7.6 Buildings

7.6.1 Damage in Dagupan City

We arrived at Dagupan city from Manila via Tarlac city through Lingayen city by car. We entered Lingayen where there are marshy districts. There are many fish farms everywhere. Lingayen is located about 10km to the west of Dagupan. By observation through the car window, damage to buildings caused by the earthquake was barely visible before entering Dagupan city.

(1) Dagupan city

Dagupan city having a population of about 130,000 is located about 200km north-northwest of Manila, and the city fronts on Lingayen Gulf in the north. Dagupan city is located at the delta between the Pantal and the Calmay rivers which flow into Lingayen Gulf. This area is marsh where there are many fish farms. It is reported that damaged part of Dagupan city was fish farms up to 30 years ago and the grounds have been reclaimed for 20 years, and many buildings have been constructed on this area.

(2) Damage in Dagupan city

Figure 7.6.1 shows a sketch of the damage to Dagupan city. The damage to buildings concentrated on a 600m wide section from east to west on the west of the Pantal river flowing almost through the city center. Numbers of subsided and inclined buildings caused by soil liquefaction are supposed to be about 300. The roads that we mainly observed were Fernandez street, Perez street and Gonzalez street. The damage along the three streets seemed to be severe.

Within the limited time, we visited the facilities and the buildings as shown in Table 7.6.1. Photos 7.6.1 to 7.6.14 show the damage of buildings. Table 7.6.2 lists the outline of hearings at city hall and city engineer office. The city itself can not rehabilitate the damaged buildings. The city

office countermeasured only upon the rehabilitation of the subsided drainage ditch and the repair of the sewage-back-flow. However, it seemed that something inaccurate about the level measuring system and workmanship. After reconnaissance of Dagupan city, we crossed the Pantal river. The buildings along the road in the eastern part of the city were hardly damaged. It was found that the damage of buildings in Dagupan city was concentrated upon the limited part of the city. From Dagupan city to Agoo, remarkable damage to buildings was not observed through the car window. However, at the entrance of Marcos highway and before and in back of the entrance to Don Marcos College in Agoo, severely damaged houses and buildings were watched again.

(3) Damage grade caused by liquefaction and the rehabilitation

We checked the earthquake intensity by hearing damage grade in Dagupan city. According to the hearing from a girl student in the schoolyard of the technical college, she could not stand up on the ground during this earthquake. From the fact that people in the second floor in the city hall got outside rapidly, it seemed that this earthquake was in the 5th degree in earthquake intensity according to criteria of the Japanese Meteorological Agency (1949). An acceleration of more than 200 gal is supposed to have occurred.

Next, we obtained the results of a boring tests taken on the 5 areas from the technical office on July 29th. We did a conventional judgement on the possibility of soil liquefaction based on the N-values.

1) Soil condition of Dagupan city

The obtained boring data were No.2 and No.3 along Fernandez street and No.4 and No.5 along Perez street among the five positions as shown in Figure 7.6.1. Figure 7.6.2 shows the soil condition.

The very loose sand layer (N-value: less than five) is obtained at about the 3m-depth in the No.2 boring position. In the other boring positions this loose sand layer is shallower than that of the No.2 boring position. Further, the medium-degree sand layer with N-value of more than 15 is obtained at the 5m-depth in the No.4 boring position. For these boring data, it will be necessary to do energy correction to extract accuracies from this circumstantial judgment.

2) Conventional judgement on the liquefaction based on N-value

Notwithstanding the state of the postdisaster liquefaction, on the basis of the above boring drawings, a calculation based on Seed's simplified judgement method was done, on the supposition that the earth surface acceleration maximum for depth-GL-3m, N=5 and depth-GL-5m, N=15 were 100 gal, 200 gal and 300 gal respectively. However, the water level and the unit weight of soil in the calculation were used as the values empirically estimated. From the results, the following matters were evaluated.

- As shown in the No.2 boring, N=5 loose sand at GL-3m may be liquefied even in the level of 100 gal input.

- As shown in the No.3 boring, N=15 medium degree compacted gray fine sand at GL-5m may be liquefied even in 200 gal input.

However, since the relative subsidence of the buildings was only measured visually, a detailed survey will be necessary for the estimation of the input earthquake wave.

3) Classification and countermeasures of building damage due to liquefaction

Table 7.6.3 summarizes the classification of building damage due soil liquefaction in Dagupan city and its countermeasures. The buildings of damage classification a) were already partially rehabilitated; some stores reopened for business. In future, engineering discussion of rehabilitation is necessary for the damage level- c) such as that in Ruzon College.

For the future rehabilitation of buildings, there will be few technical difficulties from the experience of actual rehabilitation technology in the subsided and inclined buildings resulting from the Niigata Earthquake in 1964 and the present Japanese foundation engineering. However, such rehabilitation cost will be very expensive. Therefore, following factors should be carefully examined; importance factor, emergency and damage grade. Then optimum rehabilitation methods should be well studied.

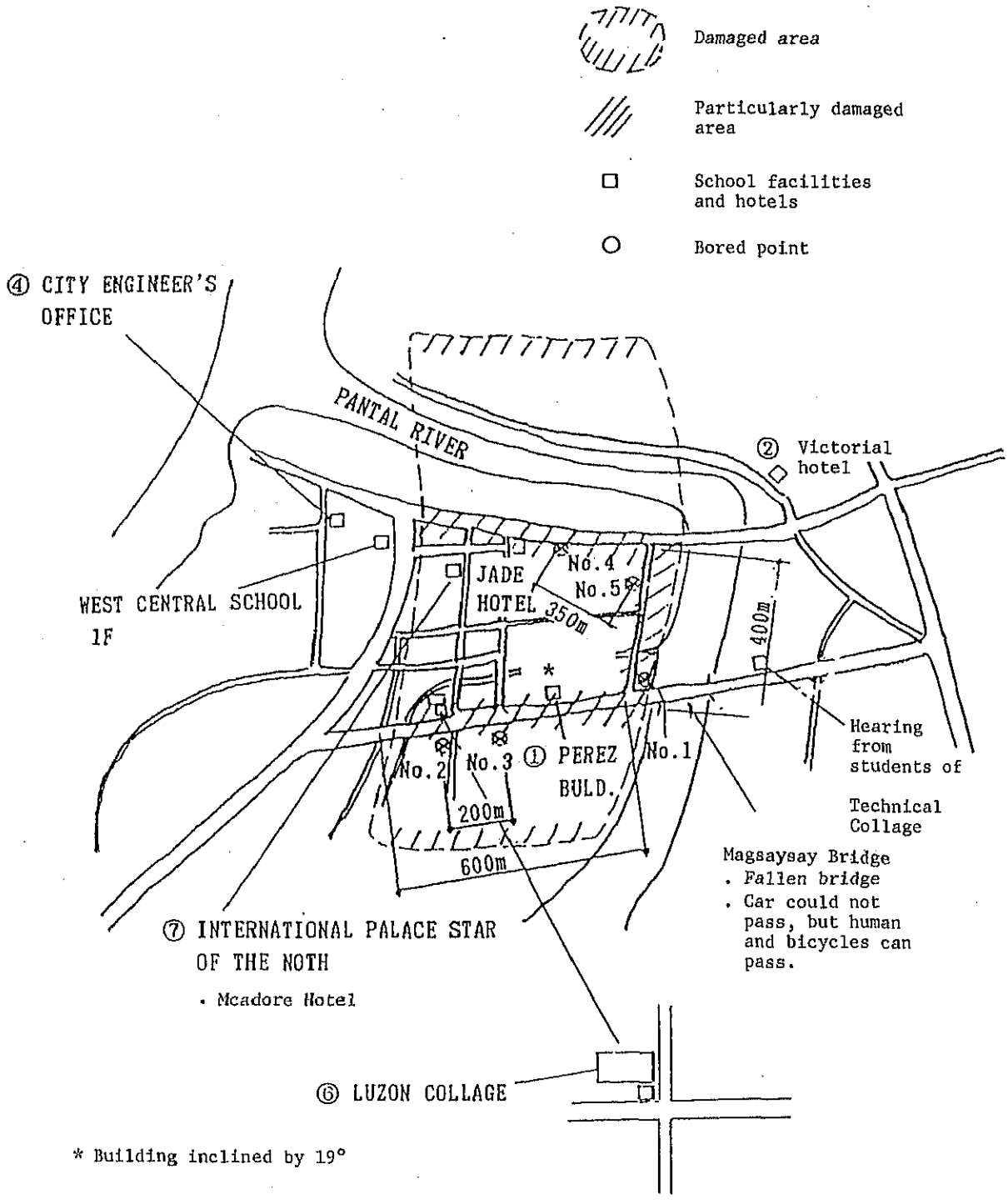


Figure 7.6.1 Damage Conditions in Dagupan City

Table 7.6.1 Outline of Reconnaissance

	Survey Position, Buildings	Reconnaissance Items	Remarks
(1)	Perez, Fernandez Street	Buildings inclined remarkably subsided.	Photos 7.6.1 - 7.6.6 7.6.11 - 7.6.12
(2)	Victoria Hotel	In and around the Victoria Hotel crossing the Pantal river, no damage.	
(3)	City Hall	Hearing on the damage conditions of the city by Mr. Atty. Virginto Corpuz.	Table 7.6.2
(4)	City Engineer Office	Hearing on the rehabilitation plan and foundations by Mr. Adelfd M. Dvifd.	Table 7.6.2
(5)	Task Force Rehab. Coordinating Center	Hearing on the damage conditions of the whole Pangasinan state by persons concerned at the center.	
(6)	Luzon Colleges	RC 5-story building, about 60cm relative subsidence from the ground surface, inclination of about 2° in the direction of the span.	Photos 7.6.7 - 7.6.10
(7)	Macadore Hotel	Cracks on a part of the exterior walls were observed. However, subsidence in the surrounding grounds were not observed, no unequal settlement existed.	Photos 7.6.13 7.6.14
(8)	The sate in the city on the way to Manila (8/1)	A part of the roads and buildings started in rehabilitation. It seems to take back the previous crowds.	Table 7.6.2

Table 7.6.2 Interview results at the City Hall and the City Engineering Office

City Hall	. Since the Mayor was absent, the damage conditions were heard about from Mr. Atty Virginto Corpuz. The City Hall was vibrated vertically for 45 seconds to 1 minute by the earthquake. . Many roads were raised up, and water and sand blew up to a height of about 1.5 m. . Seven persons died. Three of them were squeezed to death in crowds struck by serious panic, and the other four persons died in hospitals. . This was the first time that the 74 year old Mayor has actually experienced such damages. . The population is about 130,000, plus 4,000 students.
City Engineer Office	Damage conditions, restoration plan, and ground conditions were heard about from an engineer, Mr. Adelfo M. Dvifdo. . There were no fires or power interruptions from July 16 - 20. Muddy water, including sand, blew out up to about 2m. . Settled buildings and roads are now submerged under water and drainage channels are buried. For these reasons, the work of draining the water into rivers is the first thing to be planned and executed. He had no ideas about how to restore the town. . Boring data had already been obtained (separate materials).
Aspects of cities and towns seen on the way home (1 Aug.)	. The author called at Daguban City on the way home from Baguio. Fernade Street appeared to have been restored to its usual bustle and the first floor of many buildings had been repaired with concrete and sales activities had begun.

Photo 7.6.1

The row stores and houses on Perez street

. The view of the Perez street from the roof of a 3-story building beside Ruzon College.

. On both sides of the street, the 2F to 4F-buildings stand in line; subsidence and the inclination of buildings are shown.

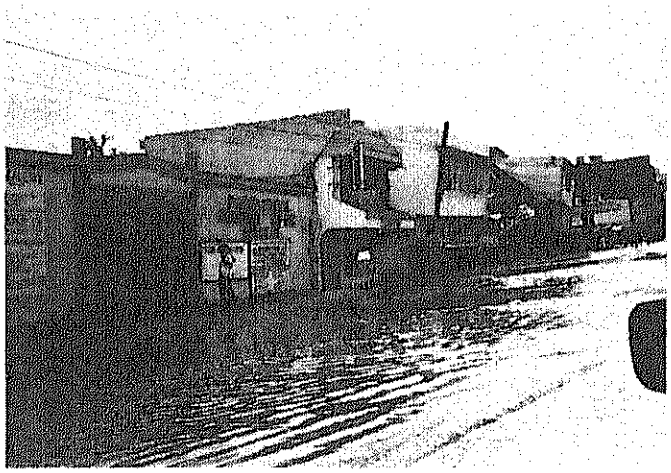


Photo 7.6.2

Damaged Buildings (1)-1

. The damage conditions of the subsidence and the inclination of the RC 3-story buildings on Perez street.

. The neighboring 1FL and 2FL buildings subsided; the damage of inclination was slight.

. The water on the street was caused by the breakdown of drain pipes.

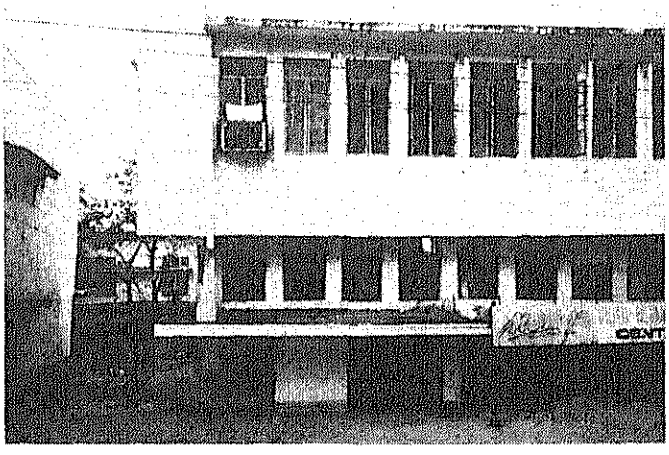


Photo 7.6.3

Damaged Houses (1)-2

. Close-up of subsided-inclined building.

. Damage to superstructures was hardly observed.

. The 1F-part subsides about 1m from the road surface, and is inclined to the road side.

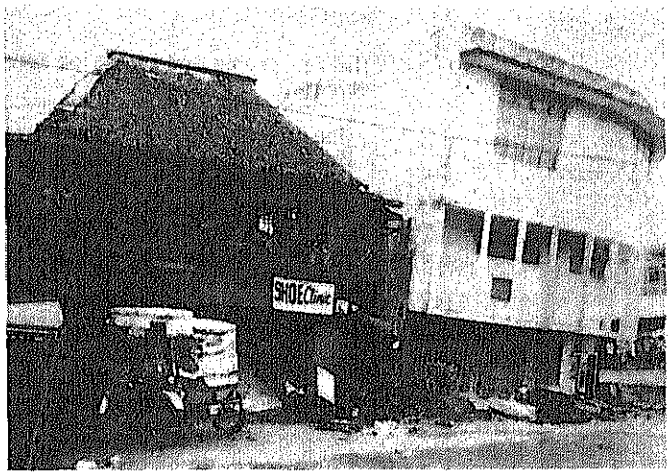


Photo 7.6.4

Damaged Buildings (2)-1

. The state of subsidence and inclination of a RC 3F building.

