Post Earthquake Rapid Damage Assessment Needs and Challenges

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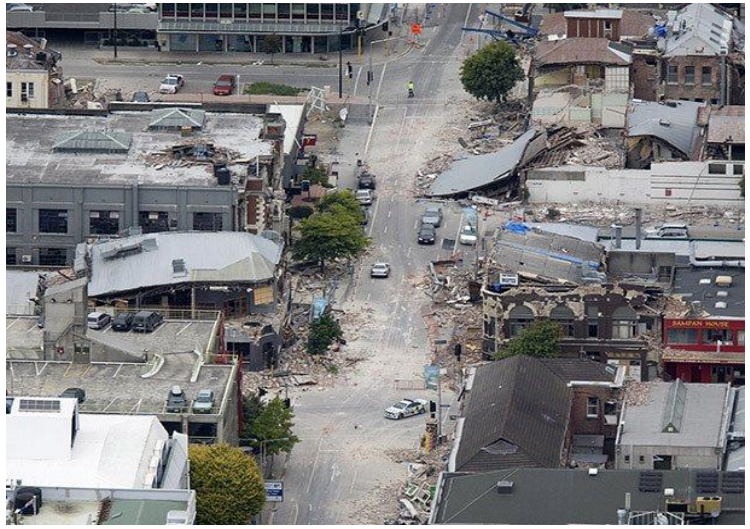
Haiti Earthquake 2010

Chile Earthquake 2010

Tohuku Earthquake, Japan (2011)

Christchurch Earthquake 2011



Major Earthquake

Earthquake Parameters	Haiti (2010)	Chile (2010)	Christchurch (2011)	Tohuku (2011)
Magnitude	7.0	8.8	6.3	9.0
Focal depth	13 km	35 km	5 km	30 km
Casualties	3,16,000	525	185	15,894
Economic Loss	USD 14 billion (more than GDP)	USD 30 billion (18% of GDP)	USD 20 Billion (10% of GDP)	USD 180 -300 billion (3 -4 % of GDP)
Damage of Buildings	80-90% critically damaged or destroyed in nearest city from epicenter	3,70,000 damaged	1,00,000 (already weak due to Canterbury EQ)	9,00,000 damaged (13% completely destroyed- Tsunami -90% & Earthquake- 10%))

What is Post Earthquake Rapid Damage Assessment?

- Post Earthquake Rapid Damage Assessment is a procedure to conduct the safety check or damage assessment of the buildings in the area impacted by earthquake.

- Post Earthquake Rapid Damage Assessment of buildings and other important infrastructure such as hospitals, schools and government offices is initiated within few hours from the earthquake as delay in the assessment may increase the risk of safety of people living in the already partially damaged buildings.

- Rapid evaluation typically includes only an exterior evaluation of structures and can be carried out by building inspectors, engineers, architects with proper training on such evaluation.

- Success of rapid evaluation lies with well defined objectives and clear understanding among all the people involved in the assessment.

Objective of Post Earthquake Rapid Damage Assessment

Primary Objective:

- Protect Human Life : People livening in damaged buildings and subjected to many aftershocks

- Save the Properties :

➢ Save the partial damaged properties to collapse further by providing immediate support,

➢ Protect nearby buildings good in conditions from the already damaged buildings in the surrounding

Secondary Objective:

- Minimize the number of homeless and the loss of economic activity, by identifying as soon as possible all buildings that are safe to occupy and use
- Indicate unsafe areas around hazardous buildings, identify temporary shelter sites and provide the number of temporary housing units
- Provide the necessary data for obtaining reliable estimates of the disaster that will allow authorities to take relief measures, formulate disaster mitigation policies and allocate available resources
- Provide data that will identify frequent causes of damage, so that potential rehabilitation plans may take into account such information
- Provide data for practical research studies that may lead to reevaluation of existing codes and construction practices, to updates of seismic hazard maps and to elaboration of seismic vulnerability models for pre-earthquake planning purposes

Post Earthquake Damage Assessment

Most of the guideline adopted for conducting post earthquake damage assessment suggest a 3 step procedure

Existing Tools and Methodology

Many countries have their own frameworks and individual methodologies for performing rapid disaster assessment. Mostly single and direct methods designed for post-earthquake building inspections. The followings are common methods for damages assessment

Rapid Impact Assessment

- Undertaken within hours of the event by emergency services and the local authority.
- To understand the overall impact and extent of affected areas and emphasis on identifying extent of damage, priorities for rescue

Rapid Building Assessment

- Carried out during a declared State of Emergency period by mostly volunteer engineers
- To quickly assess the impact of building damage for usability

