Preliminary Report
Earthquake Injury Epidemiological Aspects
Santa Cruz Earthquake, October 17, 1989.

submitted to

Natural Hazards Research
&
Applications Information Center
Quick Response Program
University of Colorado
Boulder, Co.

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On Tuesday, October 17, 1989 at 5:04 p.m. Pacific time, a magnitude 7.1 earthquake with an epicenter just north of Santa Cruz struck the northern California region. The quake caused extensive damage to the Marina district of the City of San Francisco, one span of the Bay Bridge fell from its support, a 1.5 mile section of Interstate 880 (Nimitz Freeway) in Oakland (Cypress Section) collapsed and major structural damage was reported from a number of locations in Santa Cruz County.

Once the impact of the event had been evaluated (about three hours after hearing about the event — 11 p.m. Eastern time,) the above investigators, along with Frederick Krimgold of Virginia Polytechnic Institute and State University (who also is supported by the Center) decided that this was indeed a valuable opportunity to gather the information outlined in the quick response grant proposal (copy attached.) Preliminary reports, although somewhat exaggerated, did indicate that there was significant loss of life and injury associated with the event. The only other recent event in the U.S. was the 1987 Whittier event, which was of significantly lesser impact in this regard.

Preparations were made immediately to leave on the morning of Wednesday, October 18. Activities included

- Contacting the NHR&AIC.
- Making fight reservations (to both San Francisco (SFO) and San Jose (SJC) airports, as the status of SFO was unclear.)
- Copying the quick response data collection form recently developed for this application (blank copies attached.)

[1] Preliminary report prepared by Nicholas P. Jones.

- Obtaining and copying maps of the Bay Area and Santa Cruz region.
- Collection of equipment: cameras, film, safety equipment, etc.
- Notification of student assistant needed to help in data collection.
- Notification of respective departments and rearranging existing schedules.

On Wednesday morning it was ascertained that SFO would be open, so that flight was chosen. Various strategies for deployment and collection methodologies were discussed during the flight. It was decided that the Santa Cruz area was probably the most logical area in which to concentrate the efforts. While it was clear that there was a significant concentration of fatalities at the I-880 collapse, it was considered that implementation and testing of the proposed research methodology in that region would be difficult for various reasons.

Arrival time at SFO was approximately 2:00 p.m., Pacific time. At SFO, connection was made with Fred Krimgold, who had flown in from Washington, D.C. Immediately on arrival, the group traveled by cab to downtown San Francisco. During a short press interview by Krimgold, the rest of the group determined that access to the marina district was very restricted, and the decision to concentrate on the Santa Cruz area was reaffirmed.

The group traveled by BART to Oakland to briefly view the damage and search and rescue activity at the I-880 collapse. Again, access to the area was very restricted, and it was clear that this, combined with the media concentration on that location would hinder effective data collection. After obtaining a rental car in Berkeley, the team traveled to San Jose, arriving at about 9:30 p.m. A local contact in San Jose assisted in determining appropriate travel routes to the Santa Cruz region.

Early on Thursday, October 20, the team traveled via highway 152 (the main highway from San Jose to Santa Cruz, 17, was closed due to extensive damage and landslides) to Watsonville in Santa Cruz County. After some time in the downtown area, where damage was observed and anecdotal morbidity and mortality data obtained, a visit was made to the local hospital: the Watonsville Community Hospital. At that location, a great deal of information was provided by the local staff, not only on the treatments provided at that location, but also of the general structure of the emergency medical system in the county. This was invaluable in guiding the remainder of the visit. The hospital itself sustained some structural and nonstructural damage, and time was taken to record this and ascertain the operational status of the facility after the earthquake which resulted.

Over the following two days, the following activities were undertaken:

- Visit the Santa Cruz County public health officials to obtain permission and support for the research efforts.
- Visit the Pacific Garden Mall to view and record the structural and nonstructural damage.
- Visit the Santa Cruz ambulance facility to obtain information on run records, etc.
- Visit the Santa Cruz County headquarters (location of the command center) to obtain ambulance run records and other operational information.
- Meet with County Coroner to discuss circumstances surrounding injury deaths.
- Visit County pathologist, view autopsy procedure on victims, and collect data on fatal injuries.
- View locations corresponding to all ambulance runs in the two days following the earthquake to record any damage (or nearby damage.)
- Visit the two hospitals in the City of Santa Cruz: Dominican Hospital and the Santa Cruz Community Hospital. Obtain preliminary injury information and establish contact persons.
- Visit local fire and police chiefs and discuss operational activities.

The tasks above were performed as a group or individually, as appropriate and as necessary. It must be emphasized that throughout the activities, extreme care was taken to be sensitive to the local population and contacts, given the disaster they had just experienced. While this at times perhaps slowed the effort, it was considered to be a high priority.

Activities Since Returning and Future Plans

A number of activities will be carried out over the next few months to follow up the quick response data collection. These are summarized briefly below:

- "Human subjects research" approval for working with hospital medical records and for more detailed follow-up of injured victims is being sought from human subjects review committees.