. Damage to superstructures is not observed; the building inclines to the road side remarkably.

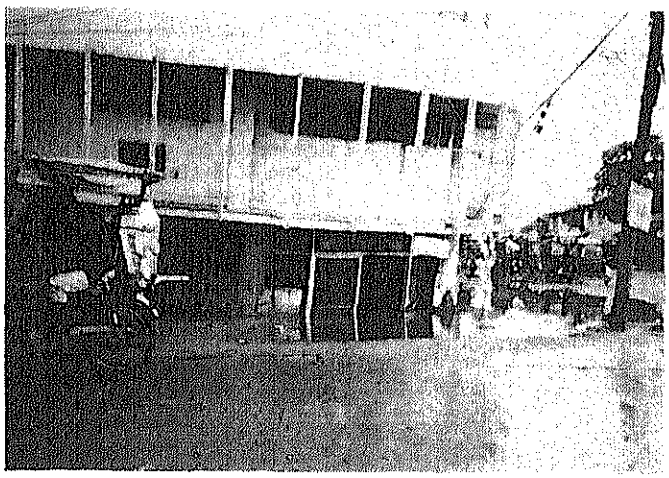


Photo 7.6.5

Damaged Buildings (2)-2

. The 1F-part sank under water. Spout-out sand is observed around the building.

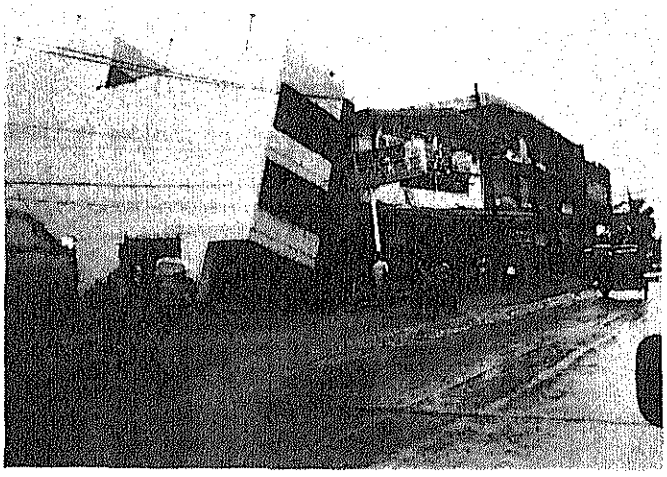


Photo 7.6.6

Damaged Houses (3)

. The building is inclined at 19 degrees to the right side, and neighboring building is damaged due to this inclination.

. The superstructures are not damaged.

Photo 7.6.7

Conditions of the road on Perez street

. The side of the buildings subside about 30cm relatively from the road face.

. Since the side of the building was higher by about 30cm than the road before the earthquake, a subsidence of about 60cm occurs relatively.

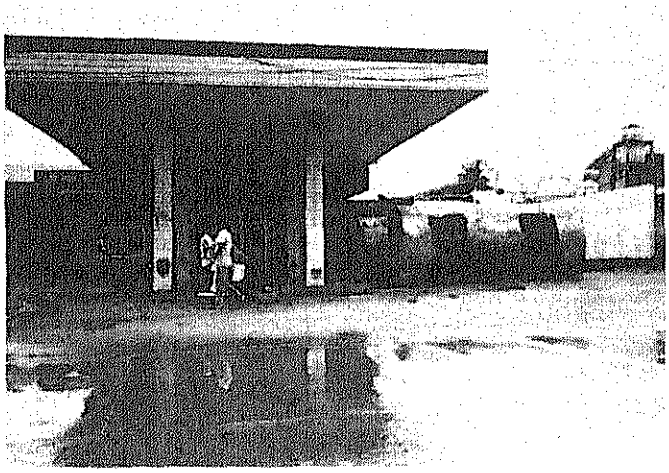


Photo 7.6.8

Tanks of a gas station

. Immediately after the earthquake, the tanks rose to the surface, and the slabs were destroyed.

. The tanks are moved to the road.

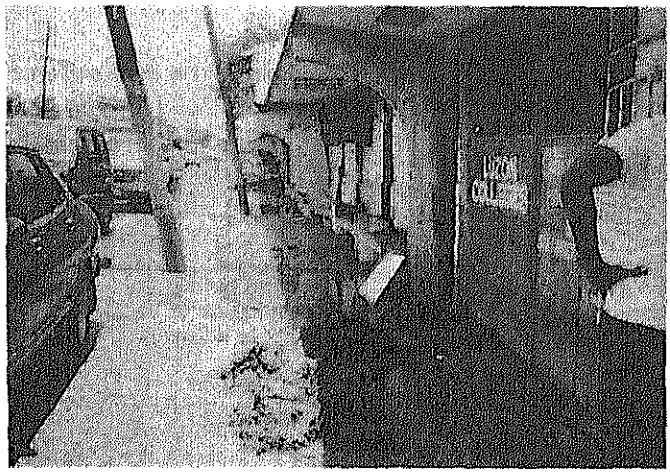


Photo 7.6.9

Luzon College - 1

. The building fronting Perez street subsides.

. The light post is inclined in the opposite direction of the building, and a lot of spouted-out sands are observed on the road.

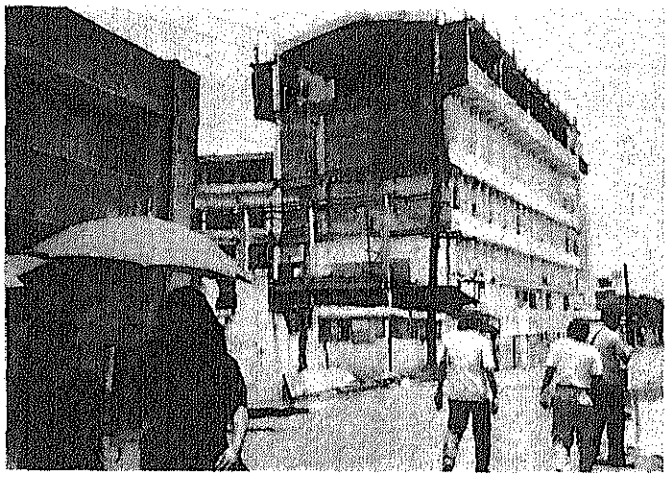


Photo 7.6.10

Luzon College - 2

. The state of the damaged RC 5F building.

. The building subsides more than 60cm from the ground surface.

. The 5FL block wall of the gable end of the new extension built on the old school is destroyed, and the blocks are being demolished.

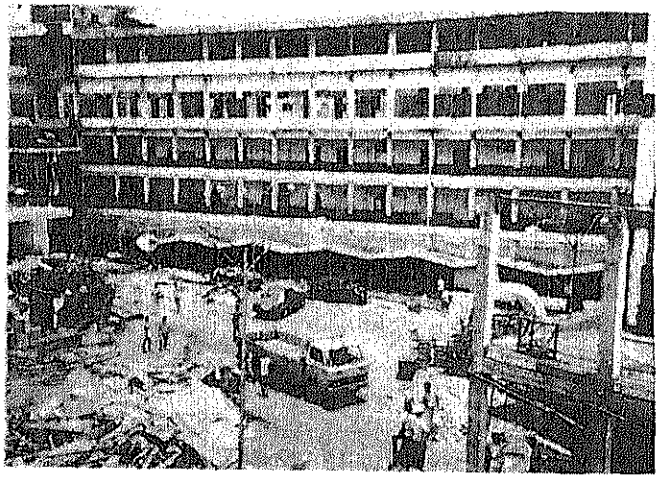


Photo 7.6.11

Luzon College - 3

. Though subsidence of the whole building is observed, the damage to the superstructure is not observed.

. The building is level in the bay direction, while it is inclined at two degrees in the span direction.

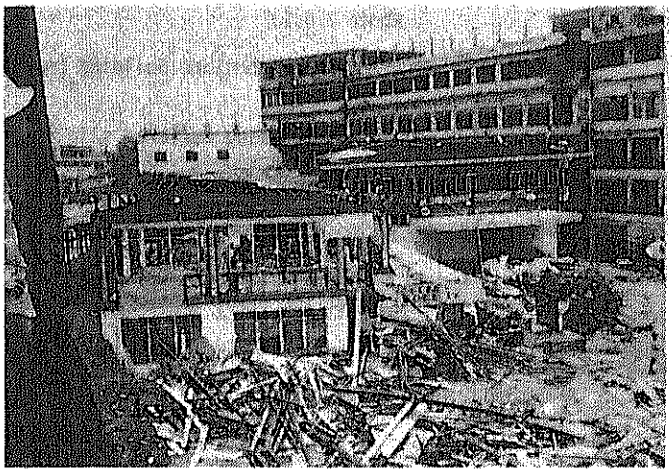
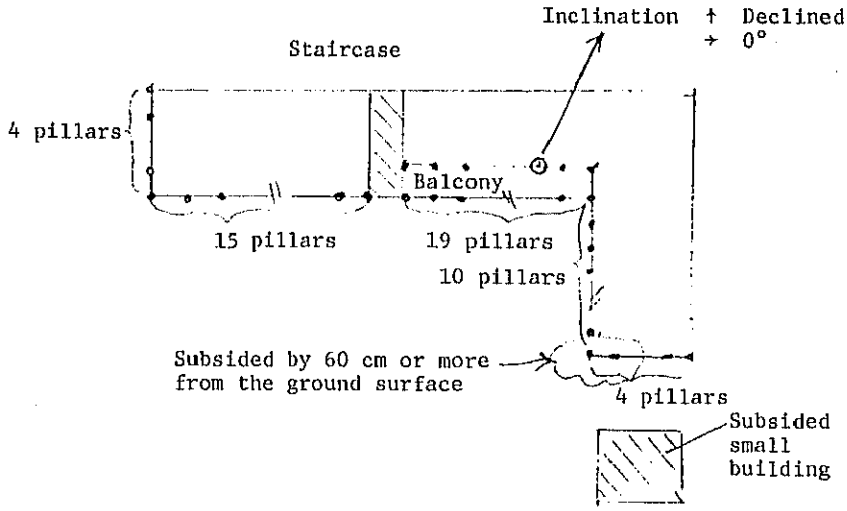


Photo 7.6.12

Luzon College - 4

. A complete view of the buildings.

. One or two story buildings are badly damaged, and they are being demolished.



o Luzon College

. RC 5-story, penthouse 1-story

. A part: Pilotis

. Constructed 20 years ago, later 5th floor was extended.

o Subsided buildings

Information from the owner

. There was a fish pond 30 years ago, the pond had been reclaimed for city area 20 years ago.

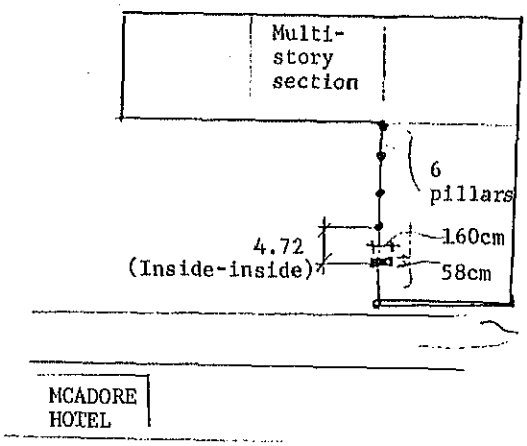
. For rehabilitation, the base is used as it is, the first floor is leveled, and the stories more than 2nd floor will be repaired.

Photo 7.6.13

Modestar Sabeniano Building (movie house)

. The building suffered slightly; cracks are observed on the exterior walls; subsidence hardly is observed in the neighborhood.

. The building was not damaged, but the panic caused casualties.



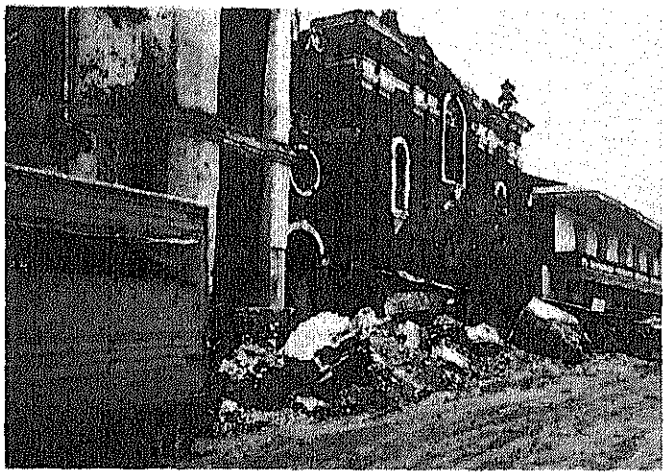
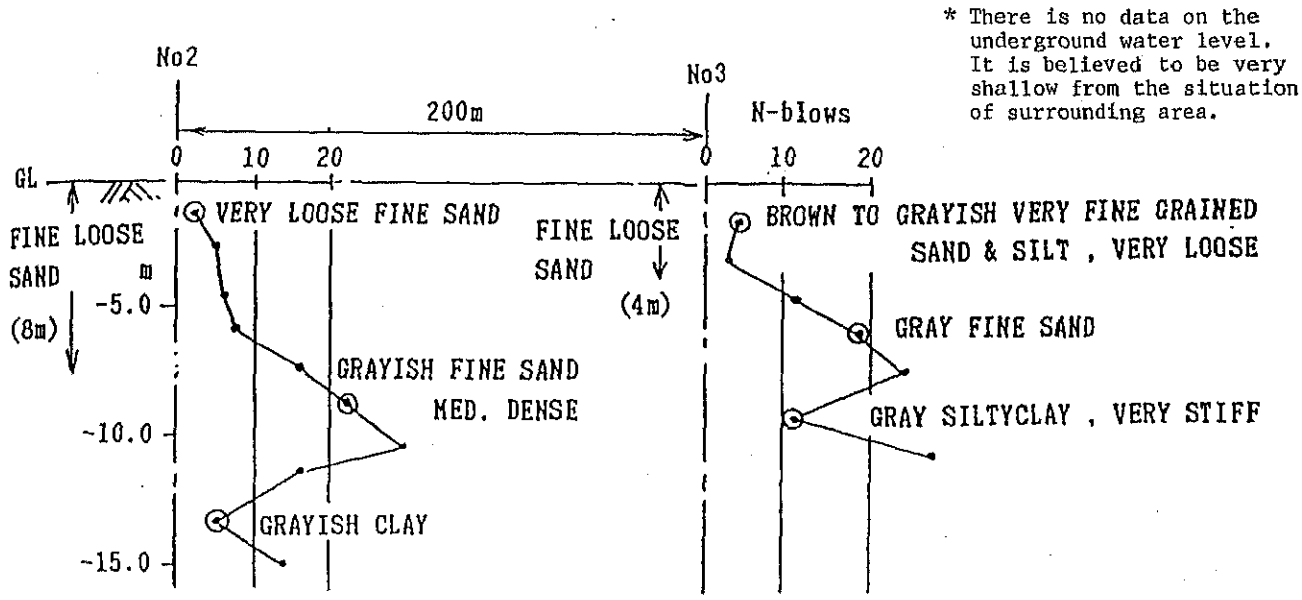