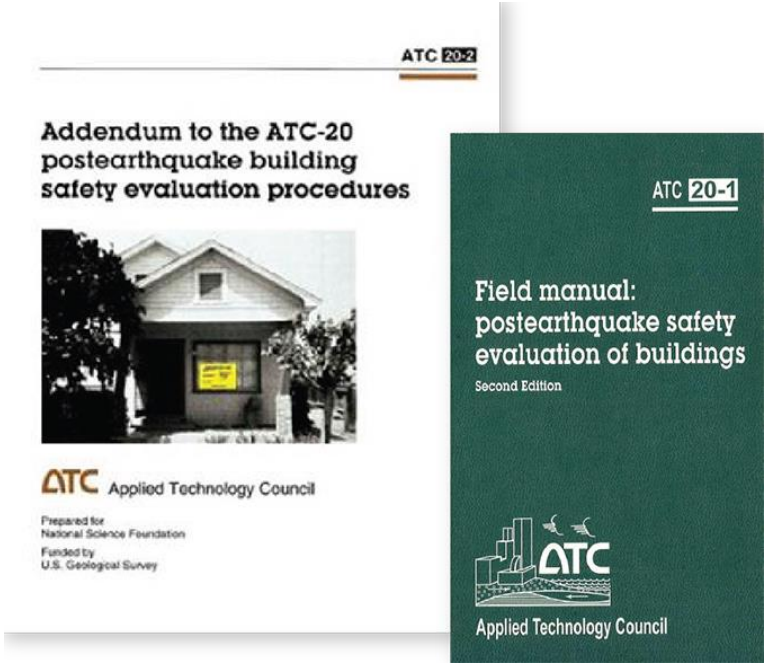
Interim Use Evaluation (IUE)

- Conducted either during or after a declared State of transition period by engineers contracted by building owners. (Unlike the Rapid Building Assessment the IUE outcome does not have a legal status.)
- Evaluator identifies and observes the vertical and lateral load-resisting systems

Detailed Damage Evaluation

- Conducted as part of the recovery phase by engineers contracted by building owners.
- To determine the full scope of repairs and rebuilds, and resource requirements.

Existing Tools and Methodology



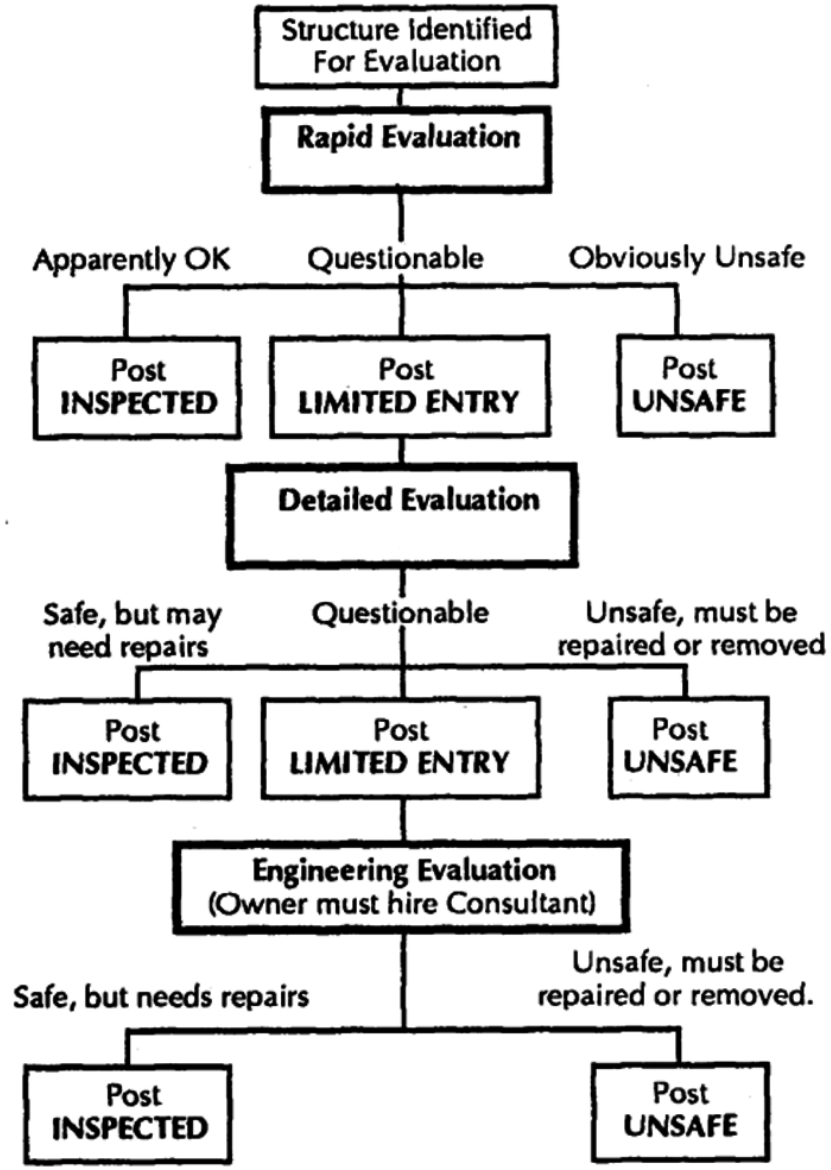
ATC 20- Applied Technology Council

Written specifically for volunteer structural engineers and building inspectors, ATC 20-Applied Technology Council reports include

