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David Stewart

Southeast Missouri State University, Cape Girardeau, MO

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David Stewart
Associate Professor, Department of Earth Sciences, Center for Earthquake Studies, Southeast Missouri State University, Cape Girardeau, MO, USA

PANEL REPORT

SYNOPSIS: Reliable probabilities of future damaging earthquakes in the New Madrid Fault Zone for purposes of mitigation and response planning are not available, even though considerable thought and research has gone into this question. Generalizations sufficient for pre-earthquake planning do exist, however, which suggest the need to prepare for at least a 50% chance of a 6.0 surface wave magnitude event within a decade, but that a repeat of the massive 8.0 magnitude events of 1811-12 need not be of concern for at least another century or two. The Loma Prieta was a significant stimulus toward greater earthquake planning and preparation in the Midwest, but of at least equal stimulus were the December 3, 1990, projection of an possible earthquake on the New Madrid Fault by Iben Browning and the occurrence of a damaging 4.6 magnitude event near New Hamburg, Missouri, on September 26, 1990. The combination of these three factors stimulated an unprecedented level of earthquake awareness and preparation in the central U.S. the benefits of which have already been enjoyed and whose benefits will continue for decades to come.

INTRODUCTION

The issue of what probabilities of future damaging earthquakes exist for the New Madrid Fault is one of considerable debate and current scientific investigation. Considering the extremely limited amount of high quality data over such short periods of time available for the New Madrid Seismic Zone, this debate will probably not be settled for several centuries to come. Nevertheless, engineers and regional planners need guidance now as to how to design and plan for future earthquakes in the Midwest.

Several researchers have addressed the issues of earthquake probabilities on the New Madrid Fault. Notably, the works of Johnston & Nava (1985), Nishenko & Bollinger (1990), and Saucier (1991). There is disparity in their conclusions mainly because of differences in the assumed statistical models to which they subscribe. These differences can only be settled in a definitive way by several more centuries of data than are now available. The New Madrid Fault is a slow moving one (compared to the San Andreas). Hence, if the recurrence interval for magnitude 8.0 or greater events is measured in periods of 500-700 years, it could take millennia before enough statistical data are available to express truly reliable probabilities.

EARTHQUAKE PROBABILITIES

Based upon current data, a table of recurrence intervals for the New Madrid Fault appears in Nuttli (1990) on p. 47, Appendix Four, as follows:

Magnitude Range	Expected Return Interval
1.0-1.9	Once every 1-2 days
2.0-2.9	Once every 2 weeks
3.0-3.9	Once every 4 months
4.0-4.9	Once every 4 years
5.0-5.9	Once every 4 decades
6.0-6.9	Once every 8 decades
7.0-7.9	Once every 2 centuries
8.0-8.9	Once every 5 centuries

Also found in Nuttli (1990) on p. 39, Appendix Two, we find a rounded summary table of probabilities which do not exactly correspond to Johnston & Nava (1985), but are more closely representative of their conclusions than those of Nishenko & Bollinger (1990). The purpose of the table found in the Nuttli (1990) publication is to provide a simple set of probabilities for pre-earthquake planning to be used by engineers, regional planners, and others who need a ball-park estimate by which to plan. For these purposes, this table is as reliable as any other set of assumptions and would lead to an appropriate level of design and planning--no more and no less. The table is as follows:

Probabilities of Earthquakes
On the New Madrid Fault

Surface Wave Magnitude	Probability By the Year 2,000 AD	2,040 AD
6.3	50%	90%
7.1	33%	67%
7.6	10%	25%
8.3	1%	3%

A 6.3 should happen approximately every 80 years and is the size of the one that shook Long Beach, California, in 1933 destroying three-quarters of its school buildings. The last one of this general size in the New Madrid Fault was near Charleston, Missouri, October 31, 1895.

A 7.1 event is the size of Loma Prieta that struck California October 17, 1989. The whole world saw that one on television and well understand what such a magnitude can mean. However, damages from such an event in the Midwest would be twenty-fold because seismic building codes have not existed here until after Loma Prieta and the geology of seismic wave propagation east of the Rocky Mountains is such that the amplitudes of ground motions remain high over more than twenty times the area as west of the Rockies. The level of damage seen in San Francisco, 60 miles from the Loma Prieta epicenter is approximately what one can expect to see in St. Louis, 150 miles away, from the same magnitude of event.

A 7.6 event is thought to be the maximum amount of strain energy current accumulated in the New Madrid Fault since the energy releases of the nineteenth century. This estimate is that of Otto Nuttli while at St. Louis University.

An 8.3 event is not considered credible within out lifetimes nor within the lifetimes of several generations to come. The last such events were 1811-12 when during a sequence of more than 2,000 events, at least three were thought to be more than 8.0 in surface wave magnitudes. Engineers and planners need not concern themselves with such possibilities at this time, as such cataclysms are not likely for at least another century or two from today.

IMPACT OF LOMA PRIETA ON THE MIDWEST

The Loma Prieta earthquake at 5:04 pm Pacific time on October 17, 1989, occurred during the opening game of the world series and is the most televised earthquake in history. It was viewed in real time by millions throughout America and the world. It was vicariously experienced by millions in the Midwest.

