in Clayton Structural Design for earthquake loads
7777 Bonhomme (Carondelet East Bldg)	7777 Bonhomme	Surf./soils (0.7)	Deep (1.0)	St. Louis (.8)	High Rise-R.C. Shear Wall (.6)	Check	Likely	6.7	
METROPOLITAN AREA HOSPITALS									
Barnes Hospital Complex	4949 Barnes Hospital Plaza at Kingshighway	Surf./soils (0.7)	Deep (1.0)	St. Louis (.8)	Hybrid (1.0)	Complex Varies 1-17	Likely	8.0	Major Hospital complex: Approx 14 wings/facilities shallow and deep founds. varies struct systems
Central Medical Center Hospital	4411 N. Newstead	Surf./soils (0.7)	Shallow (0.5)	St. Louis (.8)	Reinf-Conc. (.8)	Complex Varies 1-6	Likely	7.1	example low rise hospital reinf-conc on spread footings
St. Louis University Hospital (Firmin Desloge Replacement)	1325 S. Grand	Surf./soils (0.7)	Deep (1.0)	St. Louis (.8)	Reinf-Conc. (.8)		Likely	7.9	New Modern Hospital now under Const. Associated w/ University *favored by committee
Normandy Osteopthic Hospital South	530 Des Peres Rd. @ Daugherty Ferry	Surf./soils (0.7)	Shallow (0.5)	St. Louis (.8)	Reinf-Conc. (.8)	4/5	?	7.1	Recent low rise hospital (unusual shape): May be rock founded
Charter Hospital City and County Consolidated	5535 Delmar	Surf./soils (0.7)	Shallow (0.5)	St. Louis (.8)	Hybrid (1.0)	Complex Varies 1-8	?	7.3	Formerly St. Luke's East; Complex dates from 1881; recent const 1981
MISC. STRUCTURES									
Gateway Arch Jefferson Expansion Natl. Mem.)	Riverfront	Alluvial (1.0)	Deep (1.0)	St. Louis (.8)	Hybrid (1.0)	630-foot +	?	8.4	Gateway to the West Natl. Mon. *favored by committee
Poplar Street Bridge	Downtown St. Louis Mississippi River Bridge	Alluvial (1.0)	Deep (1.0)	St. Louis (.8)	Steel Girder Orthro. Deck	N/A	Likely— S & P	8.1	
St Charles I-70 Bridges	Interstate Bridge Missouri River Crossing	Alluvial (1.0)	Deep (1.0)	St. Louis (.8)	Steel Truss Dual Bridges	N/A	Likely— S & P	7.1	
Union Electric Cooling Tower	Calloway County	Alluvial (1.0)	Deep (1.0)	St. Louis (.8)	Reinf Conc (.8)	N/A	Yes —Wash. U.	7.9	Analysis for earthquake forces performed cooling tower on U.E. nuclear power plant *favored by committee
Apartment Complex for the Elderly	Cape Girardeau, MO	Surf./soils (0.7)	Shallow (0.5)	Cape Girardeau (1.0)	Steel Frame (.6)	6	Likely—Booker	7.1	Resistance to seismic loading by Moment resisting steel frame: Design in accordance w/BOCA —Zone 3