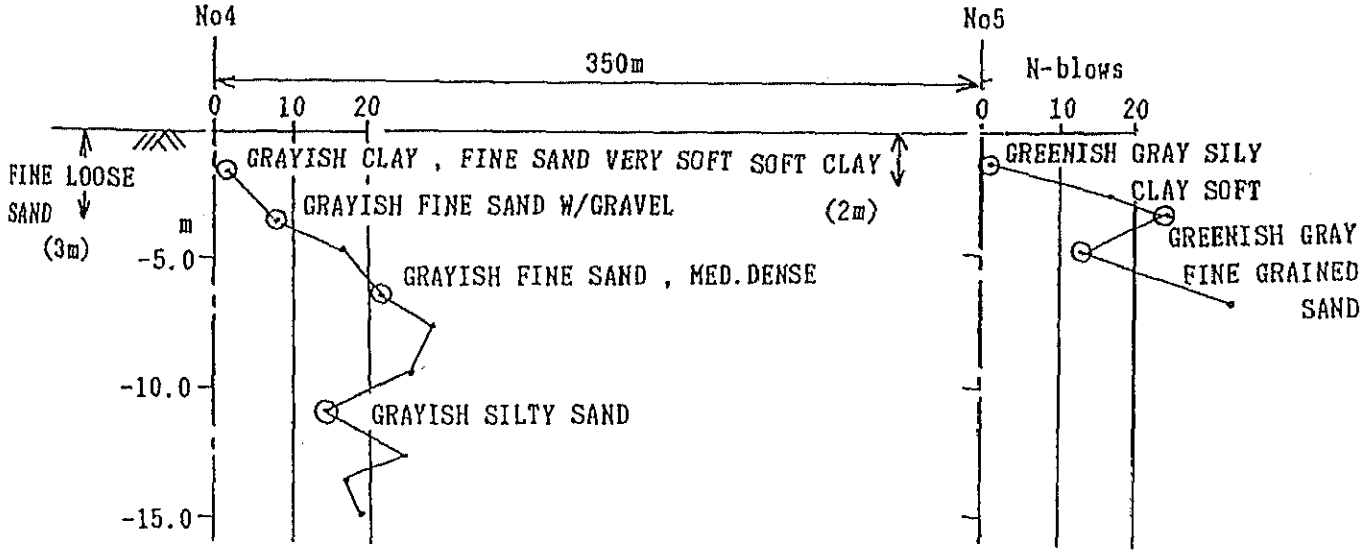
Photo 7.6.14

Macadore Hotel

. The old penthouse made of bricks is damaged.



a. Fernandez Street



b. Perez Street

Figure 7.6.2 Ground of Dagupan City

Table 7.6.3 Classification of Building Damage due to Liquefaction and its Countermeasure

Classification	The number of damaged houses, scale	Countermeasure	The point at issue
a) Less than 50cm of settlement, less than 1/100° of incline.	. One and two story buildings along Perez and Fernandez streets (more than 100 houses).	. Repairing of the mud room and making difference in level with the road.	. The use of the water supply and waste water of 1F.
b) More than 50cm of settlement, less than 1/100° of incline.	. The two to three story buildings along Perez street (30 to 50 houses).	. 1FL is rebuilt to be a warehouses, etc., and the superstructures are able to be used as it is. . The building is able to be jacked up whole.	. The jacking-up of the whole building is expensive.
c) More than 50cm of settlement, more than 1/100° of incline.	. The buildings more than three stories along Perez street (more than ten buildings including Luzon College).	. In the case of a slight incline, the foundation is left as it is, and only the superstructure is jacked up. . In the case of a sharp incline, a large scale rehabilitation work including foundation work is necessary.	. Rehabilitation work is expensive.

7.6.2 Damage in Baguio City

(1) Baguio city

Since Kennon road and Marcos highway leading to Baguio city from Dagupan are closed due to earthquake damage, we could only go via Agoo and Bauang located along the Lingayen Gulf through the Naguilian road. Though the transport of the relief things and the pedestrian traffic are heavy, everywhere the collapse of the road or slope failure are observed. Therefore, one-way traffic control is being undertaken. Vehicles run from Baguio in the morning and vehicles for Baguio in the afternoon.

Baguio city having a population of about 200,000, located about 60km northeast of Dagupan city, at an elevation of 1,500 meters, is a tableland resort city. Since there is little flatland in the city, most of the buildings are constructed on the slope.

The midtown area of the city, sandwiched between Session and Harrison roads, runs about 1 kilometer from east to west and about 500 meters from south to north. It is composed of commercial-business areas. Other areas, such as school zones, amusement quarters, residential area and industrial areas, are located as shown in Figure 7.6.4.

The main industries are sight-seeing during summer from March to May and the supply of vegetables to the Metro Manila.

(2) The features of the reconnaissanced buildings

Due to the limited time of only one day for the reconnaissance, with a hearing from the mayor and the city engineers. We surveyed each heavily damaged building and did a total inspection in the specified damaged areas. Figure 7.6.4 shows the positions of surveyed damaged buildings, and Figure 7.6.5 shows the positions of inspected

buildings along Session road. Further, we did a short-term check of the damage conditions in the housing area. Most of the medium-high rise buildings in Baguio city are made of reinforced concrete frame structures. The walls are nonstructural walls made of hollow concrete blocks finished with mortar. Most of the base of the medium-high rise buildings are supported on the ground directly by continuous footing or mat foundation. However, some buildings uses pile foundations.

The construction is separated system; in which columns are casted with beam slabs separately. After the columns and the beams are casted, the walls are arranged by laying hollow concrete blocks.

The present situation of the houses is as follows.
The houses can be classified into the following three types.

(1) Buildings for apartment houses in which the upper floor of the combined buildings are located in the commercial-business area.

(2) Residential areas occupied mostly by low-rise residential houses in the north and the south.

(3) Villas located in the northeast of the city.

The features of the low-rise buildings located in the south of the city are listed as follows.

a) The buildings are constructed between sharp slopes and the ravine.

b) The walls are made of blocks and the exterior walls are finished with mortar. The roof is constructed with light materials such as corrugated galvanized steel sheets.

c) As located on the slope, there are many houses in which the base parts were constructed by reinforced concrete frame.

d) The scale of the houses is supposed to be 50 to 80 m^2 and number of story is one or two.

(3) Damage situation

According to the Department of Public Works and High Ways, the earthquake damage in Baguio city as of July 29th is reported as follows: 385-dead, 1,101-wounded, the 235-missing, 3,668-completely destroyed houses and the 8,205-partially destroyed houses.

Table 7.6.4 shows a list of the damage contents of all reconnaisanced buildings. Many medium-high rise hotels and apartment houses are destroyed. The number of checked buildings along Session road are from number 14 to 35 (22 buildings) in this Table. According to the damage-degree criterion in Japan, these 22-buildings along Session road are classified as follows: 5-slightly damage, medium damage, 1-serious damage, 2-collapse and 13-non damage. Compared with buildings having more than serious damage from number 1 to 13, the 22-buildings are low rise buildings. The City Hall informed that the percentage of the damage to the residential districts is as follows: south districts 30%; north districts 20%. The damages of the buildings are as follows.

(1) Damage caused by the subsidence-movement of ground.

(2) Damage due to the lack of shear resistance and the lack of the deformability against the earthquake force.

(3) Damage by defects in construction works.

(4) Damage of the secondary walls.

Item (1) is found in the many low rise buildings on the slope or in the retaining walls.

Many cases of item (2) are found in the medium rise hotels and apartment houses which took a heavy toll of human lives. Mostly, the lack of the flexural strength of the columns and the shear fracture of beam-column joints was seemed to cause their collapse or serious damage.

On the basis of the observation of damaged reinforcement concrete buildings, actual seismic design method is seemed to be as follows:

a. Most of buildings are frame structure. The walls are designed as secondary walls of hollow concrete blocks.

b. The section of the columns is smaller in comparison with the section of the beam; the section of the columns is about half of that specified in Japan.

c. There are many cases in which large-size longitudinal reinforcements are used and almost of their joints are lap-splicing.

d. For the main reinforcements at the corner of columns, clustered reinforcing bars are put together frequently.

e. Due to the clustered, large-sized reinforcing bars and their lap-splicing in the small column section, the placing of the anchor reinforcements of the beam becomes difficult.

f. The amount of lateral reinforcing bars in columns is generally small. The amount of shear reinforcing bars in many buildings was less than 0.15%.

As for the damage described in item (3), generally, construction work in the Philippines is behind with respect to its mechanization; the great part of construction work

has been done by man-power. For example, many processes of the concrete works of medium-high rise buildings has been done by human powers. Ready-mixed concrete is transported by truck mixers to sites from plants, while the transport to the place to be casted and the concrete pouring work itself have been done by human power, since concrete pumps are not in general use in the Philippines. From observations of the building site, we have some doubts about the quality control on construction work or in the materials, such as the curing or the strength control of construction joints.

As for the damage described in (4), the non-structural walls made of hollow blocks, added after beam and columns were constructed, were badly damaged by the earthquake. This damage is spread from the low rise to high rise buildings. Since the responsed story drift becomes large in the case of frame structures of high rise buildings, a separate countermeasure between the structures and the secondary walls will be necessary in future. However, in the case of damage to this non-structural walls only, it will be not necessary to consider structural problems if the walls are repaired.