- ❖ Rapid Evaluation Safety Assessment
- ❖ Detailed Evaluation Safety Assessment procedures

for evaluating earthquake-damaged buildings and posting them as INSPECTED (apparently safe, green placard), LIMITED ENTRY (yellow placard), or UNSAFE (red placard).

❖ The ATC-20-3 report has been designed as an instructional guide for rapid evaluation.



Flow Chart of Building Damage/Safety Assessment

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to local authorities; reinspection may be required.

Inspector Comments:

_____
_____
_____
_____

Facility Name and Address:

_____
_____
_____

Date _____

Time _____

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Inspector ID / Agency

_____
_____
_____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

_____
_____
_____
_____

Entry, occupancy, and lawful use are restricted as indicated below:

_____
_____
_____
_____
_____
_____

Facility Name and Address:

_____
_____
_____

Date _____

Time _____

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Inspector ID / Agency

_____
_____
_____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

UNSAFE

DO NOT ENTER OR OCCUPY (THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

_____
_____
_____
_____
_____
_____

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:

_____
_____
_____

Date _____

Time _____

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Inspector ID / Agency

_____
_____
_____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

UNSAFE

DO NOT ENTER OR OCCUPY
(THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

Date

Time

This facility was inspected under emergency conditions for:
Naval Medical Hospital Twentynine Palms (NHTP)
(Jurisdiction)

Inspector ID / Agency

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:
Marine Corps Air Combat Center
Naval Medical Hospital Twentynine Palms

RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

Date

Time

(Caution: Aftershocks since inspection may increase damage and risk.)

Entry, occupancy, and lawful use are restricted as indicated below:

☐ Do not enter the following areas:

☐ Brief entry allowed for access to contents:

☐ Other restrictions:

This facility was inspected under emergency conditions for:
Naval Medical Hospital Twentynine Palms (NHTP)
(Jurisdiction)

Inspector ID / Agency

Facility Name and Address:
Marine Corps Air Combat Center
Naval Medical Hospital Twentynine Palms

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

☐ Inspected Exterior Only

☐ Inspected Exterior and Interior

Report any unsafe condition to local authorities; reinspection may be required.

Inspector Comments:

Date

Time

(Caution: Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:
Naval Medical Hospital Twentynine Palms (NHTP)
(Jurisdiction)

Inspector ID / Agency

Facility Name and Address:
Marine Corps Air Combat Center
Naval Medical Hospital Twentynine Palms

How to conduct Rapid Damage Assessment of Buildings after Earthquake?

Rapid Assessment:

- Assessment is usually conducted by the team of at least 2 trained people.
- Rapid assessment helps to minimize the number of building requiring detailed Assessment.
- The outside of the building is inspected. Entry to building is only permitted when it is safe to go inside.
- Expected time for evaluation of 1 building = 10 -30 min (depend upon size)
- Visual examination for damage to load bearing elements or to secondary elements (chimenys , roof, infill walls, façade etc.)
- Check the sign of residual drift or permanent displacement at ground level (column or foundation displacement)

Detailed Inspection

- To give a more reliable estimate of the condition of the building
- Conducted for building falling under YELLOW and RED Placards after Rapid Inspection
- Detailed assessment can also be conducted for the building falling under GREEN Placard if further damage is reported by the owner of the building
- Expected time for Detailed Evaluation = 1-2 hrs (Depend upon size)
- Detailed assessment team must have certified/experience structural engineer

Case Study 1: Bhuj Earthquake, India (2001)

- Date: 26th January 2001
- Magnitude: M 7.7
- Epicenter: Kutch District, Gujarat
- Focal Depth: 16 km
- Total Number of aftershocks: 101 (M>3)
- Number of casualties : Aprrox. 138000
- Number of Buildings Damaged: Approx 400,000

Case Study 1: Bhuj Earthquake, India (2001)

- January 27, under the banner of Gujarat Institute of Civil Engineers and Architects (GICEA), local engineers began inspecting buildings in Ahmedabad on request from building and house owners.
- Classification was quite subjective due to no uniform damage classification criteria.
- On January 31, 2 engineers from Hyderabad came to Ahmedabad to provide informal advice to local administrators.
- Even after week no assessment started properly, so confusion was growing among people looking for quick solution for safety of their buildings.
- Experts from outside the area, on reaching Ahmedabad on February 3, emphasized the need for objective damage assessment criteria.