This event immediately caused midwesterners to reflect upon their own faults, namely the New Madrid Fault Complex which is known to be capable of quakes like Loma Prieta and more. The national news media did not lose any time making the connection and featured short spots on the evening news within hours after Loma Prieta as to what this meant for the central and eastern United States.

During the next fourteen months, until December 1990, the central United States was to engage in more earthquake education and preparation than in all previous history. Seismic building code bills were introduced in several midwestern states with versions of such codes passing in Missouri by May 1990, with a similar bill to eventually pass in Arkansas as well the next year.

Literally thousands of public presentations were made that personally touched hundreds of thousands, millions of pieces of literature were distributed on earthquake safety, thousands of earthquake videos were duplicated and distributed, innumerable articles appeared in every corner of the print media, and hundreds of engineers and utility officials trained in earthquake mitigation and seismic building provisions. For the first time in history, virtually every school within reach of the New Madrid fault developed and practiced an earthquake response plan. For the first time in history, virtually every hospital in the region also devised and exercises earthquake plans.

A tremendous amount of beneficial networking also occurred with county and state emergency officials communicating with local fire, police and ambulance services along with cooperative communications between businesses, schools, hospitals, and government agencies. It was the first time such all-pervasive cooperation, planning and communication had ever occurred.

One California official was quoted as saying that after December, 1990, the Midwest was better educated and prepared for earthquakes than most of California. That would be excluding buildings, of course, inasmuch as California contractors have been following seismic codes for more than 50 years in some parts of the state while in the midwest we are just starting. Nevertheless, we are started and some day when a really big earthquake hits thousands of lives will be saves and billions in losses prevented because of the massive grass-roots efforts that took place following Loma Prieta.

In at least one instance, lives have already been saved attributed to the earthquake safety training that virtually everyone in the midwest received during 1990. A tornado struck a western suburb of St. Louis in October. A building collapsed containing 80 people, a small business establishment. As the building began to fall, everyone inside knew exactly what to do--they ducked and covered just as they had been taught during recent earthquake drills. Not one person was even injured. The newspaper coverage following the incident quoted several of the survivors as saying that they credit their earthquake education and training with saving their lives.

It would be misleading not to mention two other factors that contributed to the unprecedented levels of earthquake awareness and preparation in the midwest during 1990. One was the projection by a climatologist from New Mexico, Dr. Iben Browning, who said that based upon his calculations of tidal forces, there was a 50% chance of a damaging earthquake on or about December 3, 1990. This was made public almost immediately after Loma Prieta inasmuch as he had made a speech in San Francisco only shortly before October 17, 1989, in which he had implied that a large quake could hit the San Francisco area on or about October 18. The projection did not die, but was kept in the public mind throughout 1990 with many believing that the possibility was not to be ignored.

The second factor that stimulated such galvanic action on the part of the residents of the midwest was a real earthquake that occurred September 26, 1990, centered about 15 miles south of Cape Girardeau in a fault zone considered by some to be the northern New Madrid Fault and by others as the Southern Ozark Uplift Seismic Region. It is academic which name goes with the fault inasmuch as they are connected. The event triggered an almost frenzied reaction on the part of thousands who ran to stores buying up supplies, camping gear, and almost every other sort of emergency supply available. The earthquake occurred at 8:19 am and by that afternoon the merchants of Cape Girardeau had all sold out of, among other things, bottled water.

The September 26 quake whose epicenter was near the tiny town of New Hamburg, MO, was felt in seven states and did several hundred thousand dollars in damages. Most of this damage consisted of small cracks in masonry, but a gas pipeline did break in Cape Girardeau along with several instances of broken windows, including one school. Other damage of a serious nature occurred in restricted areas as far as Piggott, Arkansas, (80 miles west) and Desoto, Illinois, (50 miles north). A slope failure in Piggott did some $20,000 in damages to each of two houses and minor damage to a third home on the same hill.

While hundreds of insurance claims were filed, few were paid inasmuch as almost all of the damage fell within the deductibles which range from 2% to 10% or the amount of the policy. Hence, unless damages resulted in $2000 or more, the losses were borne by the property owners. The event did, however, shock the insurance industry into realizing what a catastrophe they would have if a truly large earthquake were to occur. During the last months of 1990, tens of thousands of earthquake insurance policies were sold in the midwest which probably makes the percent of earthquake insured greater there than even California where only 13% of property owners have policies.

CONCLUSIONS

While the final word will be centuries in the making as to earthquake probabilities on the New Madrid Fault, probabilities with sufficient credibility and reliability exist already by which intelligent planning can be made in the central United States. Such probabilities, as presented here in this article, are rounded and approximate, but further precision and refinement of such forecasts is not really meaningful in light of the insufficiencies of current data. The New Madrid fault needs to have a lot more large earthquakes, which will take centuries, before better recurrence rates can be obtained.

As for the impact of Loma Prieta on the midwest, a lot of lifestyles and ways of thinking have been permanently changed in the midwest subsequent to that event. While it started October 17, 1989, with the earthquake we all saw on television, of at least equal importance in influence was the projection of Dr. Iben Browning for December 3, 1990, and the real quake of September 26, 1990. Browning's earthquake did not happen, but his projection was a false alarm in time only. It was a real alarm for concern over the earthquake future of the central United States. Thanks to the events of 1989 and 1990, the Midwest is readier than it ever has been before for what we all know is inevitable.

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