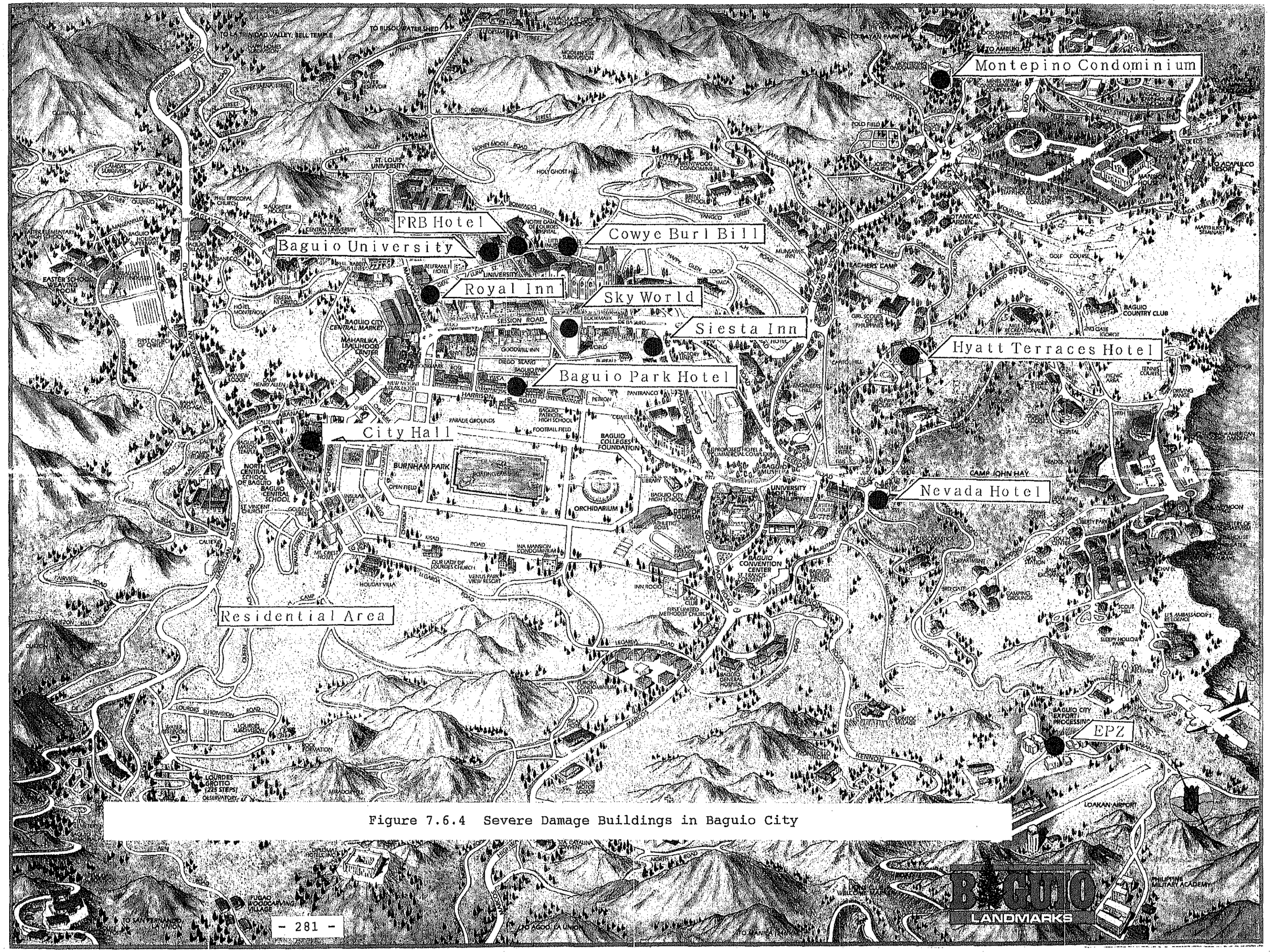


Figure 7.6.4 Severe Damage Buildings in Baguio City

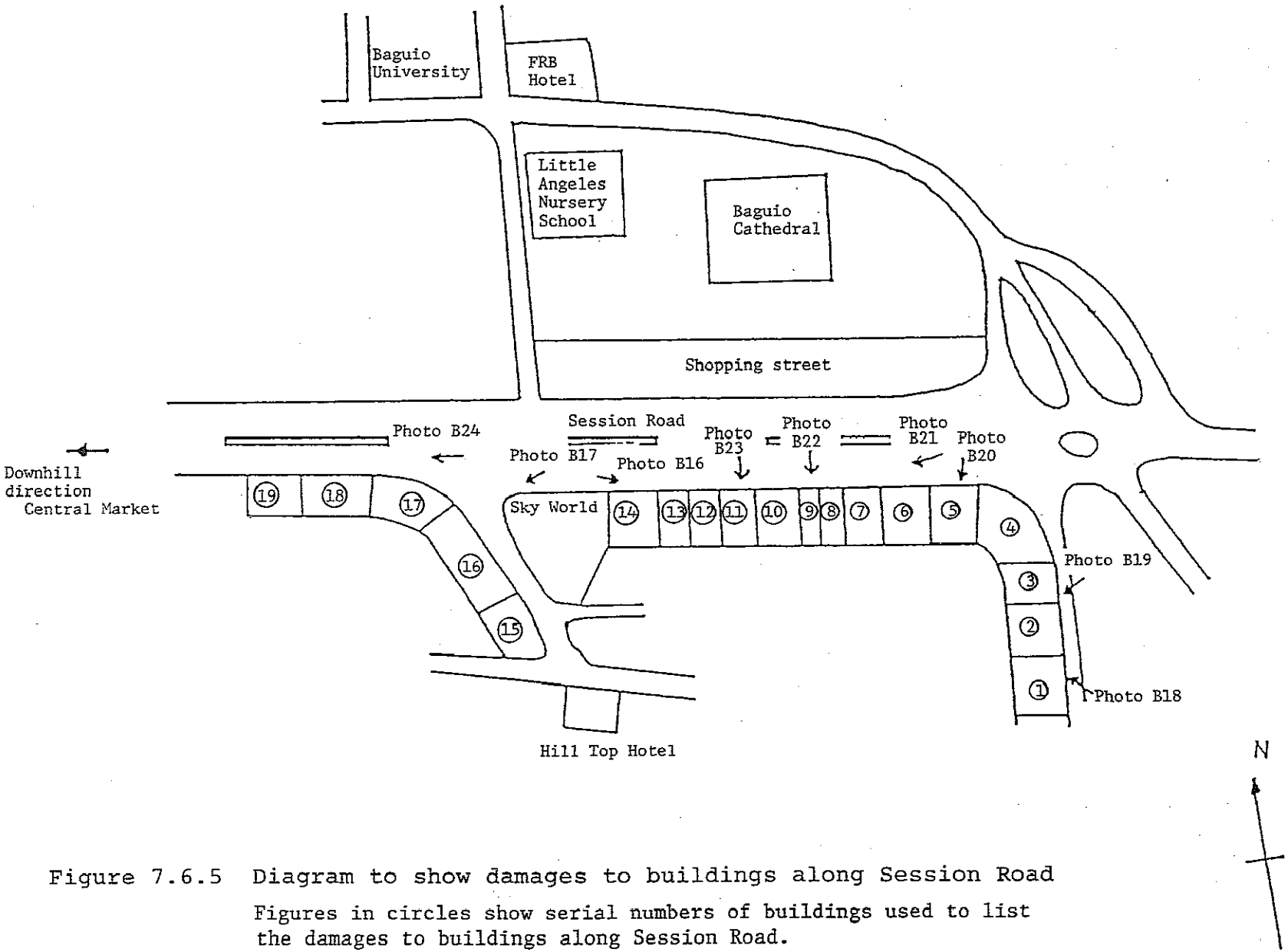


Figure 7.6.5 Diagram to show damages to buildings along Session Road

Figures in circles show serial numbers of buildings used to list the damages to buildings along Session Road.

Table 7.6.4 List of the Damage Conditions of Buildings in Baguio City

No.	Name of Buildings	Use	Structure Type	Stories	Damage Conditions	Damage Degree	Number of Photo
1	Export processing zone (EPZ)	Factory	RC	3	Collapse, fire occurrence after the disaster.	Collapse	7.6.15 - 16
2	Nevada Hotel	Hotel	RC	4	Collapse of 1FL and 2FL part, due to subsidence, 4-stories changed into 2-stories.	Collapse	7.6.17
3	Hyatt Terraces Hotel	Hotel	RC	7 11	Collapse of the terrace part (constructed 1978) and the tower part (constructed 1982).	Collapse	7.6.18 - 20
4	Monte Pino Condominium	Apartment house	RC	10	1FL-columns and walls were badly damaged, constructed 1966.	Serious damage	7.6.21 - 23
5	The Tower	Apartment house	RC, Pile foundation	8	Non-damage.	Non-damage	7.6.24
6	Baguio Park Hotel	Hotel	RC	8	Collapse.	Collapse	7.6.25 - 26
7	Sky World	Apartment house	RC	9	Serious damage of the 1FL-columns and walls, the state just before collapse.	Serious damage	7.6.27 - 29
8	Royal Inn	Hotel	RC	3	Collapse of 1FL part, due to subsidence, 3-storied building changed into 2-storied building.	Collapse	7.6.30
9	FRB Hotel	Hotel	RC	5	Collapse of 1F and 2F parts.	Collapse	7.6.31 - 32
10	Cowye Burl Bill	Office	RC	5	Serious damage to the columns and the walls of 1F and 2F.	Serious damage	7.6.33

No.	Name of Buildings	Use	Structure Type	Stories	Damage Conditions	Damage Degree	Number of Photo
11	Baguio University	School	RC	7	Collapse above 3FL, constructed forty years ago.	Collapse	7.6.34 - 35
12	Siesta Inn	Hotel	RC	4	Collapse of 1FL part, due to subsidence, 4-storied building changed into 3-storied building.	Collapse	7.6.36
13	Buildings in the residence areas	Unknown	RC	2	Collapse of 1FL part.	Collapse	7.6.37
14	Baguio Cathedral	Church	RC	1	Shear cracks in the 4-columns.	Slight damage	7.6.38
15	Little Angeles Nursery School	School	RC	5	Damage of the part of the columns and walls.	Slight damage	—
16	Unknown	Hotel	RC	4	Collapse	Collapse	7.6.39 - 40
17	Baden Powell	Mixed residence	RC	2	Non-damage	Non-damage	7.6.43
18	Siesta Inn	Hotel	RC	4	See the list of the damage conditions of the buildings in Baguio city.		7.6.44
19	Amapola	Restaurant	RC	2	Serious damage of 1F part.	Serious damage	7.6.44
20	Filtel	Telephone office	RC	2	Non-damage	Non-damage	—

No.	Name of Buildings	Use	Structure Type	Stories	Damage Conditions	Damage Degree	Number of Photo
21	BPI	Bank	RC	2	Non-damage	Non-damage	7.6.45
22	RCBC	Mixed residence	RC	2	Damage on parts of the columns and walls.	Slight damage	—
23	RCPI	Mixed residence	RC	3	Non-damage	Non-damage	—
24	Unknown	Mixed residence	RC		Non-damage	Non-damage	—
25	City Trust	Bank	RC	6	Peeling of the facing bricks.	Slight damage	7.6.47
26	AI-YAN	Mixed residence	RC	3	Non-damage	Non-damage	—
27	Philam Life	Mixed residence	RC	2	Non-damage	Non-damage	7.6.48
28	Manahan Bill	Mixed residence	RC	3	Non-damage	Non-damage	—
29	Fill Indian	Store	RC	4	Non-damage	Non-damage	—
30	Fighting Justice	Mixed residence	RC		Non-damage	Non-damage	—

No.	Name of Buildings	Use	Structure Type	Stories	Damage Conditions	Damage Degree	Number of Photo
31	Llamas Pol	Mixed residence	RC	2	Damage in the walls.	Slight damage	—
32	Benguet Prime	Hotel	RC	6	Damage in the 3FL-walls.	Slight damage	7.6.42
33	Handaan sa Baguio	Mixed residence	RC	2	Peeling of finishes.	Slight damage	7.6.49
34	Unknown	Mixed residence	RC	3	Damage in the columns.	Half-damage	—
35	Baguio Goodwill	Hotel	RC	4	Damage in the columns.	Slight damage	—

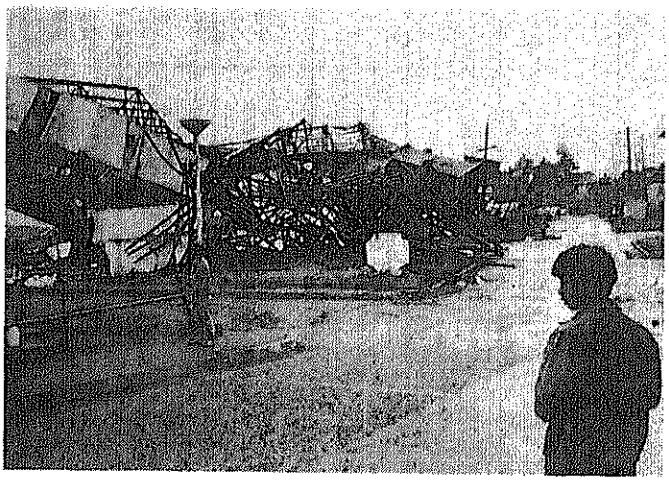


Photo 7.6.15

Name of the building:
Export processing area

Condition of the building:
Collapse

Fire occurrence after the disaster, steel framed truss structure of the roof structure only.

There are the two same buildings with the road between. The left side building collapsed.

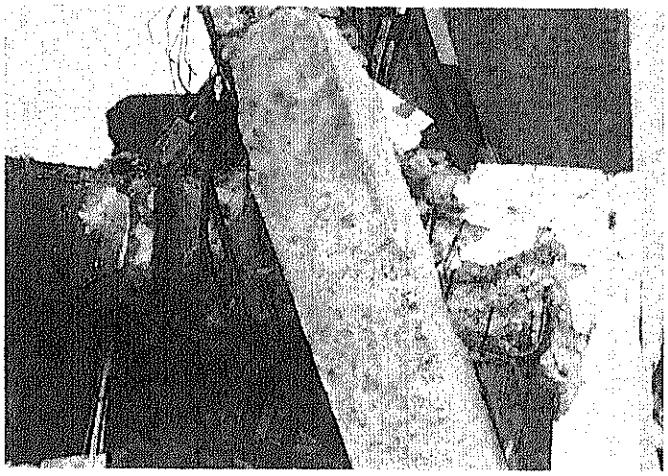


Photo 7.6.16

The joint part of the column-beam of 3F, the column: 40cm square (8-D35). The section of the column is smaller than that of the beams. The interval of the columns to the direction of the beam is 5.5m.

Photo 7.6.17

Name of the building: Nevada Hotel

Damage conditions:
Collapse of the 1F part

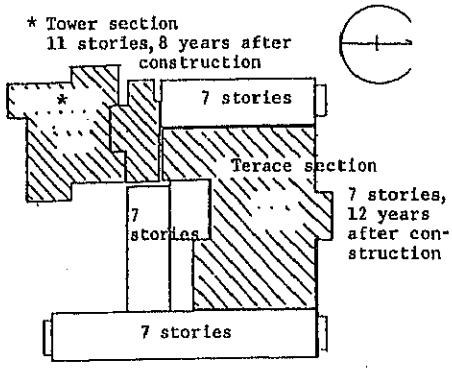
the beam: 35cm-width, main reinforcement: D16, the stirrup: D10, the columns: 39cm squares, man reinforcement D18 x 8 (bundled two bars)

Photo 7.6.18

Name of the building:
Hyatt Terrace Hotel

Condition of the building:
Collapse

Collapsed condition of the tower parts.



Note: Shaded areas indicate collapsed sections.

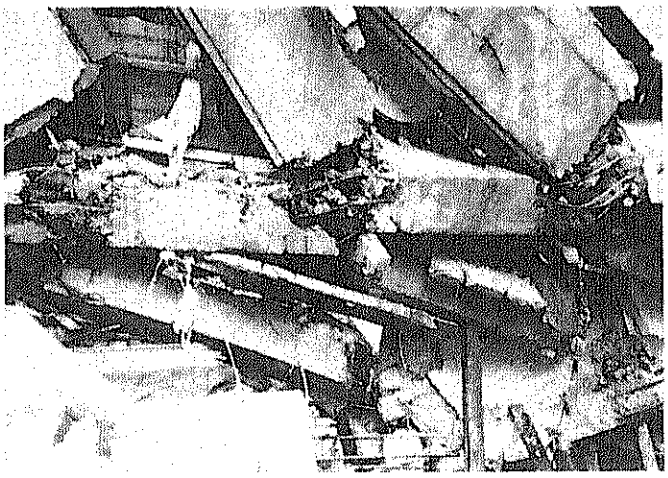


Photo 7.6.19

Damage of the column-beam joints:
The columns are seen horizontally. The dimension of the column is smaller than that of the beams. The section of the 1F columns: 60 x 75cm, main reinforcement: 10-D38, hoop: D16-200@
The interval of the column: 4.0m

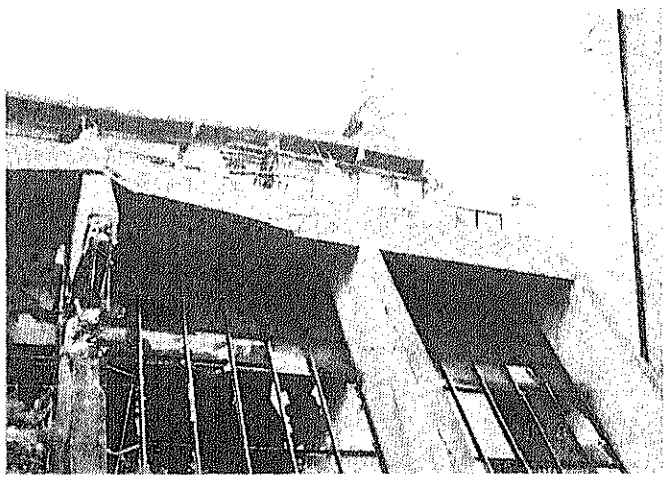


Photo 7.6.20

The damage condition of the entrance side of the terrace: The structural joint with the right side building is not observed; the section of the oblique column: 850 x 55cm, main reinforcement: 8-D32 hoop: D10-300@

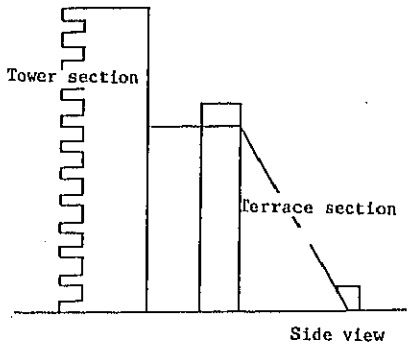
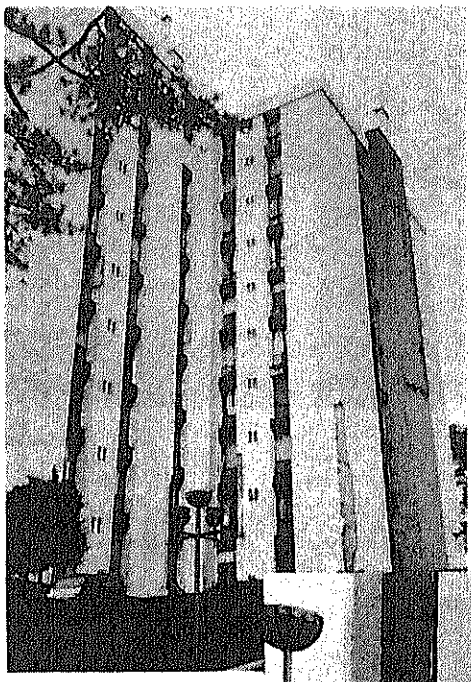


Photo 7.6.21

Name of the building:
Moute Pino Condominium

Condition of the building:
Serious damage at the columns and wall parts, the peeling at the exterior walls up to 4F.