Table C–2 Ranking of Structures in St. Louis

BUILDING NAME	SITE/FOUNDATION FACTORS/CRITERIA		I1	C1	C1*I1	STRUCTURE FACTORS/CRITERIA				I2	C2	C2*I1	OTHER CRITERIA & WEIGHING FACTORS				I3	C3	C3*I3	INDEX
	SITE	FOUND.	S.F.C			MATR.	SYSTEM	GEOM.	PERIOD	S.C.			LIFELINE	FAULT PROXIMITY	DOUCUMENT AVAIL	SPEC INTEREST	OCF			SUM C*I
MERCANTILE CENTER	0.70	1.00	1.70	1.00	1.70	0.60	0.50	0.50	0.50	2.10	1.00	2.10	0.70	0.80	0.50	1.00	3.00	1.00	3.00	6.80
SOUTHWESTERN BELL	0.70	1.00	1.70	1.00	1.70	0.60	0.80	1.00	0.50	2.70	1.00	2.70	1.00	0.80	0.50	0.70	3.00	1.00	3.00	7.40
ST LOUIS PLACE	0.70	1.00	1.70	1.00	1.70	0.70	0.80	1.00	0.50	2.80	1.00	2.80	0.70	0.80	0.50	0.70	2.70	1.00	2.70	7.20
PET INC	0.70	1.00	1.70	1.00	1.70	0.80	0.80	0.50	0.50	2.90	1.00	2.90	0.70	0.80	0.30	0.70	2.50	1.00	2.50	7.10
FEDERAL COURTS AND CUSTOM	0.70	0.70	1.40	1.00	1.40	0.80	0.70	1.00	0.50	2.70	1.00	2.70	0.70	0.80	0.10	0.70	2.30	1.00	2.30	6.40
SHELL BUILDING	0.70	0.70	1.40	1.00	1.40	0.80	0.80	0.70	0.50	2.90	1.00	2.90	0.70	0.80	0.30	1.00	2.80	1.00	2.80	7.10
RALSTON PURINA	0.70	0.70	1.40	1.00	1.40	0.80	0.80	0.70	0.50	2.90	1.00	2.90	0.70	0.80	0.50	0.70	2.70	1.00	2.70	7.00
SHERATON ST LOUIS HOTEL	0.70	1.00	1.70	1.00	1.70	0.80	0.80	0.50	0.50	2.90	1.00	2.90	0.70	0.80	0.50	0.70	2.70	1.00	2.70	7.30
CLARION HOTEL	0.70	1.00	1.70	1.00	1.70	0.80	0.60	0.50	0.50	2.50	1.00	2.50	0.70	0.80	0.10	0.70	2.30	1.00	2.30	6.50
MARRIOT PAVILION	0.70	1.00	1.70	1.00	1.70	0.70	0.80	1.00	0.50	2.80	1.00	2.80	0.70	0.80	0.30	0.70	2.50	1.00	2.50	7.00
MAYFAIR HOTEL	0.70	0.70	1.40	1.00	1.40	0.80	0.80	1.00	0.50	2.90	1.00	2.90	0.70	0.80	0.10	0.70	2.30	1.00	2.30	6.60
CHASE PARK PLAZA	0.70	0.70	1.40	1.00	1.40	0.80	0.80	1.00	0.50	2.90	1.00	2.90	0.70	0.80	0.10	0.70	2.30	1.00	2.30	6.60
RAILWAY EXCHANGE BLDG	0.70	1.00	1.70	1.00	1.70	0.70	0.80	1.00	0.50	2.80	1.00	2.80	0.70	0.80	0.10	0.70	2.30	1.00	2.30	6.80
CERVANTES CONVENTION CENT	0.70	0.70	1.40	1.00	1.40	0.60	0.50	1.00	0.50	2.10	1.00	2.10	0.70	0.80	0.50	0.70	2.70	1.00	2.70	6.20
SOUTHWESTERN BELL PARK. B	0.70	1.00	1.70	1.00	1.70	0.70	0.70	1.00	0.50	2.60	1.00	2.60	0.70	0.80	0.30	0.70	2.50	1.00	2.50	6.80
PIERRE CHOUTEAU BLDG	0.70	1.00	1.70	1.00	1.70	0.60	0.80	1.00	0.50	2.70	1.00	2.70	0.70	0.80	0.30	0.70	2.50	1.00	2.50	6.90