Case Study 1: Bhuj Earthquake, India (2001)

- On February 04, experts started working on rapid evaluation criteria for RC frame building along with other type of buildings.
- Local authorities in Ahmedabad realized that the damage classification should be done by a fairly independent agency.
- Center for Environmental Planning and Technology (CEPT) at Ahmedabad was entrusted with the job of carrying out the damage assessment survey for multistory residential buildings in Ahmedabad.
- Although no prior experience on earthquake issues, CEPT agreed to take lead and work on a direct cost reimbursement.
- The cooperative societies of multistory residential buildings had to apply by a certain cut-off date to request a free survey of their building.

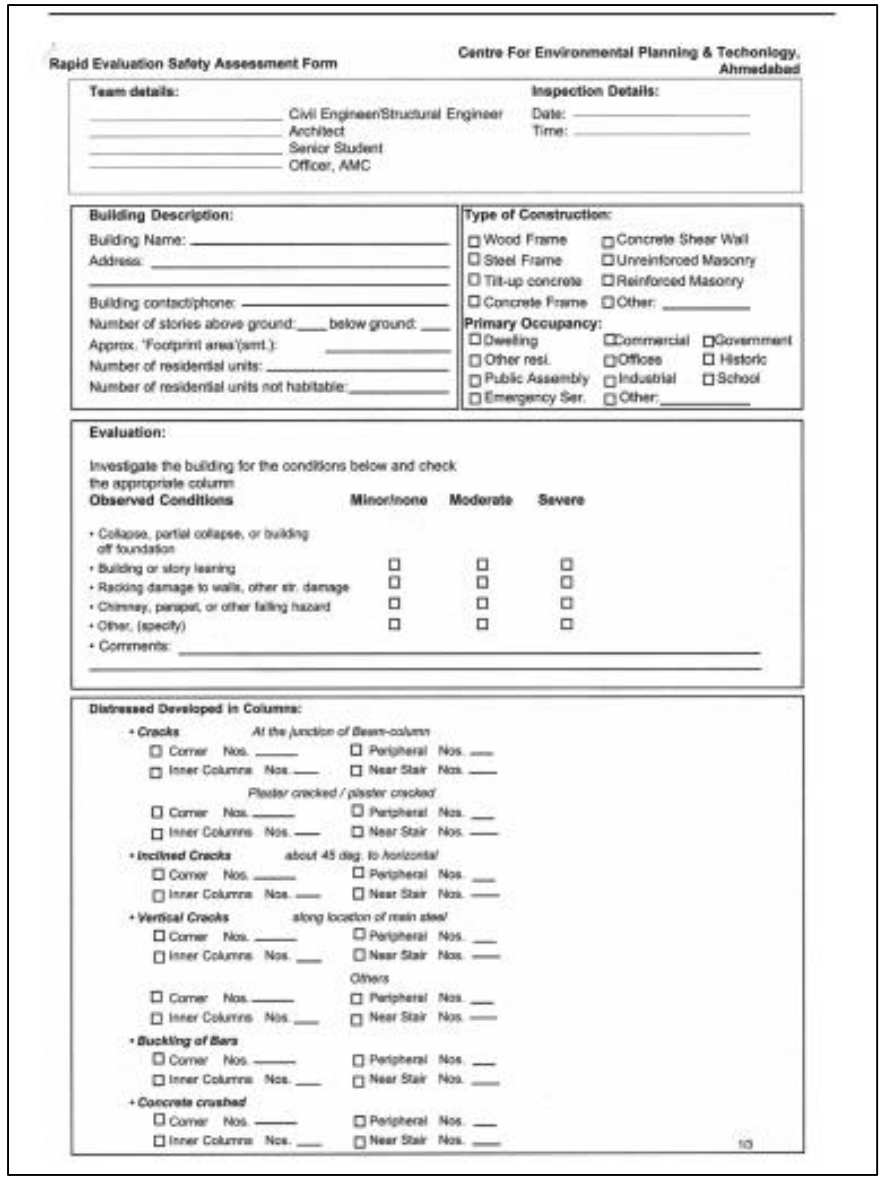
Case Study 1: Bhuj Earthquake, India (2001)