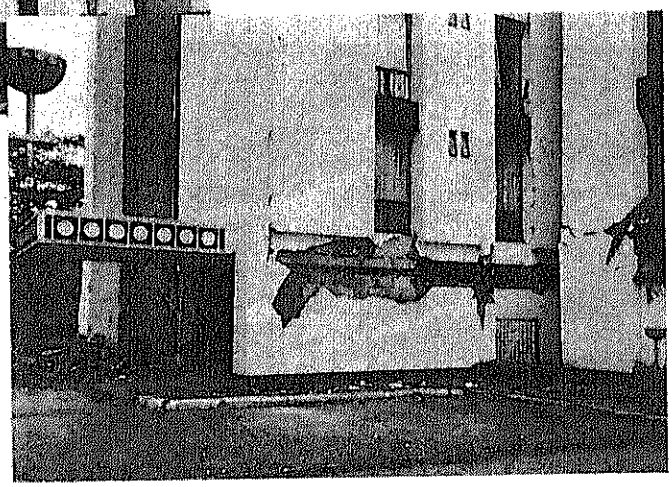


Photo 7.6.22

The east end of the north face: Serious damage of the short column parts, serious damage of the secondary walls made of blocks.

Photo 7.6.23

The end part of the west side of the north face: Serious damage of the 1F column-wall parts (Buckling of the main reinforcement, collapse of the secondary walls).

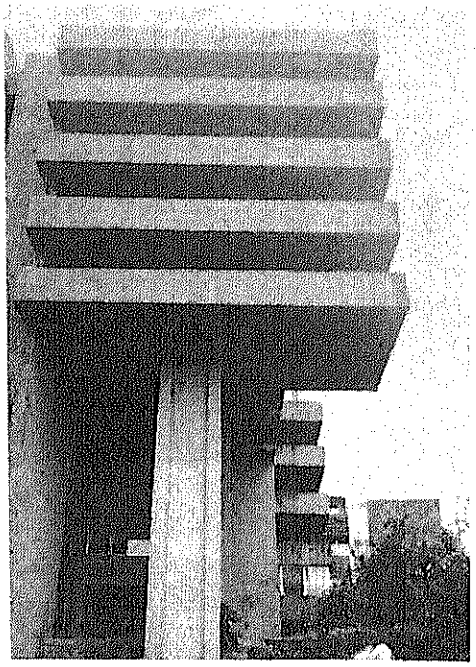


Photo 7.6.24

Name of the building: The Tower

Condition of the building:
Non-damage

The wall area and the column section are larger than those of the other buildings.

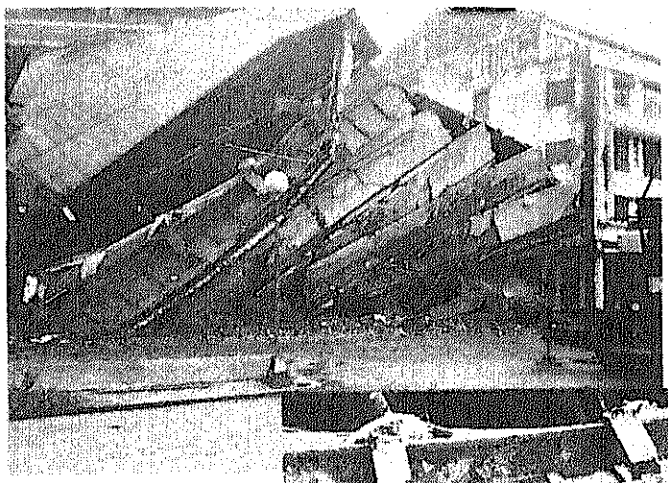


Photo 7.6.25

Name of the building:
Baguio Park Hotel

Condition of the building:
Collapse

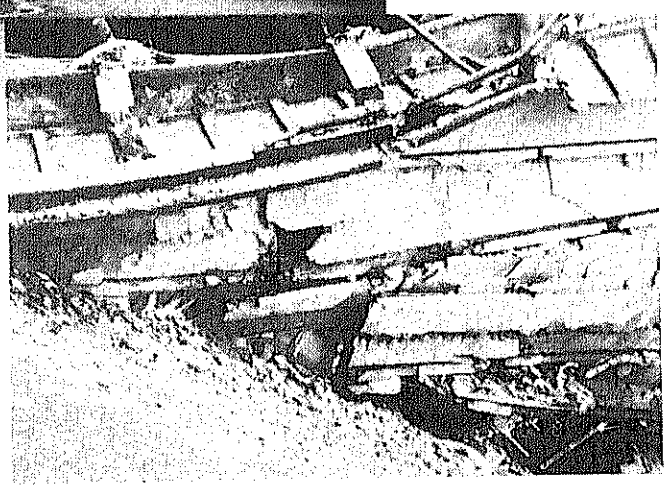


Photo 7.6.26

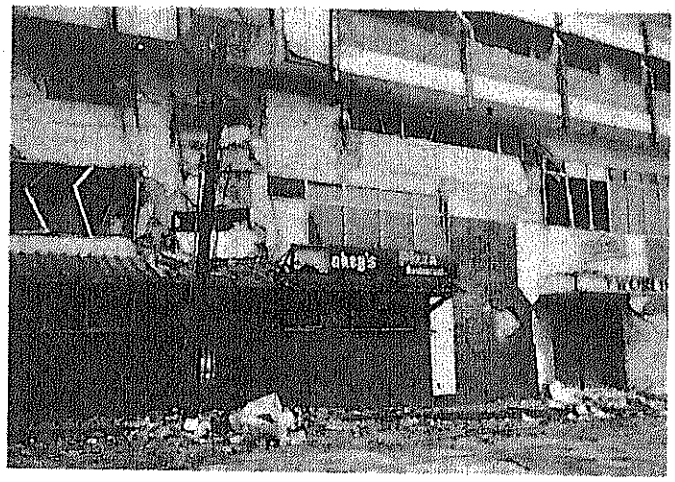


Photo 7.6.27

Name of the building: Sky World

Condition of the building:
Serious damage to the column and wall parts, the short columns from 1F to 5F: short column shear fracture.

Photo 7.6.28

The 30 to 50cm floor height at 1F descends.

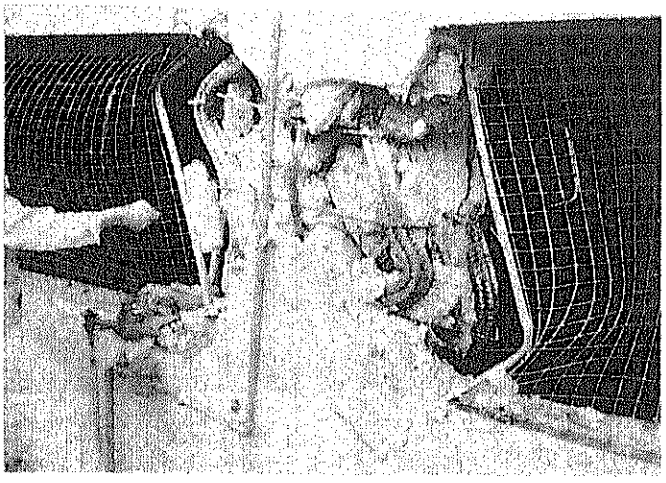


Photo 7.6.29

The condition of the damage of the short columns: The 4-main reinforcing bars (D29) are bundled at the corners; amount of hoop (D10) is few.

Photo 7.6.30

Name of the building: Royal Inn

Condition of the building:
Collapse of 1F parts

Post tension PC cables are used in the beams.

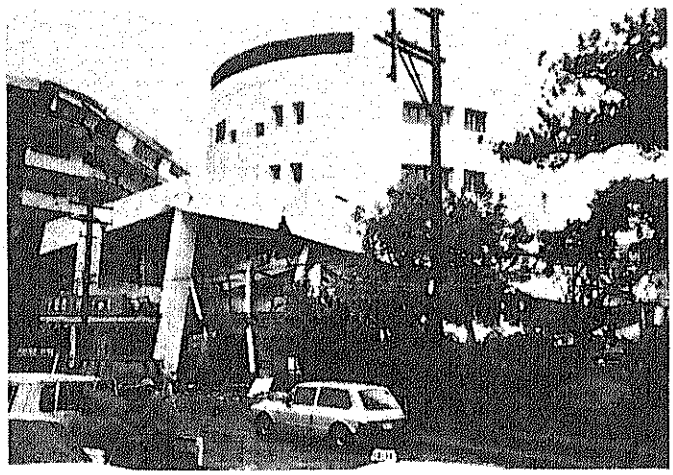


Photo 7.6.31

Name of the building: FRB Hotel

Condition of the building:
Collapse of the 1-2F parts

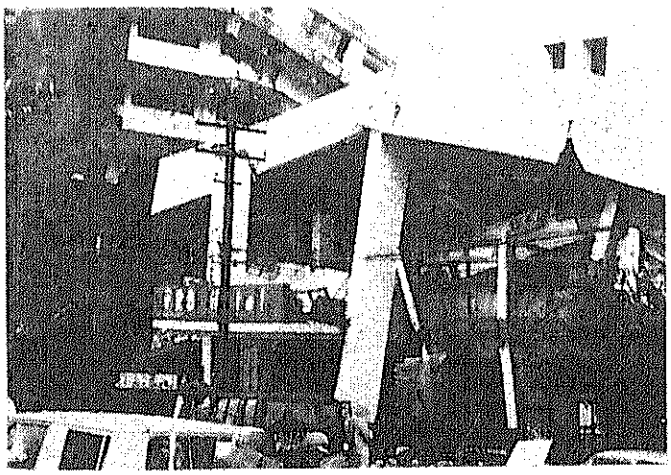


Photo 7.6.32

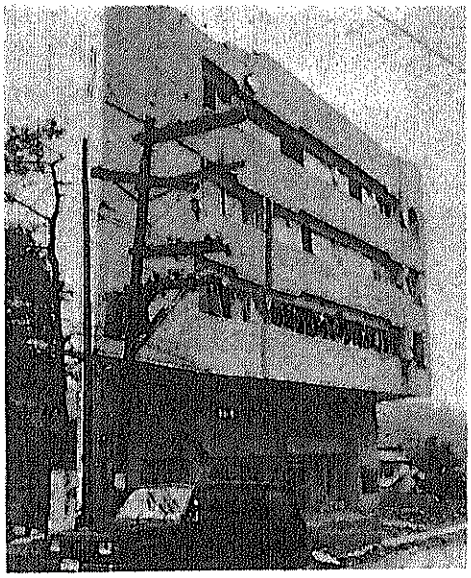


Photo 7.6.33

Name of the building:
Cowye Burl Bill

Condition of the building:
Serious damage in the columns and walls, collapse of the column of the cantilever parts at 3 to 5F.

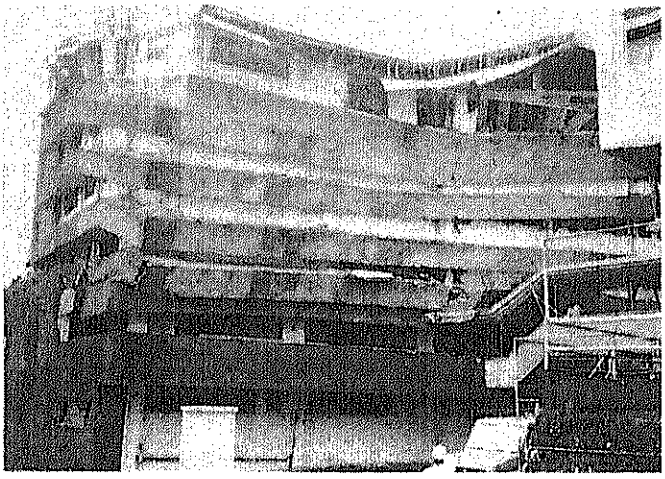


Photo 7.6.34

Name of the building:
Baguio University

Condition of the building:
Collapse above 3F

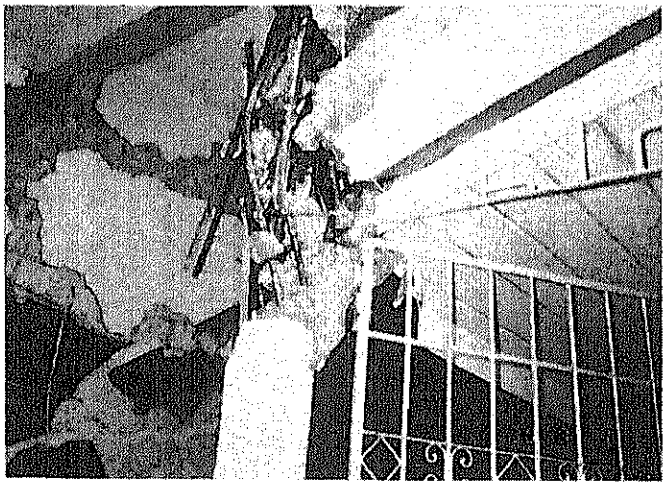


Photo 7.6.35

The joints of the columns and the beams in the neighboring building

Photo 7.6.36

Name of the building: Siesta Inn

Condition of the building:
Collapse of 1F part

The 4-storied building changed into a 3-storied building. There is a valley at the opposite side.

Photo 7.6.37

Name of the building:
Mixed residence

Condition of the building:
Collapse 1F and 2F parts

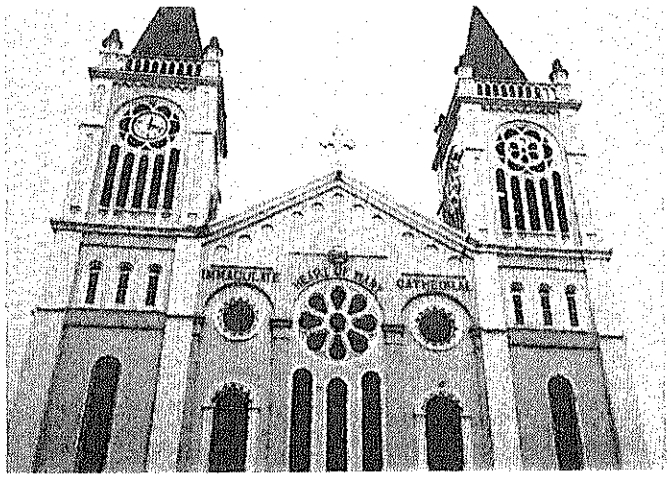


Photo 7.6.38

Name of the building:
Baguio Cathedral

Condition of the building:
Collapse in parts of the columns and walls.