GATEWAY MALL	0.70	1.00	1.70	1.00	1.70	0.80	0.70	0.50	0.50	2.70	1.00	2.70	0.70	0.80	0.50	1.00	3.00	1.00	3.00	7.40
METROPOLITAN LIFE	0.70	1.00	1.70	1.00	1.70	0.70	0.80	1.00	0.50	2.80	1.00	2.80	0.70	0.80	0.50	1.00	3.00	1.00	3.00	7.50
ST LOUIS COUNTY GOV. CTR.	0.70	1.00	1.70	1.00	1.70	0.80	0.80	1.00	0.50	2.90	1.00	2.90	0.70	0.80	0.50	1.00	3.00	1.00	3.00	7.60
UNIVERSITY CLUB	0.70	1.00	1.70	1.00	1.70	0.60	0.80	1.00	0.50	2.70	1.00	2.70	0.70	0.80	0.50	0.70	2.70	1.00	2.70	7.10
APEX OIL HEADQUARTERS	0.70	1.00	1.70	1.00	1.70	0.80	0.80	0.70	0.50	2.90	1.00	2.90	0.70	0.80	0.50	0.70	2.70	1.00	2.70	7.30
7777 BONHOMME	0.70	1.00	1.70	1.00	1.70	0.80	0.60	0.70	0.50	2.50	1.00	2.50	0.70	0.80	0.30	0.70	2.50	1.00	2.50	6.70
BARNES HOSIPITAL COMPLEX	0.70	1.00	1.70	1.00	1.70	0.80	1.00	0.50	0.50	3.30	1.00	3.30	1.00	0.80	0.50	0.70	3.00	1.00	3.00	8.00
CENTRAL MEDICAL CENTER	0.70	0.50	1.20	1.00	1.20	0.80	0.80	1.00	0.50	2.90	1.00	2.90	1.00	0.80	0.50	0.70	3.00	1.00	3.00	7.10
ST. LOUIS U. HOSIPITAL	0.70	1.00	1.70	1.00	1.70	0.80	0.80	1.00	0.50	2.90	1.00	2.90	1.00	0.80	0.50	1.00	3.30	1.00	3.30	7.90
NORMANDY OSTEOPATHIC	0.70	0.50	1.20	1.00	1.20	0.80	0.80	0.50	0.50	2.90	1.00	2.90	1.00	0.80	0.50	0.70	3.00	1.00	3.00	7.10
CHARTER HOSIPITAL	0.70	0.50	1.20	1.00	1.20	0.80	1.00	1.00	0.50	3.30	1.00	3.30	1.00	0.80	0.30	0.70	2.80	1.00	2.80	7.30
GATEWAY ARCH	1.00	1.00	2.00	1.00	2.00	0.70	1.00	0.50	0.70	3.40	1.00	3.40	0.70	0.80	0.50	1.00	3.00	1.00	3.00	8.40
POPLAR ST. BRIDGE	1.00	1.00	2.00	1.00	2.00	0.60	1.00	1.00	0.50	3.10	1.00	3.10	1.00	0.80	0.50	0.70	3.00	1.00	3.00	8.10
ST. CHARLES I-70 BRIDGE	1.00	1.00	2.00	1.00	2.00	0.60	0.50	1.00	0.50	2.10	1.00	2.10	1.00	0.80	0.50	0.70	3.00	1.00	3.00	7.10
UE CALLOWAY COOLING TOWER	1.00	1.00	2.00	1.00	2.00	0.80	0.40	1.00	0.50	2.10	1.00	2.10	1.00	0.80	1.00	1.00	3.80	1.00	3.80	7.90
CAPE GIRARDEAU ELDERLY AP	0.70	0.50	1.20	1.00	1.20	0.60	0.80	1.00	0.50	2.70	1.00	2.70	0.70	1.00	0.50	1.00	3.20	1.00	3.20	7.10
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
BUILDING NAME	SITE/FOUNDATION FACTORS/CRITERIA SITE	FOUND.	I1 S.F.C	C1	C1*I1	STRUCTURE FACTORS/CRITERIA MATR.	SYSTEM	GEOM.	PERIOD	I2 S.C.	C2	C2*I1	OTHER CRITERIA & WEIGHING FACTORS LIFELINE	FAULT PROXIMITY	DOUCUMENT AVAIL	SPEC INTEREST	I3	C3	C3*I3	INDEX SUM C*I