- CEPT conducted damage surveys of about 6,670 buildings.
- On the basis of CEPT appeal to structural engineers to support the damage assessment voluntarily, 160 senior structural engineers from several parts of the country joined the CEPT team.
- Engineers from out of the area spent about a week in Ahmedabad.
- Volunteer engineers were reimbursed for their travel expenses, provided local hospitality, and a nominal honorarium.
- Around 80 senior students from various engineering college of Gujarat and 30 junior engineers also support work by CEPT.
- A typical damage survey team from CEPT consisted of:
  - A senior structural engineer
  - A junior engineer, who could also be a senior student of civil engineering
  - One cameraman to take pictures
  - One representative of the local authorities for liaison

Case Study 1: Bhuj Earthquake, India (2001)

- Teams were given about 1hr 30 orientation. 25-30 teams ..10 buildings per team per day..6 to 7 people team to scrutinize the submitted assessment form.
- Damage assessment started on 05 Feb and took almost 3 months.
- Financial aid from the government for repair and rehabilitation of buildings was linked with the damage category.
- In view of the financial aid, there were instances of the beneficiaries putting pressure to have their property classified in a higher damage category.
- Initially major focus for damage assessment was in Ahmedabad only. Assessment in Bhuj started almost after a month.

Tools and Damage Grade Used in Bhuj Earthquake



Rapid Evaluation Safety Assessment Form

Centre For Environmental Planning & Techonlogy, Ahmedabad

Team details:

_____ Civil Engineer/Structural Engineer
_____ Architect
_____ Senior Student
_____ Officer, AMC

Inspection Details:

Date: _____
Time: _____

Building Description:

Building Name: _____
Address: _____
_____
Building contact/phone: _____
Number of stories above ground: ___ below ground: ___
Approx. 'Footprint area'(sqmt.): _____
Number of residential units: _____
Number of residential units not habitable: _____

Type of Construction:

☐ Wood Frame ☐ Concrete Shear Wall
☐ Steel Frame ☐ Unreinforced Masonry
☐ Tilt-up concrete ☐ Reinforced Masonry
☐ Concrete Frame ☐ Other: _____

Primary Occupancy:

☐ Dwelling ☐ Commercial ☐ Government
☐ Other resi. ☐ Offices ☐ Historic
☐ Public Assembly ☐ Industrial ☐ School
☐ Emergency Ser. ☐ Other: _____

Evaluation:

Investigate the building for the conditions below and check the appropriate column

Observed Conditions	Minor/none	Moderate	Severe
• Collapse, partial collapse, or building off foundation			
• Building or story leaning	☐	☐	☐
• Racking damage to walls, other str. damage	☐	☐	☐
• Chimney, parapet, or other falling hazard	☐	☐	☐
• Other, (specify)	☐	☐	☐
	☐	☐	☐

• Comments: _____

Distressed Developed in Columns:

• **Cracks** *At the junction of Beam-column*
☐ Corner Nos. ___ ☐ Peripheral Nos. ___
☐ Inner Columns Nos. ___ ☐ Near Stair Nos. ___
Plaster cracked / plaster cracked
☐ Corner Nos. ___ ☐ Peripheral Nos. ___
☐ Inner Columns Nos. ___ ☐ Near Stair Nos. ___

• **Inclined Cracks** about 45 deg. to horizontal
☐ Corner Nos. ___ ☐ Peripheral Nos. ___
☐ Inner Columns Nos. ___ ☐ Near Stair Nos. ___

• **Vertical Cracks** along location of main steel
☐ Corner Nos. ___ ☐ Peripheral Nos. ___
☐ Inner Columns Nos. ___ ☐ Near Stair Nos. ___
Others
☐ Corner Nos. ___ ☐ Peripheral Nos. ___
☐ Inner Columns Nos. ___ ☐ Near Stair Nos. ___

• **Buckling of Bars**
☐ Corner Nos. ___ ☐ Peripheral Nos. ___
☐ Inner Columns Nos. ___ ☐ Near Stair Nos. ___

• **Concrete crushed**
☐ Corner Nos. ___ ☐ Peripheral Nos. ___
☐ Inner Columns Nos. ___ ☐ Near Stair Nos. ___

10

Table 16-1. Categorization scale adopted for evaluation of reinforced concrete frame buildings damaged in Gujarat