- Since returning, State of California Health Officials have been contacted to obtain permission and support for continued research in the area, and to arrange collaboration and coordination with their ongoing research activities.
- Write "miniproposal" to NSF to support travel for follow-up study in several weeks.
- Continue communication with contact persons at various facilities, and describe information required.
- Contact various sources of additional structural information, including the County Inspector and the engineer in charge of the post-earthquake safety evaluations.
- Obtain detailed autopsy reports and medical records for dead and injured.
- Visit the site for follow-up study and interviews.

The above list is not exhaustive: there are sure to be additional tasks which become necessary as the project proceeds.

Conclusions

As can be seen from the above description of accomplished and proposed tasks, the quick-response grant was certainly of significant use. Much "perishable" and preliminary data were obtained, and important contacts made with local people. We feel that the opportunity to be on site as soon as possible after the event was very important; the success of the studies resulting will critically depend on this factor.

A more complete report, using the data obtained over the next few months will be forthcoming as the research is completed.

Forms and Supporting Documentation used for Field Data Collection

Note: These were *draft* forms. Since the field experience, slight modifications have been made already. The victim form was not used in the field due to the circumstances of the event, but will be used, when revised, to collect and organize the data from the medical records.

Name of Surveyor: Date of Survey: Time of Survey:

General Information

Location _____

Date _____ Time of Day _____

Day of Week M T W Th F S Su

Foundation _____

Damage to Utilities W E G S T

Hazardous Materials _____

Evidence/potential of Fire Y N

Building Information

Building #

Function	Pub Assem
Residential	School
Commercial	Govt Bldg
Office	Emer Serv
Industrial	Hist Bldg

Address _____

_____

Est # Stories _____

Building Name _____

Est Max Occupancy _____

% of Max 10 20 30 40 50 60 70 80 90 100

Occupancy Type

Access/Transportation Information

Any blocked exits? Y N

Location within block _____

Road Conditions near building

Scale:

Room Classification		Percent Collapse
Class	%	Zero
A		10 60
B		20 70
C		30 80
D		40 90
E		50 100
No Voids		

Building Type	W S1 S2 S3 S4 C3/S5 C1 C2 PC1 PC2 RM URM
Floor/Roof Type	W S/C LS MD WS J/S FS T HC O

Failure Type	TC C R/F W IW P F NS C/E SS CR OV L O
Exterior Walls	PC G URM MI PS S CB NCB M RC RB O

Comments

VICTIM NUMBER: FILING NUMBER: NAME OF SURVEYOR:

PATIENT INFORMATION

NAME _____

_____

SEX M F AGE _____

HEIGHT FT IN _____

WEIGHT LB KG _____

NEXT OF KIN _____

_____

_____

BEHAVIOR _____

_____

INFORMATION AT DISCOVERY/INJURED TIME OF DISCOVERY _____

INJURY SEVERITY SCORE TS RPV _____

TYPE(S) OF INJURY C L T A CS P W AB FT F/E F/S F/P IA H N B O

CAUSE(S) OF INJURY _____

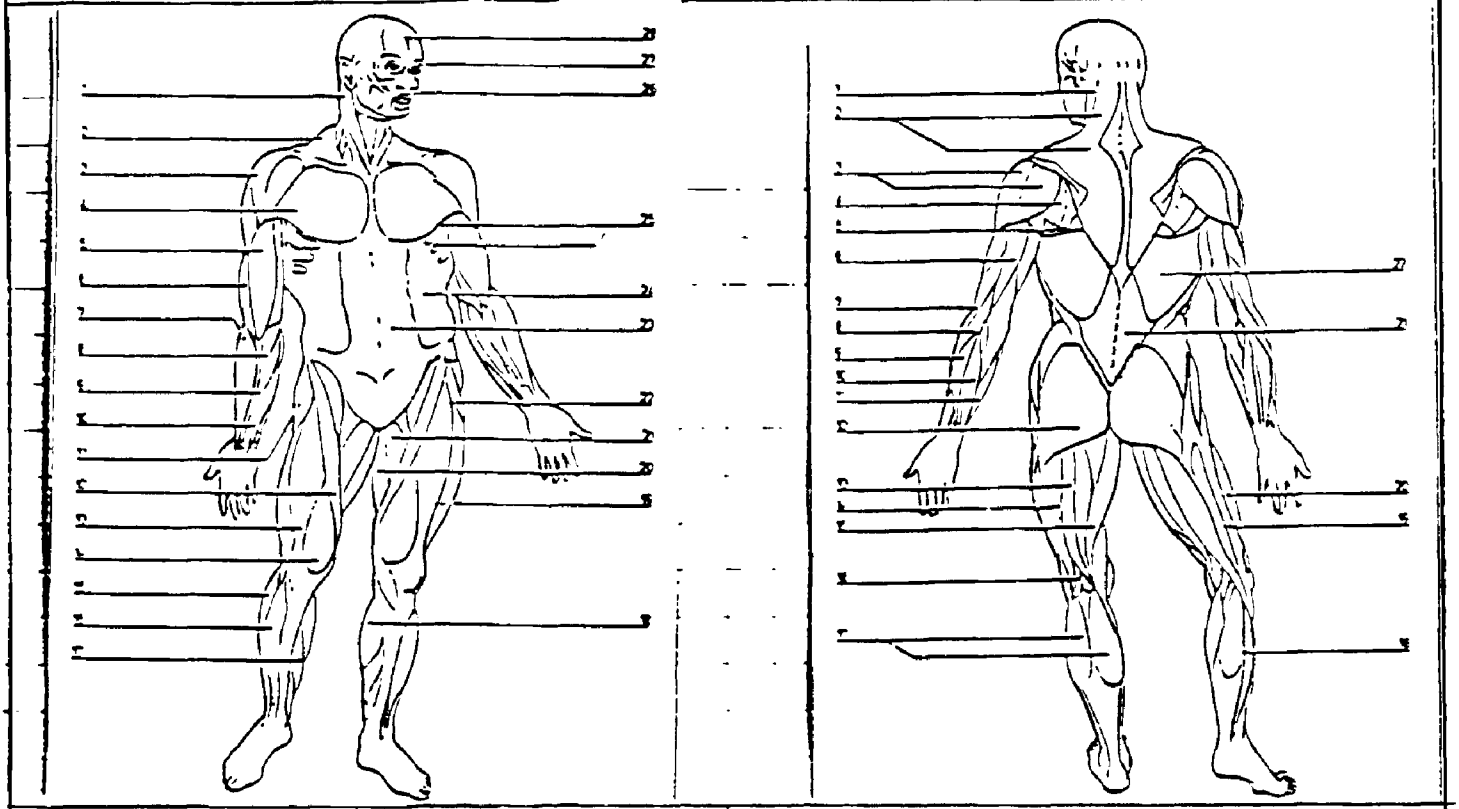
_____

INFORMATION OF DISCOVERY/DEATH TIME OF DISCOVERY _____

TYPE OF DEATH AC H C HE/S HY DI DE CA SB O

CAUSE OF DEATH _____

_____



INFORMATION AT EXTRICATION/TRANSPORTATION

TIME UNTIL FIRST TREATMENT _____

WHO ADMINISTERED FIRST TREATMENT _____

_____

INJURY SEVERITY SCORE TS RPV _____

TIME BETWEEN DETECTION AND EXTRICATION _____

MODE OF TRANSPORT TO TREATMENT FACILITY _____

_____

WHICH TREATMENT FACILITY _____

INJURY SEVERITY SCORE UPON ARRIVAL AT TREATMENT FACILITY TS RPV

SEARCH AND RESCUE INFORMATION

WHO DISCOVERED VICTIM _____

METHOD OF DETECTION/LOCATION _____

_____

_____

WHO EXTRICATED VICTIM _____

METHOD OF EXTRICATION _____

_____

_____

EXTRICATION DIFFICULTY _____

PROBLEMS _____

BUILDING TYPES (from ATC-21)

Building Type	General Description
W	Wood Buildings of all types
S1	Steel moment resisting frames
S2	Braced steel frames
S3	Light Metal Buildings
S4	Steel Frames with cast-in-place concrete shear walls
C3/S5	Concrete or steel frame buildings with unreinforced masonry walls
C1	Concrete moment resisting frames
C2	Concrete shear wall buildings
PC1	Tilt-Up Buildings
PC2	Precast concrete frame buildings
RM	Reinforced Masonry
URM	Unreinforced Masonry

FAILURE TYPES

Failure Type	General Description
TC	Total collapse of the building
C	Column Failure
R/F	Roof/Floor collapse (e.g., Punching Shear Failure)
W	Walls buckling outwards
IW	Infill walls buckling outwards
P	Pounding with adjacent structures
F	Foundation failure excluding liquefaction
NS	Nonstructural damage
C/E	Cladding/exterior damage
SS	Soft story failure
CR	Significant cracking
OV	Overturning of structure
L	Liquefaction failure
O	Other types of failure

EXTERIOR WALLS

Exterior walls	General description
PC	Precast concrete panels
G	Glass panels
URM	Unreinforced masonry walls
MI	Masonry infill walls
PS	Plywood sheathing
S	Stone panels
CB	Concrete bearing walls
NCB	Non-load carrying concrete bearing walls
M	Metal skin
RC	Reinforced concrete
RB	Reinforced brick
O	Other types of walls

TYPES OF INJURY

Type of injury	General description
C	Contusion
L	Laceration
T	Traumatic
A	Amputation
CS	Crush syndrome
P	Pneumontis
W	Wound infections
AB	Abrasions
PT	Pneumothorayx
F/E	Fracture of extremites
F/S	Fracture of spinal cord
F/P	Fracture of pelvic area
IA	Intra-abdominal
H	Head injuries
N	Neck injuries
B	Burns
O	Other types of injuries

TYPES OF DEATH

Types of Death	General description
AC	Airway comprimise/asphixiation
H	Massive head injuries
C	Massive chest injuries
HE/S	Hemorrage/Shock
HY	Hypothermia
DI	Dust inhalation
DE	Dehydration
CA	Cardiac arrest
SB	Severe burns
O	Other types of death