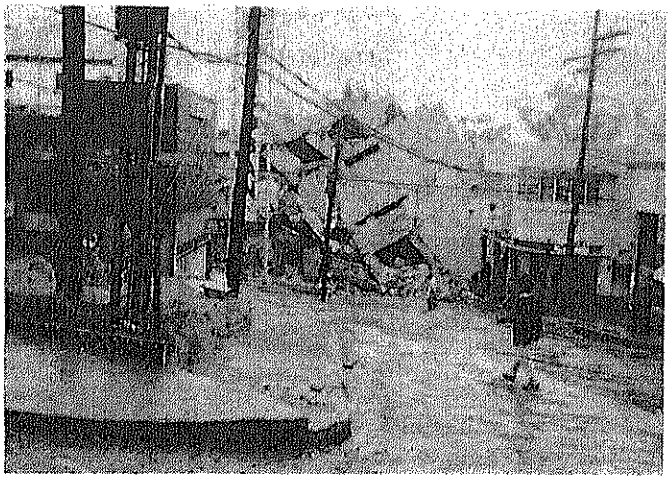


Photo 7.6.39

Name of the building: Unknown

Condition of the building:
Collapse

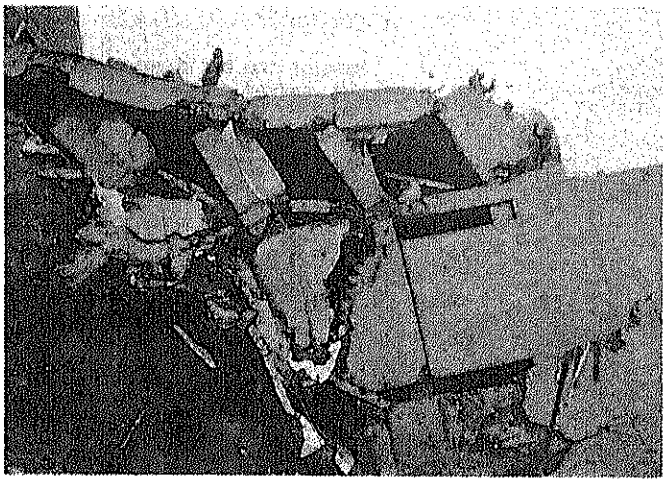


Photo 7.6.40

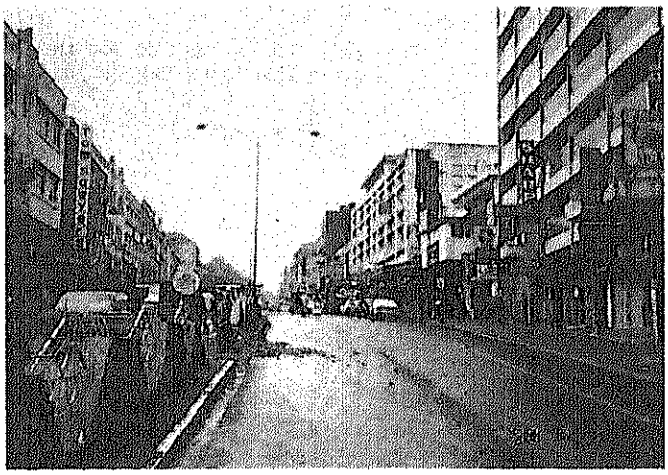


Photo 7.6.41

See the head of a slope from Sky World.

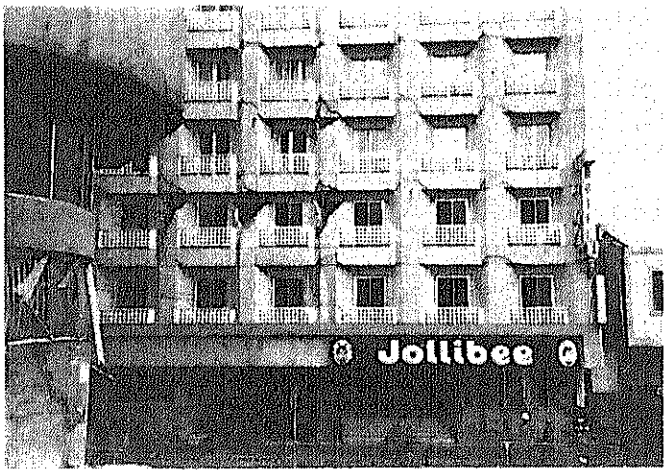


Photo 7.6.42

See the Benguest Prime Hotel from Sky World.

Photo 7.6.43

Baden Powell Hill at the head of a slope.

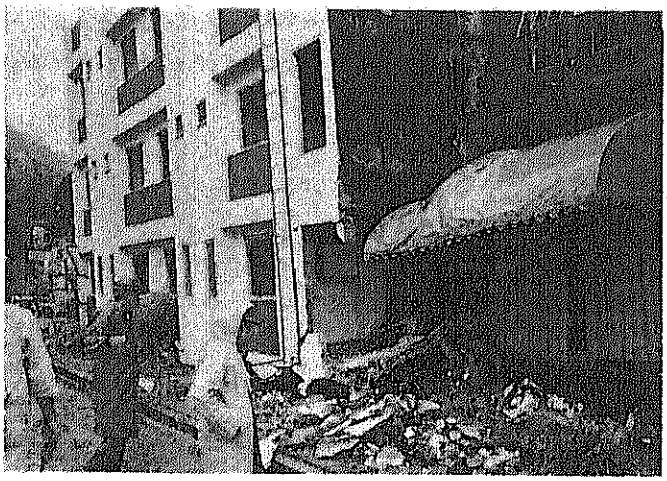


Photo 7.6.44

This side is Amapola, and the other side is the Siesta Inn.

Photo 7.6.45

BPI building

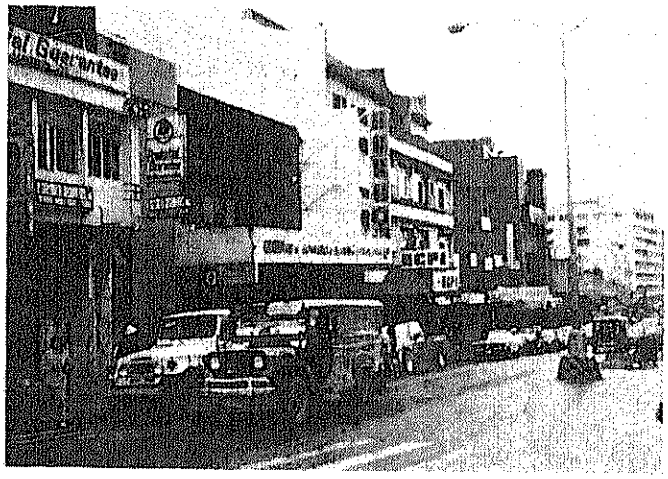


Photo 7.6.46

See the BPI direction from Sky World.

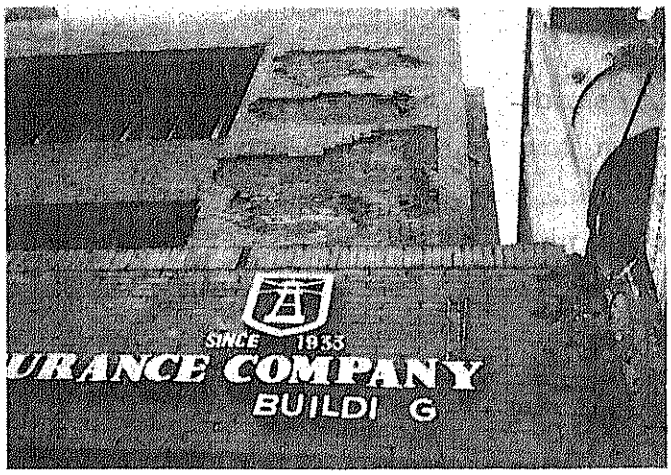


Photo 7.6.47

City Trust building

Photo 7.6.48

Philam Life building

Photo 7.6.49

See the foot of the slope from Sky World.

7.6.3 Damage to the Metro-Manila

In the Manila area, we reconnaissanced a total of 12-buildings in the three cities; Manila, Quezon and Pasay. Figure 7.6.6 shows the urban area of the Metro-Manila. Surveyed buildings are plotted on the map. The 7-buildings in the west of Manila city are located along the Passing River. From the results of the investigation and the hearings, ground liquefaction did not occur in these areas.

In Quezon city, there are many government buildings and the municipal office. This city was developed with the concept of a subcenter of a metropolis. Makati city and Pasay city are located in the eastern part of the Metro-Manila.

Table 7.6.5 shows the results of damaged 12 buildings.

Further, Photos 7.6.50 to 7.6.68 show the damage situation and the sketch of the surveyed buildings. Generally, they were slightly damaged. However, the dimensions of columns, which are almost as same as those in Baguio, are smaller than those of Japanese buildings. Furthermore the size of span in buildings is relatively larger.

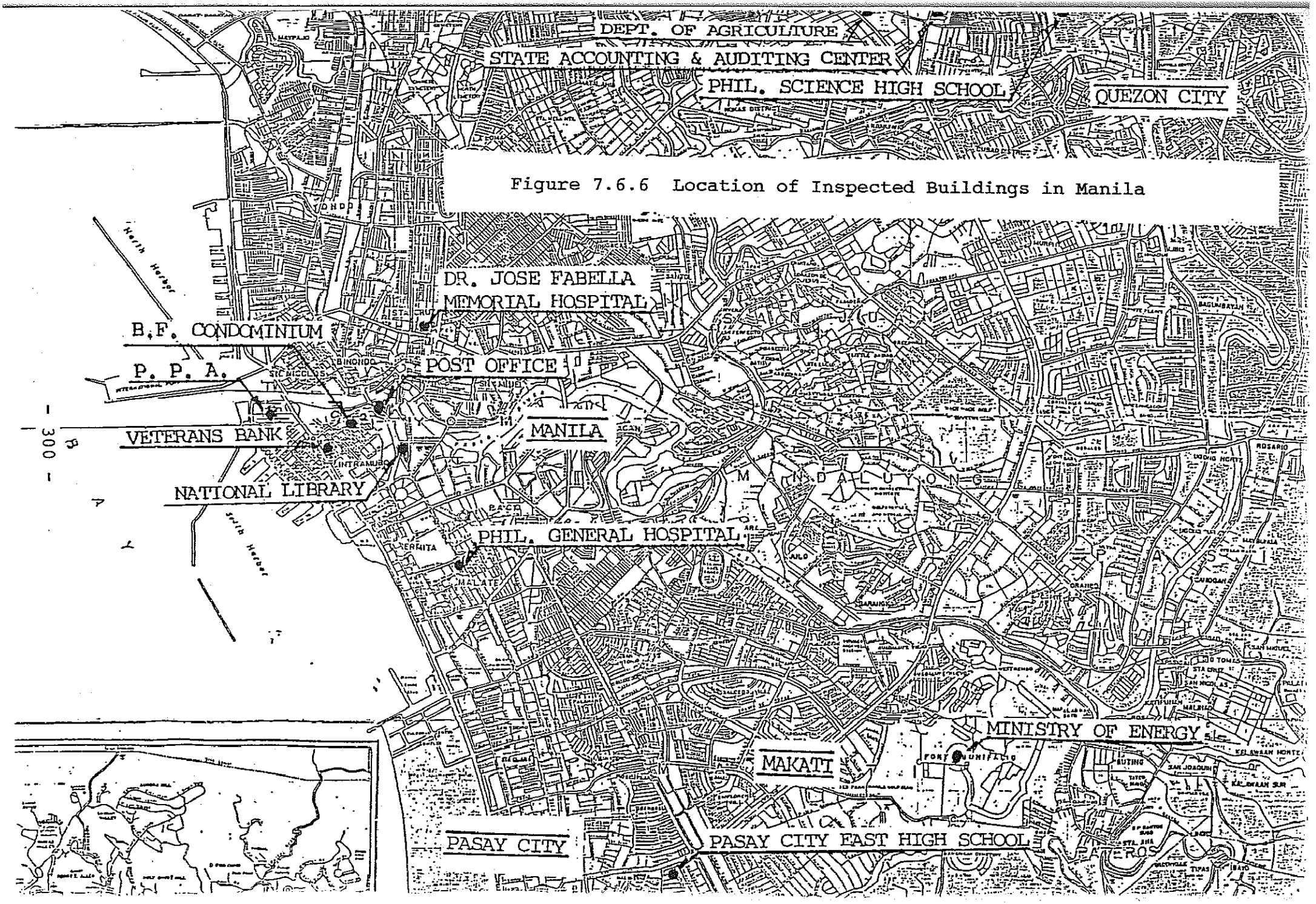


Figure 7.6.6 Location of Inspected Buildings in Manila

Table 7.6.5 List of the Damage Conditions of Buildings in Metro Manila

No.	Name of Buildings	Use	Structure Type	Stories	Damage Conditions	Damage Degree	Number of Photo
1	Veterans Bank (Manila)	Bank	RC		The columns at the end of the south side and the foots of the columns of 3F buckled. Shear cracks are observed on the walls. Survey of external appearance only.	Slight damage	7.6.50 - 51
2	B.F Condominium (Manila)	Multiple dwelling houses	RC	7	Only 1F was investigated; cracks were observed on the finishes and the block walls.	Slight damage	7.6.52
3	P.P.A (Manila)	Office	RC	5	Shear cracks at the head of the column at 4F (one position), cracks on the block walls, the concrete strength by test hammers (4F-beam): about 180kg/cm².	Slight damage	7.6.53
4	National Library (Manila)	Library	RC	7	Shear cracks on the inner block walls, horizontal cracks at the construction joints of the 1F-columns and the middle-3F-columns, the concrete strength by test hammers (1F-column): about 310 to 360 kg/cm².	Slight damage	7.6.54 - 55
5	Phil. General Hospital (Manila)	Hospital	RC	8	Damage at the walls and the floors of the joints of the higher story part and of the low-rise parts (due to rigid connection), horizontal cracks on exterior decorated columns, peeling of mortar.	Slight damage	7.6.56 - 58

No.	Name of Buildings	Use	Structure Type	Stories	Damage Conditions	Damage Degree	Number of Photo
6	Dr. Jose Fabella Memorial Hospital (Manila)	Hospital	RC	4	Deformation of the stairs and the window sash, cracks at the block walls at 2F to 4F, falls of under-floor concrete, after the earthquake in 1968, RF-beam was reinforced by steel frames, concrete strength: 206kg/cm² (1F-column).	Slight damage	7.6.59 - 60
7	Department of Agriculture (Quezon City)	Office	RC	5	Non-damage (two years ago, the top story was extended), concrete strength: 206kg/cm² (1F-column).	Non-damage	7.6.61
8	Phil. Science High School (Quezon City)	School	RC	4	Cracks at the block walls of the top story, concrete strength: 270kg/cm² (1F-wall).	Slight damage	7.6.62
9	State Accounting & Auditing Center (Quezon city)	Office	RC	3	Peeling of the finishing mortar of the columns and the beams at the top story, horizontal cracks at the top story (poor concrete parts) damage at the block walls (1F), concrete strength: 310kg/cm² (the column of the top story).	Slight damage	7.6.63 - 64
10	Ministry of Energy (Makati)	Office	RC	4	Cracks at the head part of the columns of 4F, beams for reinforcing at 4F part (original 3-story building), damage at the block wall.	Slight damage	7.6.65