Category	Damage	Extent of damage in nonengineered component	Extent of damage in RC column		Suggested postearthquake action
			Individual column	All columns in ground story	
0	None	No damage	No damage or visual cracks	No damage	Seismic strengthening is required for long-term seismic safety.
G1	Slight non-structural damage	Thin cracks in plaster, falling of plaster bits in limited parts	Very fine cracks in columns, which are to be seen with much attention.	40%-50% of columns with G1; rest in Category 0	Remove plaster across cracks and replaster. Building need not be vacated. Seismic strengthening is required for long-term seismic safety.
G2	Slight structural damage	Small cracks in walls, falling of plaster in large bits over large areas; damage to non-structural parts, such as chimneys, projecting cornices, etc. The load carrying capacity of the structure is not reduced appreciably.	Wider cracks in column, approaching 1 mm width, going through core of column. Visible to eye.	40%-50% in G2; rest in Category G1	Remove plaster and grout cracks using epoxy or similar materials. Building need not be vacated. Seismic strengthening is required for long-term seismic safety .
G3	Moderate structural damage	Large and deeps cracks in walls. Widespread cracking of walls, columns and piers and tilting or falling of chimneys. The load carrying capacity of structure is partially reduced.	Cracks in column at top and within height approaching 2 mm width, with some crushing of concrete at the cracks, but without relative movement between two parts.	40%-50% in G3; rest in Category G2	Building needs to be vacated. To be reoccupied after restoration and strengthening. Structural restoration and seismic strengthening necessary before reoccupation.
G4	Severe structural damage	Gaps occur in walls; inner or outer walls collapse; failure of ties to separate parts of building. Approximately 50 percent of the main structural elements fail. The building is in a dangerous state.	Diagonal cracks/ torsional cracks/ substantial crushing of concrete. Buckling of reinforcement; 'through' wide cracks in column includ ing relative movement in parts of column and floor.	40%-50% in G4; rest in Category G3	Building needs to be vacated. Either building has to be demolished or extensive restoration and strengthening work has to be done before reoccupation.
G5	Collapse	A large part or the entire building collapses.	A large part or the entire building collapses.		Cleaning the site and reconstruction.

Case Study 2: Nepal Earthquake 2015

- Date: 25th April 2015 , Big aftershock on 12th May 2015
- Magnitude: M 7.8 , M 7.3 (aftershock on 12th May)
- Epicenter: Gorkha District (77 Km northwest of Kathmandu)
- Focal Depth: 15 km
- Total Number of aftershocks: 484
- Number of casualties : Aprrox. 9000
- Number of Buildings Damaged: Approx 850,000
- Number of Districts Affected: 31 of 75 districts of Nepal, 14 out of 31 severely affected

Case Study 2: Nepal Earthquake 2015

- Nepal has their own guideline for “Seismic Vulnerability Evaluation Guideline for Private and Public Buildings, Part II: Post Disaster Damage Assessment” (DUDBC, 2009)
- Nepal Prepared this guideline based on ATC 20 guideline “Procedures for Post Earthquake Safety evaluations of Buildings”. Detailed evaluation described in Nepal guideline is more extensive than ATC 20 with the aim to assist the appraisal of compensations to households, the planning for reconstruction activity and assessing the intervention for repair and retrofitting. 3 color Placarding suggested. Detailed evaluation should be conducted for all the buildings.
- However Nepal guideline is only limited to concrete and brick buildings while large part of damaged buildings were made of rubble stone or adobe with mud mortar..
- Rapid evaluation was conducted for all type of occupancy in urban areas while in rural areas, only institutional buildings were evaluated.

Case Study 2: Nepal Earthquake 2015

- While evaluation process was partly voluntary in nature, placarding of assessed buildings was not generally practiced.
- Government of Nepal also started a separate survey in rural areas mainly with the objective of reconstruction planning. Buildings were classified into 3 groups 1.) collapsed 2.) semi-damaged 3.) Not damaged or limited damaged
- Some institutions there own methodology and forms for rapid evaluation.
- Nepal Guidelines also have lack of clarity on changing /continuation of placards after detail evaluation.
- Nepal has no legislative framework for post earthquake building safety evaluation.

Case Study 2: Nepal Earthquake 2015

- In Nepal, rapid evaluation was conducted by volunteers or employees of DUDBC, Nepal Engineers Association (NEA), NSET, consulting companies, DoE, team from other countries team and development partners

- In some cases, owners of large private buildings (multistoried apartments) also hired structural engineers

- A call center was established by NEA so that affected people can request for rapid evaluation . NEA did not placard houses rather worked as counsellors to home owners.

Case Study 2: Nepal Earthquake 2015

Whether this Rapid Evaluation of Buildings in Nepal was efficient?

- Multiple tools, multiple methodologies hence multiple opinions
- Difficulty in consolidating the data due to various approach for work
- Extremely conservative and inconsistent evaluation in many cases
- Unclear messages or interpretation of placards whenever used: Ex. Some engineers suggested demolition of all Red (unsafe) card buildings without asking for detailed level assessment . This created panic among property owners due to financial consequences
- Lack of capacity, confidence and good engineering judgement in building inspectors as most of them were trained just after the earthquake
- Rapid Evaluation was useful for lifeline buildings and people to allow return to their home giving them confidence

Case Study 2: Nepal Earthquake 2015

- Wrong interpretation of words : No absolute safe building as there is always a level of risk involved i.e. safe but be cautious (Canterbury earthquake also had same issue)
- People even occupied or worked around building with red placard
- Barricading of severely damaged or collapsed building was not followed a norm: In a subsequent earthquake , it can be very dangerous
- In some areas, people were forced to occupy the damaged buildings as there was no alternative options
- This situation was even complicated due to lack of security arrangements of personal property
- Many people erected tents near their damaged houses to safeguard their property despite the risk of nearby damaged buildings
- Perception of risk was a major issues for people from different cultural, educational, socio-economic background

Case Study 2: Nepal Earthquake 2015

No Barricading : Children playing near the damaged building

School building with collapsed walls. The building was used for post-earthquake accommodation.