Table C–3 Ranking of Structures in Memphis, Tennessee.

USGS - New Madrid (St. Louis) Instrumentation of
Structures Advisory Committee
Candidate Structures List - Final
Memphis, Tennessee

BUILDING NAME	STRUCT COMPLETE	LOCATION	ALLUVIAL VS. ROCK	FOUNDATION DEPTH	S=I1	C1	STRUCT MATERIAL	STRUCT SYSTEM	GEOMETRY	PERIOD LENGTH	S=I2	C2	LIFELINE	PROXIMTY TO FAULT	S=I3	C3	DOCUMENT AVAIL.	SPECIAL INTEREST	S=I4	C4	INDEX
ONE MEMPHIS PLACE	NO	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.8	1.0	1.0	3.6	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.8
CLARK TOWER	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	1.0	3.4	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.6
FIRST TENNESSEE BANK	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.6	0.8	1.0	1.0	3.4	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.6
NATIONAL BANK OF COMMERCE	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.6	0.8	1.0	1.0	3.4	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.6
UNION PLANTERS NAT. BANK	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	1.0	3.4	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.6
WHITE STATION TOWER	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	1.0	3.4	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.6
BAPTIST MEM. HOSP.-EAST	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.4
MEMPHIS POLICE H'QUARTERS	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.4
MHM CENTRAL-CENTRAL TOWER	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.6	0.8	1.0	0.5	2.9	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.4
MHM CENTRAL-EAST WING	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.4
MHM CENTRAL-THOMAS WING	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.4
ST. FRANCIS HOSPITAL	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.4
VET. ADMIN. MED. CENTER	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.4
BAPTIST MEMORIAL HOSPITAL	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	1.0	0.5	0.5	2.8	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.3
MHM CENTRAL-SHERARD WING	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	1.0	0.5	0.5	2.8	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.3
M.I.A., FAA CONTROL TOWER	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.4	1.0	0.5	2.7	1.0	1.0	1.0	2.0	1.0	0.5	0.0	0.5	1.0	7.2
BRISTER LIBRARY, MSU	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.1
C.U.B., UNION AVE. EXT.	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.1
CLIFFORD DAVIS FED. BLDG.	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.1
HYATT REGENCY	YES	MEMPHIS	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	0.7	1.0	1.7	1.0	0.5	0.0	0.5	1.0	7.1

ABBREVIATIONS:
C.U.B.= COMMERCE UNION BANK
MHM= METHODIST HOSPITALS OF MEMPHIS
M.I.A.= MEMPHIS INTERNATIONAL AIRPORT
MSU= MEMPHIS STATE UNIVERSITY

Table C-4 Description of Structures in Louisville, Kentucky for Ranking Purposes

STRUCTURE	LOCATION	SOIL CONDITIONS	FOUNDATION TYPE	PROXIMITY TO SOURCE	STRUCTURE TYPE	NO. OF STORIES	AVAILABILITY OF DRAWINGS & CALCULATIONS	INDEX NO.	OTHER COMMENTS
Humana Tower Hospital	500 W. Main St.	Glacial outwash	Concrete mat on driven piles	Louisville	Welded steel frame w/con. floor slabs	27	Wind design Plans available	7.7	Regular and symmetric
Galt House	4th Street and River Road	Glacial outwash w/clay deposit	Concrete mat on piles	Louisville	Reinforced concrete frame and slabs	18	Wind and earthquake zone 2	7.4	Near Ohio River Regular, symmetric
Citizen's Bank Building	5th and Jefferson	Glacial outwash 50 to 100'	Concrete mat	Louisville	Precast concrete frame, slip formed core	30	Wind design (Kentucky building code). Plans available	6.9	Regular and symmetric
First National Tower	101 S. 5th St.	Glacial outwash	Concrete mat on piles	Louisville	Braced steel frame	40	Wind design	7.1	Regular, symmetric tallest building in Louisville
City Hall	601 Jefferson	Glacial outwash	Wall footing	Louisville	Load bearing masonry	4	Completed in 1871 Some drawings available	5.9	
The Brown Hotel	4th Avenue and Broadway	Glacial outwash		Louisville	Reinforced concrete clay tile exterior walls	14	Constructed c. 1920 Some plans available	5.8	Under renovation
The Glenview (Apartments)	5100 Brownsboro Road	Rock, 0-15 feet below surface	Caissons on rock	12 miles outside Louisville	Load bearing CMU walls, precast concrete floor	12	Earthquake zone 1 and wind	5.4	Irregular V-shaped structure

Table C–5 Ranking of Structures in Louisville, Kentucky.