No.	Name of Buildings	Use	Structure Type	Stories	Damage Conditions	Damage Degree	Number of Photo
11	Pasay City East High School (Pasay City)	School	RC	2	Peeling of the finishing mortar of the joint parts of the outside columns and the handrails, after the earthquake in 1974, RC columns for strengthening two center columns, concrete strength: 206kg/cm² (1F-column).	Slight damage	7.6.66 - 67
12	Post Office	Office	RC	3	Non-damage	Non-damage	7.6.68

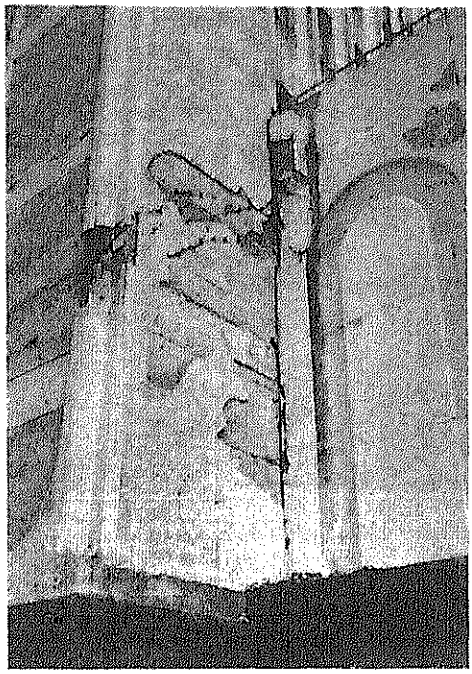
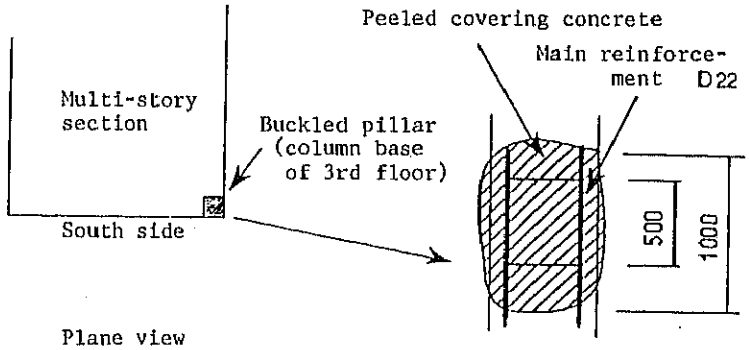


Photo 7.6.50

Name of the building:
Veteyans Bank

Condition of the building:
The buckling of bottom of the column at the south side of 3F.

Shear cracking of the walls, peeling of the bricks.



Plane view

Elevational view

Photo 7.6.51

Peeling of the finishing wall surface at 1F.

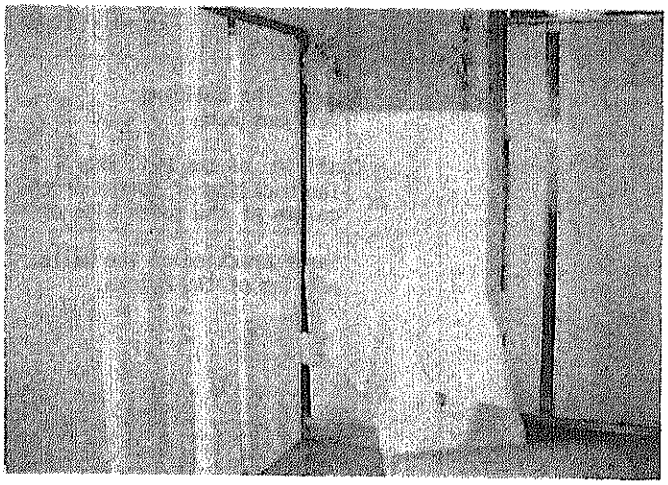
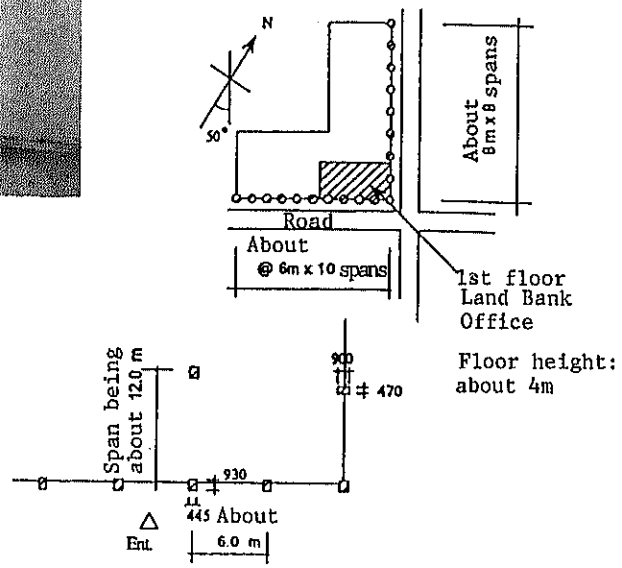


Photo 7.6.52

Name of the building:
Dr. Jose Fabella
Memorial Hospital Nurse
Dormitory

Damage conditions:
Cracks at the secondary block
wall.



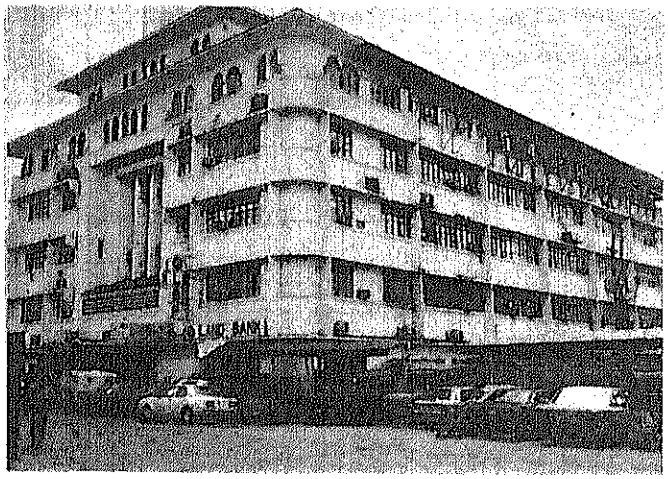
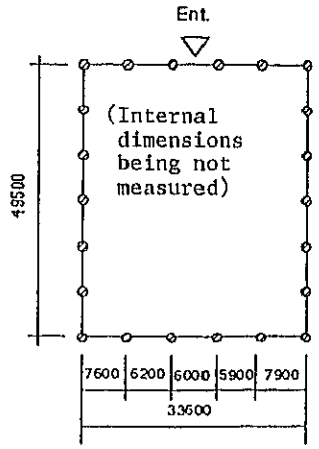
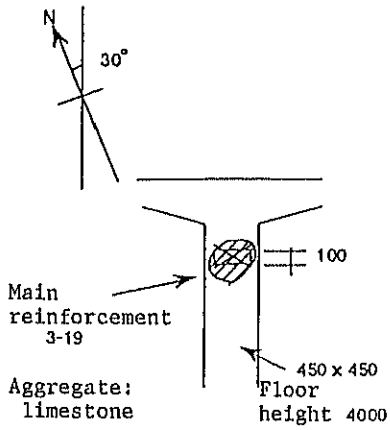


Photo 7.6.53

Name of the building: P.P.A.

Damage conditions:
Cracks at the block walls and
the head of the columns.





Capital of 4th floor

Photo 7.6.54

Name of the building:
National Library

Damage conditions:
Cracks at the
earthquake-resisting wall.

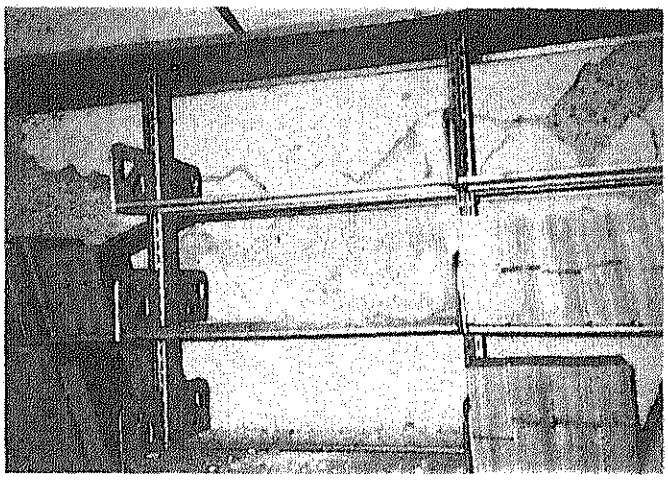


Photo 7.6.55

After the earthquakes in 1968 and 1984, the block walls were reinforced, and further the block walls were changed into RC walls; however, shear cracks occurred there.

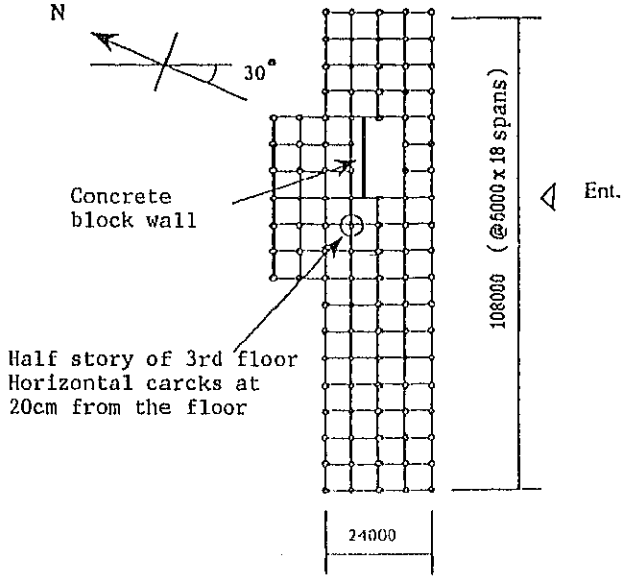


Photo 7.6.56

Name of the building:
Philippine General Hospital

Damage conditions:
Damage at the expansion joints and peeling of the mortar of the decorated column at the low-rise parts.

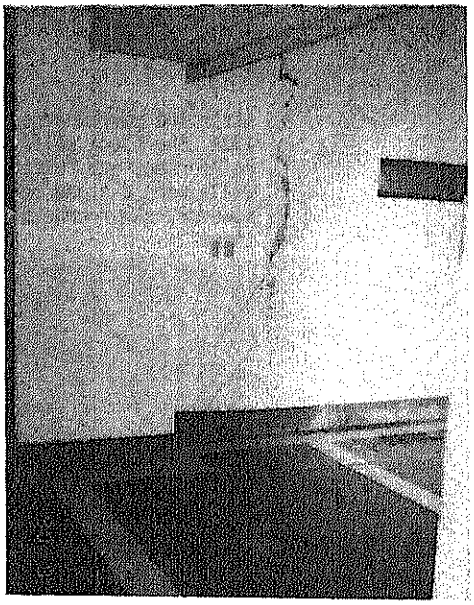
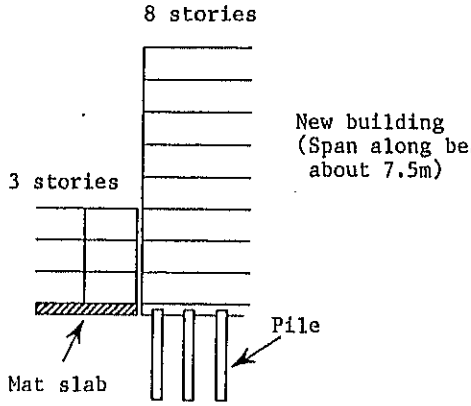


Photo 7.6.57

Cracks at the simplified expansion joint.



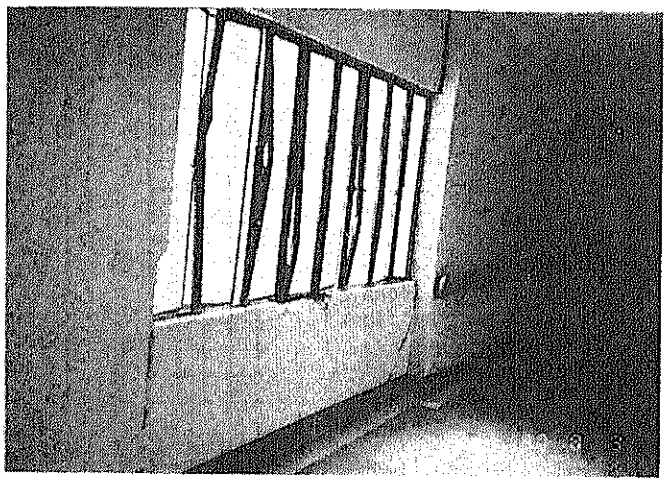


Photo 7.6.58

Damage of the window in the expansion areas.

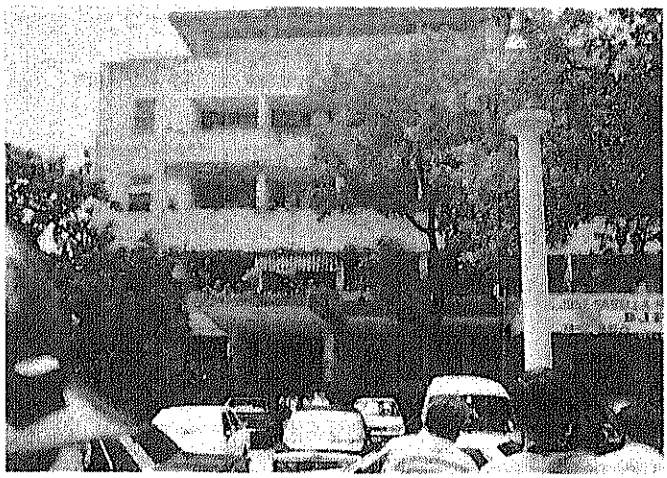


Photo 7.6.59

Name of the building:
Dr. Jose Fabella
Memorial Hospital Nurse
Dormitory

Damage conditions:
Cracks at the secondary block wall.