Occupied school building placarded as “unsafe”

Lessons Learned for Post Earthquake Rapid Damage Assessment

- Clear Objective of the Assessment to be defined.
- Tools should be developed for all the probable building typologies in the earthquake prone areas of the country.
- The classifications (i.e., Inspected, Limited Entry, and Unsafe) should be further divided into sub-classifications.
- Rapid assessment along with use of space technology can be more effective to accelerate the process and mobilize resources effectively.
- The assessors must have the skills necessary to speak accurately and respectfully and understand sensitivity of the time, place, and context.

Lessons Learned for Post Earthquake Rapid Damage Assessment

- Clear communication to the public is critical to avoid confusion, rumor, and trauma during a disaster.
- The public and engineers need to be informed that buildings carry a level of inherent seismic risk and that they cannot be guaranteed to be earthquake-proof or safe.
- A review of a certain percentage of completed evaluations for quality control is important.
- All the outcomes of discussions and cross-checks should be discussed with evaluation teams for the improvement of evaluations.
- The purpose of the framework have to be clear while the frameworks states that its purpose is to provide criteria and guidance for damage assessment, (need to connect between damage and “safety”).
- Assessment should be coordinated by one government agency, involve multi stakeholders, and include relevant government agencies from appropriate levels, be that local, regional or national.

Lessons Learned for Post Earthquake Rapid Damage Assessment

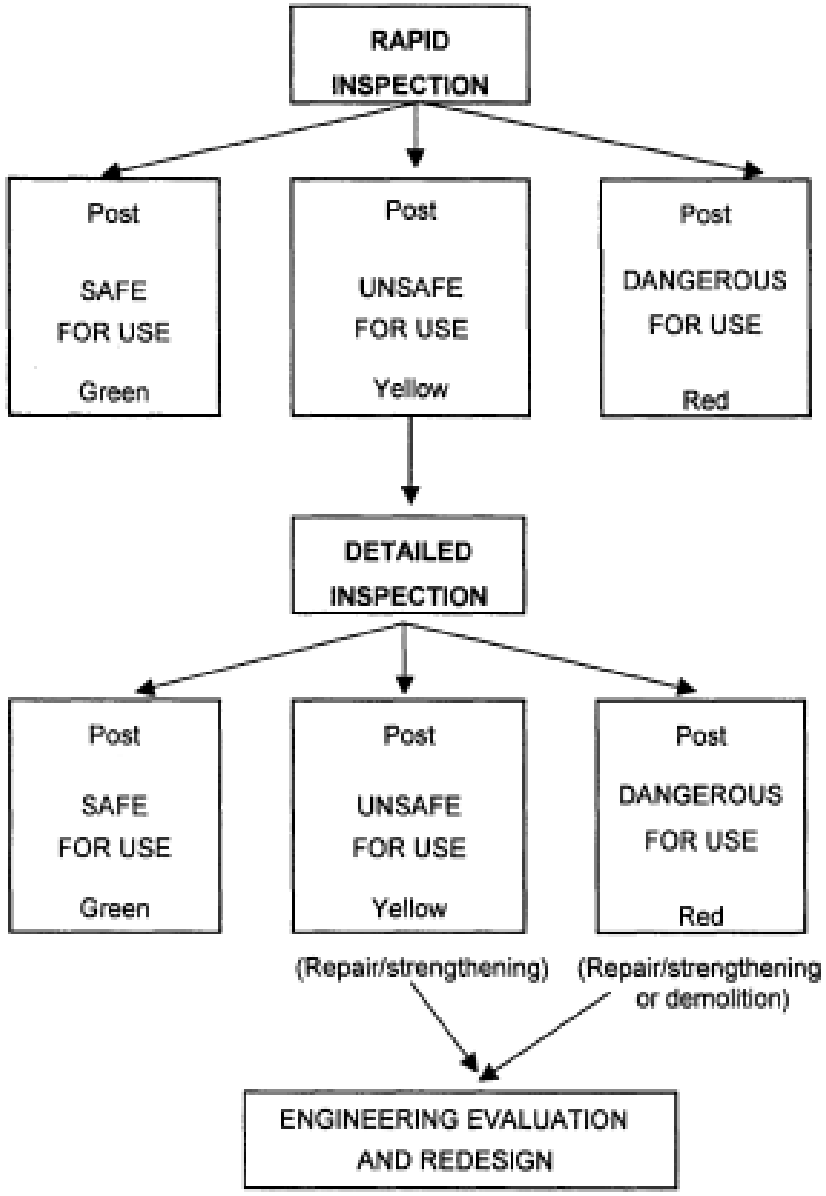
- An institutional framework has to be established in order to clearly define the people who will be involved in the assessment.