USGS - New Madrid (St. Louis) Instrumentation of
Structures Advisory Committee
Candidate Structures List and Tabulation
Louisville, Kentucky

BUILDING NAME	STRUCT COMPLETE	LOCATION	ALLUVIAL VS. ROCK	FOUNDATION DEPTH	S=I1	C1	STRUCT MATERIAL	STRUCT SYSTEM	GEOMETRY	PERIOD LENGTH	S=I2	C2	LIFELINE	PROXIMITY TO FAULT	S=I3	C3	DOCUMENT AVAIL.	SPECIAL INTEREST	S=I4	C4	INDEX
HUMANA HOSPITAL, TOWER	YES	LOUISVILLE	1.0	1.0	2.0	1	0.6	0.8	1.0	1.0	3.4	1	1.0	0.8	1.8	1	0.5	0.0	0.5	1	7.7
GALT HOUSE	YES	LOUISVILLE	1.0	1.0	2.0	1	0.8	0.8	1.0	0.8	3.4	1	0.7	0.8	1.5	1	0.5	0.0	0.5	1	7.4
FIRST NATIONAL BANK	YES	LOUISVILLE	1.0	1.0	2.0	1	0.6	0.5	1.0	1.0	3.1	1	0.7	0.8	1.5	1	0.5	0.0	0.5	1	7.1
CITIZEN'S BANK	YES	LOUISVILLE	1.0	0.5	1.5	1	0.8	0.6	1.0	1.0	3.4	1	0.7	0.8	1.5	1	0.5	0.0	0.5	1	6.9
CITY HALL	YES	LOUISVILLE	1.0	0.5	1.5	1	1.0	0.4	1.0	0.5	2.9	1	0.7	0.8	1.5	1	0.0	0.0	0.0	1	5.9
BROWN HOTEL	YES	LOUISVILLE	1.0	0.5	1.5	1	0.8	0.4	1.0	0.5	2.7	1	0.7	0.8	1.5	1	0.1	0.0	0.1	1	5.8
THE GLENVIEW APTS	YES	LOUISVILLE	0.5	0.5	1.0	1	0.7	0.7	0.5	0.5	2.4	1	0.7	0.8	1.5	1	0.5	0.0	0.5	1	5.4

Table C–6 Description of Structures in Kansas City, Missouri for Ranking Purposes

Structure	Location	Soil Conditions	Foundation Type	Proximity To Source	Structure Type	No. of Stories	Availability of Drawings & Calculations	Index No.	Other Comments
AT&T	1100 Walnut	44' soil over rock	Mat	Kansas City	Conc core and steel frame	40 stories, 550'	Modal analysis by 1982 UBC	7.4	Under construction -
Mercantile Bank	1101 Walnut	Shallow soil over rock	On rock	Kansas City	Steel frame on 6 steel columns	20 stories, 262'	1973 Design	7.1	Interesting geometry -
Mutual Benefit Life	2345 Grand	Shallow soil over rock	Rock	Kansas City	Concrete frame and core	28 stories	1975 Design	7.3	Regular geom. concrete -
Crown Center Hotel	One Pershing Rd.	Rock	Spread Footings	Kansas City	Concrete frame on steel frame	14 story tower on 4 story function block	1970± Design	6.4	L-shaped, on rock outcrop-
C. Crosby Kemper Arena	1800 Genessee	Shallow soil on rock		Kansas City	Steel rigid frame roof support	N/A	1975 Completion	4.8	Presently instrumented with 62 channels
Persing #2 Office	2300 Main	15' to 40' soil over rock	Caisson	Kansas City	Moment resist. concrete frame	11 story tower + 4 story garage	1982 UBC	6.3	Rectangular w/open middle on garage. Under construction
Ward Parkway Office	9450 Ward Parkway	Rock	Caisson	Kansas City	Concrete braced frame	12 stories	1982 UBC. Equivalent lateral force	6.0	Short period, curved in plan
Vista International Hotel	12th and Central	Shallow soil over rock	Caisson to rock (12')	Kansas City	Concrete shear wall	22 stories, 230'	1979 UBC. Equivalent lateral force	6.1	Conc. tower on conc. truss transfer level
City Center Square	1100 Main St.	Shallow soil over rock	Piers to rock (8')	Kansas City	Concrete tube	30 story tower on 7 story base, 393'	1970 UBC. No dynamic analysis	5.9	First new tall building in Kansas City
Crown Plaza Hotel	4445 Main St.	On rock	Spread footing	Kansas City	Concrete shear wall (tower)	18 story tower + 3 story base	1982 UBC. Equivalent lateral force	5.9	Under construction
Solgrave Apartments	121 W. 48th	Shallow soil to rock, 10'	Caisson and spread footing	Kansas City	Concrete shear wall	10 stories + 3 story bsmt.	1959 UBC. No earthquake	5.6	Flat plate
Alameda Park Plaza	Wornall Road and Ward Parkway	0 to 30' soil over rock	Caisson	Kansas City	Concrete shear wall	13 story tower + 2 story u.g. plaza	1967 UBC. No earthquake	5.1	Pie shaped in plan
Tower Hyatt Regency	2345 McGee	Rock	Spread footings	Kansas City	Concrete frame and shear walls	40 story tower on 4 story function block	1972 UBC	6.1	Regular geometry
Bartle Exposition Center	301 W. 13th	30' soil on rock	Belled caisson on rock	Kansas City	Saw tooth truss roof	N/A	1975 Completion	5.2	Open span 270'