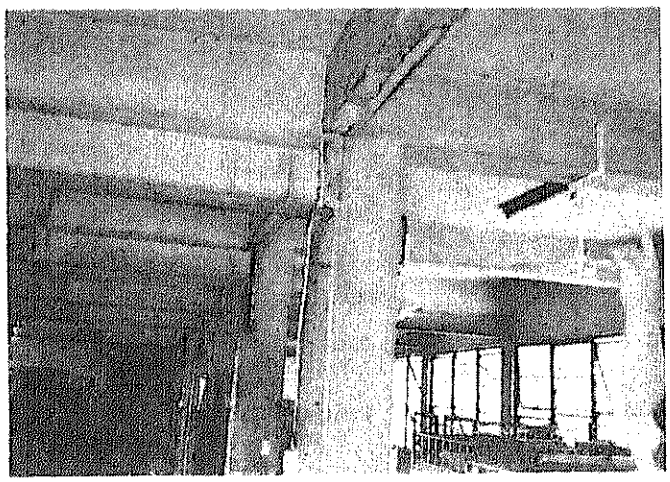
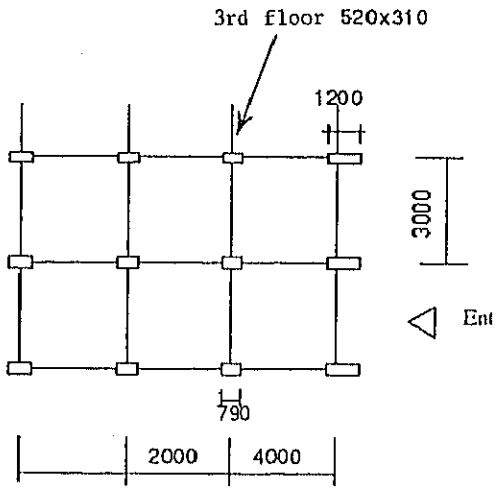


Photo 7.6.60

After the earthquake in 1968, reinforcement by steel frames.



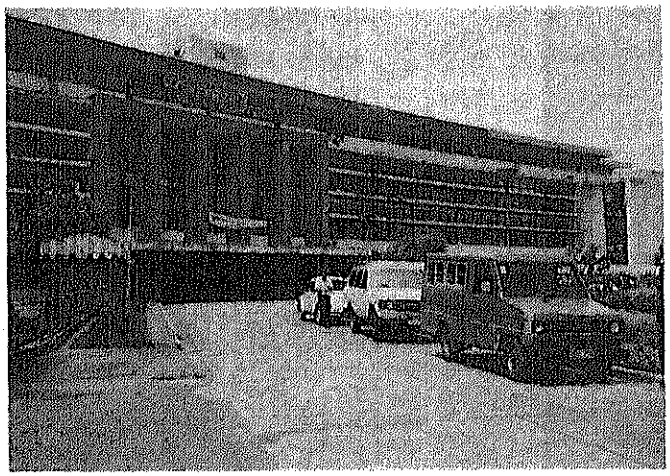
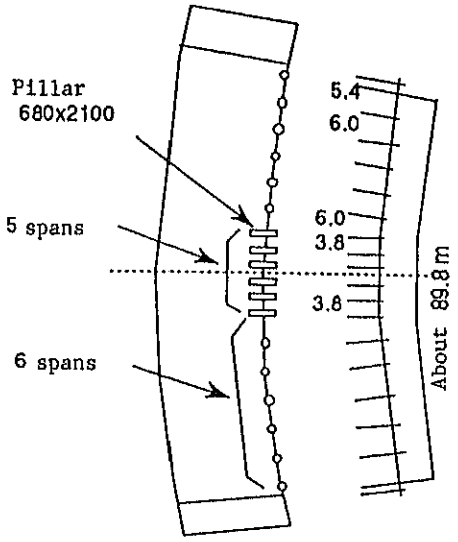


Photo 7.6.61

Name of the building:
Department of Agriculture

Damage conditions:
Non-damage, after completion of 5-story building, the 6F part was extended.



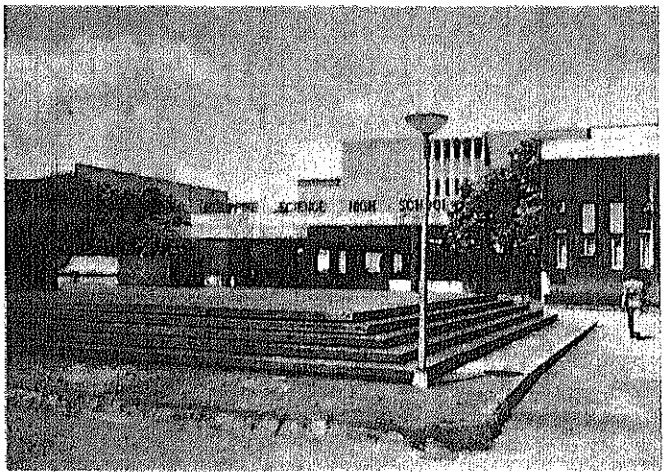
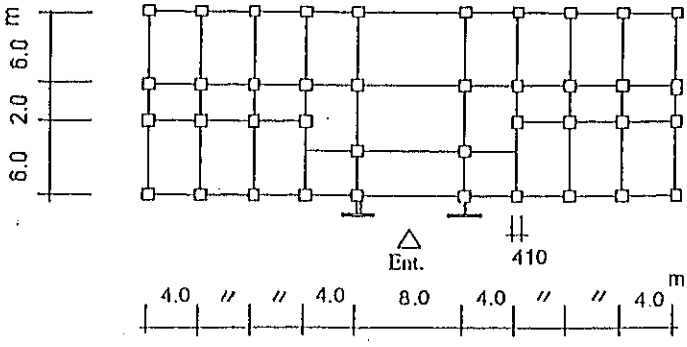


Photo 7.6.62

Name of the building:
Phil. Science High School

Damage conditions:
Cracks at the block walls.



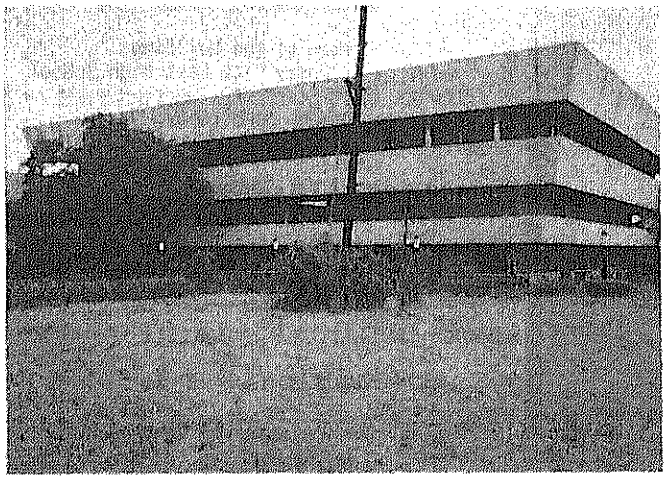
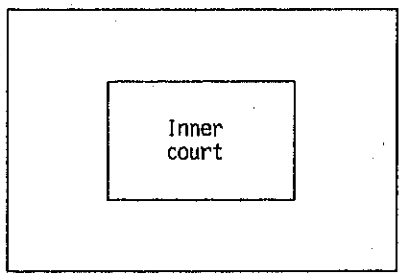


Photo 7.6.63

Name of the building:
State Accounting & Auditing Center

Damage conditions:
Cracks at the columns and walls in the top story.



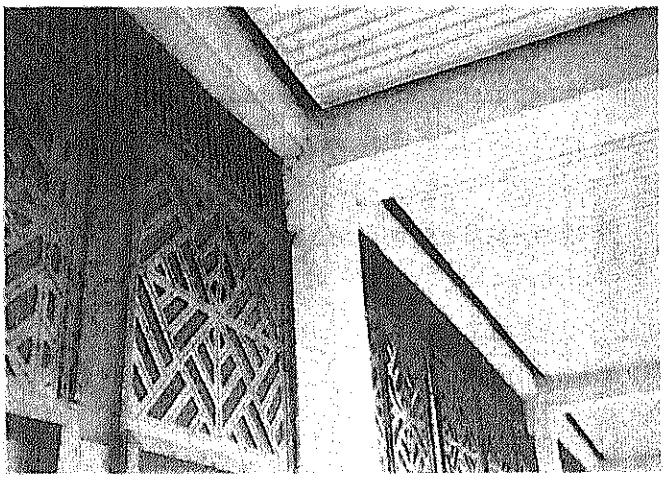


Photo 7.6.64

Bendings and cracks at the head of the column of 2F.

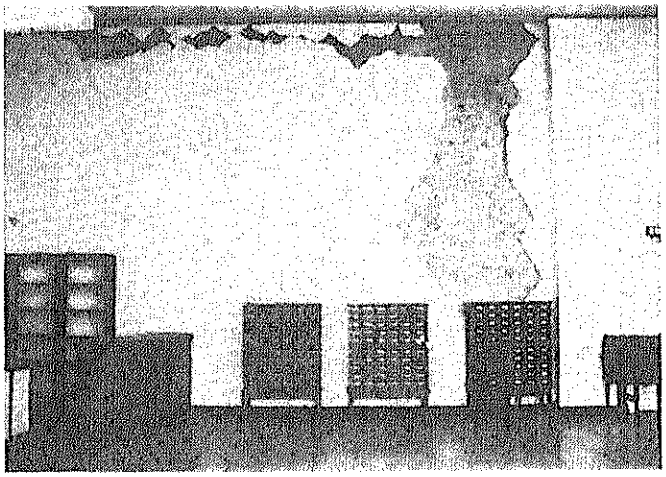
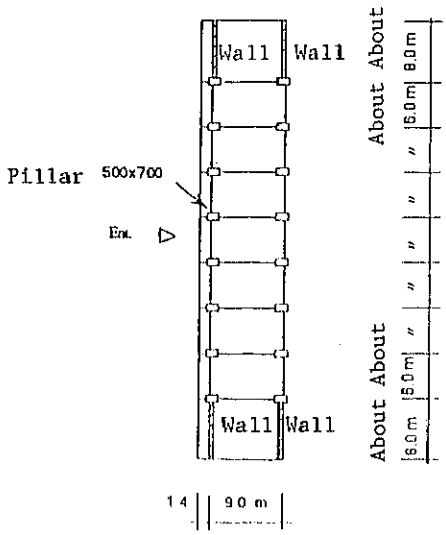


Photo 7.6.65

Name of the building:
Ministry of Energy

Damage conditions:
Cracks at the head parts and the block walls of 4F.



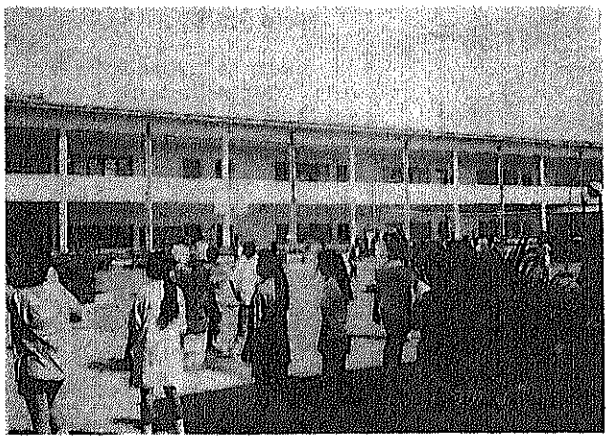


Photo 7.6.66

Name of the building:
Pasay City East High School

Damage conditions:
Cracks at the block walls.

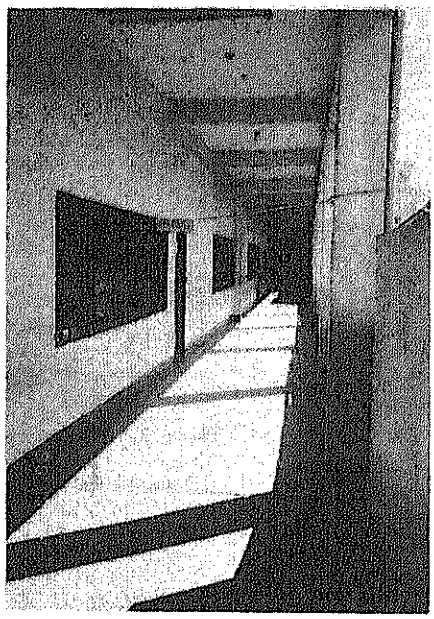


Photo 7.6.67

The RC columns for strengthening after the earthquake in 1974 are projected from the wall surface.

Photo 7.6.68

Name of the building: Post Office

Damage conditions: Non-damage

7.6.4 Recommendations

(1) Matters of urgent countermeasure

1) The rehabilitation of the buildings damaged by the soil liquefaction and subsidence in Dagupan areas

In the Dagupan areas, the remarkable unequal settlement and inclination caused by the soil liquefaction. Further, the water supply, the drainage and so on are hindered by the subsidence. Therefore, we fear that secondary disasters caused by aftershocks will occur and sanitary conditions will become worse.

For this reason, urgent measures to regain functioning of the damaged buildings will be necessary.

The measures considered:

(1) Important buildings are to be rehabilitated using jack-up methods and repaired.

A) For some buildings restoration work acting as a model case will be done.

B) In order to promote the rehabilitation of the entire area while making good use of the experience obtained from the above model work, "rehabilitation leading engineers" should be trained, in parallel with A) above.

a. Training while participating in model work.

b. A laying down "the rehabilitation plan and enforcement manual" in which is collected the experiments of the model works.

(2) For the model rehabilitation building, "the check of seismic diagnose" shall be measured, and the

rehabilitation effect shall be improved by necessary repairs.

2) The strengthening and rehabilitation of the medium rank damaged buildings in Baguio, etc.

In each area around Baguio and other cities, though the buildings are not damaged to the degree that they have to be demolished, structurally damaged buildings are left as is without confirming safety. We fear that secondary disasters will occur if the such damaged buildings are used as is. Therefore, in damaged buildings, the precise judgement should be enforced. If reuse by rehabilitation is judged to be reasonable, urgent enforcement is necessary.

Measures considered:

(1) The enforcement of seismic diagnoses, the damage-rank judgment and the decision of the strengthening plan.

A) The decision of enforcement items for damage-rank judgement.

B) The training of judgement guidance engineers for the judgment enforcement of model buildings.

C) The decision on a strengthening plan for the model buildings.

(2) The enforcement recommendation and the aid of the seismic reinforcement to the building's owner, and the enforcement of the model works of some buildings.

3) Grant of the temporary houses

In the Baguio and Dagupan areas, housing was badly damaged, and there is some fear with respect to the sanitary conditions of the people. In these areas, simple frame houses (prefabricated houses: about 1,000) are accommodated for damaged people.

(2) The matters requiring urgent enforcement of technical cooperation in the future.

1. Medium-term cooperation

1) The technical guidance on countermeasure techniques against soil liquefaction in Manila.

2) The technical guidance on the seismic diagnoses of the existing buildings in the Manila Metropolitan area.

3) The technical guidance on the seismic strengthening of the existing buildings in the Manila Metropolitan area.

4) The strong vibration predictive survey covering the Manila Metropolitan area.

5) The establishment and operation of the strong vibration observation network.

2. Long-term cooperation

1) The cooperation for reconsideration-amendment of the Building Codes.

2) The cooperation for reconsideration-amendment of the aseismic design standard.

3) The cooperation for the reconsideration-amendment of the structural design examples and the standard specifications.