Table C-7 Ranking of Structures in Kansas City, Missouri

USGS - New Madrid (St. Louis) Instrumentation of
Structures Advisory Committee
Candidate Structures List and Tabulation
Kansas City, Missouri

BUILDING NAME	STRUCT COMPLETE	LOCATION	ALLUVIAL VS. ROCK	FOUNDATION DEPTH	S=I1	C1	STRUCT MATERIAL	STRUCT SYSTEM	GEOMETRY	PERIOD LENGTH	S=I2	C2	LIFELINE	PROXIMITY TO FAULT	S=I3	C3	DOCUMENT AVAIL.	SPECIAL INTEREST	S=I4	C4	INDEX
AT&T TOWER	NO	K.C.MO	1.0	0.5	1.5	1	0.7	1.0	1.0	1.0	3.7	1	0.7	0.5	1.2	1	1.0	0.0	1.0	1	7.4
MERCANTILE BANK	YES	K.C.MO	0.5	0.5	1.0	1	0.6	0.8	1.0	1.0	3.4	1	0.7	0.5	1.2	1	0.5	1.0	1.5	1	7.1
MUTUAL BENEFIT LIFE	YES	K.C.MO	0.5	0.5	1.0	1	0.8	0.8	1.0	1.0	3.6	1	0.7	0.5	1.2	1	0.5	1.0	1.5	1	7.3
CROWN CENTER HOTEL	YES	K.C.MO	0.5	0.5	1.0	1	0.7	1.0	0.5	0.5	2.7	1	0.7	0.5	1.2	1	0.5	1.0	1.5	1	6.4
KEMPER ARENA	YES	K.C.MO	0.5	0.5	1.0	1	0.6	0.4	1.0	0.5	2.5	1	0.7	0.5	1.2	1	0.1	0.0	0.1	1	4.8
PERSHING #2	NO	K.C.MO	1.0	0.5	1.5	1	0.8	0.8	1.0	0.5	3.1	1	0.7	0.5	1.2	1	0.5	0.0	0.5	1	6.3
WARD PARKWAY OFC	YES	K.C.MO	0.5	1.0	1.5	1	0.8	0.5	0.5	0.5	2.3	1	0.7	0.5	1.2	1	1.0	0.0	1.0	1	6.0
VISTA INT'L HOTEL	YES	K.C.MO	0.5	1.0	1.5	1	0.8	0.6	0.5	0.5	2.4	1	0.7	0.5	1.2	1	1.0	0.0	1.0	1	6.1
CITY CENTER SQUARE	YES	K.C.MO	1.0	0.5	1.5	1	0.8	0.4	0.5	1.0	2.7	1	0.7	0.5	1.2	1	0.5	0.0	0.5	1	5.9
CROWN PLAZA HOTEL	NO	K.C.MO	0.5	0.5	1.0	1	0.8	0.6	0.5	0.8	2.7	1	0.7	0.5	1.2	1	1.0	0.0	1.0	1	5.9
SOLGRAVE APARTMENTS	YES	K.C.MO	0.5	1.0	1.5	1	0.8	0.6	0.5	0.5	2.4	1	0.7	0.5	1.2	1	0.5	0.0	0.5	1	5.6
ALAMEDA PARK PLAZA	YES	K.C.MO	0.5	0.5	1.0	1	0.8	0.6	0.5	0.5	2.4	1	0.7	0.5	1.2	1	0.5	0.0	0.5	1	5.1
HYATT REGENCY TOWER	YES	K.C.MO	0.5	0.5	1.0	1	0.8	0.6	1.0	1.0	3.4	1	0.7	0.5	1.2	1	0.5	0.0	0.5	1	6.1
BARTLE EXPOSITION CNTR	YES	K.C.MO	0.5	0.5	1.0	1	0.6	0.4	1.0	0.5	2.5	1	0.7	0.5	1.2	1	0.5	0.0	0.5	1	5.2

Table C-8 Ranking of Structures in Carbondale (Ill.), Evansville (Ind.), Little Rock (Ark.), Paducah (Ky.), and Poplar Bluffs (Mo.)

USGS - New Madrid (St. Louis) Instrumentation of
Structures Advisory Committee
Candidate Structures List - Final
Five Cities: Carbondale, Illinois; Evansville, Indiana;
Little Rock, Arkansas; Paducah, Kentucky;
Poplar Bluff, Missouri

BUILDING NAME	STRUCT COMPLETE	LOCATION	ALLUVIAL VS. ROCK	FOUNDATION DEPTH	S=I1	C1	STRUCT MATERIAL	STRUCT SYSTEM	GEOMETRY	PERIOD LENGTH	S=I2	C2	LIFELINE	PROXIMTY TO FAULT	S=I3	C3	DOCUMENT AVAIL.	SPECIAL INTEREST	S=I4	C4	INDEX
BAPTIST MEDICAL CENTER	YES	L. ROCK	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	7.3
LOURDES HOSPITAL	YES	PADUCAH	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	7.3
MEMORIAL HOSP, NURSING	YES	CARBON.	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	7.3
MEMORIAL HOSP, PHASE I	YES	CARBON.	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	7.3
VET. ADMIN. MED. CENTER	YES	N.L.R.	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	7.3
WESTERN BAPT HOSP, 1970	YES	PADUCAH	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	7.3
WESTERN BAPTIST HOSPITAL	YES	PADUCAH	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	7.3
MEMORIAL HOSPITAL	YES	N.L.R.	1.0	1.0	2.0	1.0	0.8	1.0	0.5	0.5	2.8	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	7.2
ARK. DEPT. OF EMP. SEC.	YES	L. ROCK	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	0.7	0.9	1.6	1.0	0.5	0.0	0.5	1.0	7.0
FEDERAL BUILDING	YES	CARBON.	1.0	1.0	2.0	1.0	0.8	0.6	1.0	0.5	2.9	1.0	0.7	0.9	1.6	1.0	0.5	0.0	0.5	1.0	7.0
GTE	YES	CARBON.	1.0	1.0	2.0	1.0	0.6	0.7	1.0	0.5	2.8	1.0	0.7	0.9	1.6	1.0	0.5	0.0	0.5	1.0	6.9
FEDERAL BUILDING	YES	PADUCAH	1.0	1.0	2.0	1.0	0.6	0.6	1.0	0.5	2.7	1.0	0.7	0.9	1.6	1.0	0.5	0.0	0.5	1.0	6.8
ST. VINCENT INFIRMARY	YES	L. ROCK	1.0	1.0	2.0	1.0	0.8	0.6	0.5	0.5	2.4	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	6.8
UNIVERSITY MEDICAL CENTER	YES	L. ROCK	1.0	1.0	2.0	1.0	0.8	0.6	0.5	0.5	2.4	1.0	1.0	0.9	1.9	1.0	0.5	0.0	0.5	1.0	6.8
ARK. DEPT. OF EDUCATION	YES	L. ROCK	1.0	1.0	2.0	1.0	0.8	0.6	0.5	0.5	2.4	1.0	0.7	0.9	1.6	1.0	0.5	0.0	0.5	1.0	6.5

ABBREVIATIONS:
GTE= GENERAL TELEPHONE & ELECTRONICS
L. ROCK= LITTLE ROCK
N.L.R.= NORTH LITTLE ROCK

NOTE: AS THE FINAL LIST HAS BEEN REDUCED TO INCLUDE 15 BUILDINGS, EVANSVILLE AND POPLAR BLUFF ARE NOT REPRESENTED.

Note: In this table, no structures from Evansville, IN and Poplar Bluff, MO are represented because this is a list derived from a larger list of 51 structures. As a result of ranking, the structures in this list were on the top 15 presented here.