- A clear organizational structure has to be defined in advance to conduct such operations after earthquake.

- It is important to build the capacity of professionals for conducting such assessment. It could be short term training program, certification course, credit course for university student or introduction of the subject in undergraduate / graduate level course curriculum of relevant discipline.

Example from Greece

- Greece has a history of medium to lagre scale earthquakes.
- Greece is one of the world's most seismically active countries.
- Most of Crete, Greece, and the Greek islands are contained in a "box" of fault lines running in different directions.
- Undersea earthquake, Earthquakes due to Volcano
- The Athens Earthquake of 1999



Example from Greece

SAFE
FOR USE

ADDRESS ..... SECTION No .....
DATE OF INSPECTION ..... TIME:.....
CREW No ..... REPORT No.....

INSPECTION TEAM DATA

1. Name/ Title ..... Signature .....
2. Name / Title ..... Signature .....

The building is in general safe and may be used under the occasional restrictions as indicated.

TYPE OF INSPECTION

RAPID (1st) ☐ DETAILED (2nd) ☐

RESTRICTIONS IN USE – SAFETY MEASURES TO BE TAKEN

NO RESTRICTIONS ☐

ACCESS TO THE FOLLOWING AREAS IS PROHIBITED: .....

THE FOLLOWING ELEMENTS SHOULD BE DEMOLISHED OR REMOVED:.....

.....

DO NOT REMOVE THIS PLACARD UNTIL PERMISSION IS GIVEN BY LOCAL AUTHORITIES

UNSAFE
FOR USE

ADDRESS ..... SECTION No .....
DATE OF INSPECTION ..... TIME:.....
CREW No ..... REPORT No.....

INSPECTION TEAM DATA

1. Name/ Title ..... Signature .....
2. Name / Title ..... Signature .....

The building has suffered damages (as indicated in the inspection form) and cannot be used before the detailed (2nd) inspection takes place. Entry only at own risk and only for a limited time period. Aftershocks may cause injury or even death. Safety measures stated herein have to be taken immediately.

TYPE OF INSPECTION

RAPID (1st) ☐ DETAILED (2nd) ☐

RESTRICTIONS IN USE – SAFETY MEASURES TO BE TAKEN

URGENT SUPPORT REQUIRED ☐

ACCESS TO THE FOLLOWING AREAS IS PROHIBITED: .....

THE FOLLOWING ELEMENTS SHOULD BE DEMOLISHED OR REMOVED: .....

.....

THE FOLLOWING UTILITIES MUST BE DISCONNECTED:

ELECTRICITY ☐ WATER ☐ GAS ☐

OTHER: .....

DO NOT REMOVE THIS PLACARD UNTIL PERMISSION IS GIVEN BY LOCAL AUTHORITIES

Example from Greece

A. BUILDING LOCATION AND ID

Street..... No. .....Postal Code..... Town/Municipality .....
Section No: .....Block No:.....Or Streets surrounding block: 1.....
2.....3.....4.....5.....

Position of building in block: ☐ 1=Free 2=Middle (2 opposite sides free) 3=Corner (2 or 3 sides free)

C. DAMAGE (a) SEVERITY (1st BOX) : 1 = None 2 = Slight 3 = Moderate - Heavy 4 = Severe –Total
(b) *EXTENT (2nd BOX) :* *1 = None 2 =1 to Few 3 = Few to several 4 = Several to many*

COLUMNS	☐☐	SHEAR WALLS/ ELEV. SHAFT	☐☐	FRAME JOINTS	☐☐	BEAMS	☐☐
STAIRS	☐☐	BEARING WALLS	☐☐	INFILL WALLS (masonry, ecc)			☐☐
ROOF	☐	CHIMNEYS, PARAPETS	☐☐	BUILDING OUT OF PLUMB			☐

Apparent ground problems: ☐ 1= None 2 = Settlement 3 = Liquefaction 4 = Slope movement
5 = Ground fissures 6 =Rockfalls 7 = Other (explain) .....

Indirect damage: ☐ 1=None 2=Pounding to adjacent building 3=Fire 4=Other (explain).....

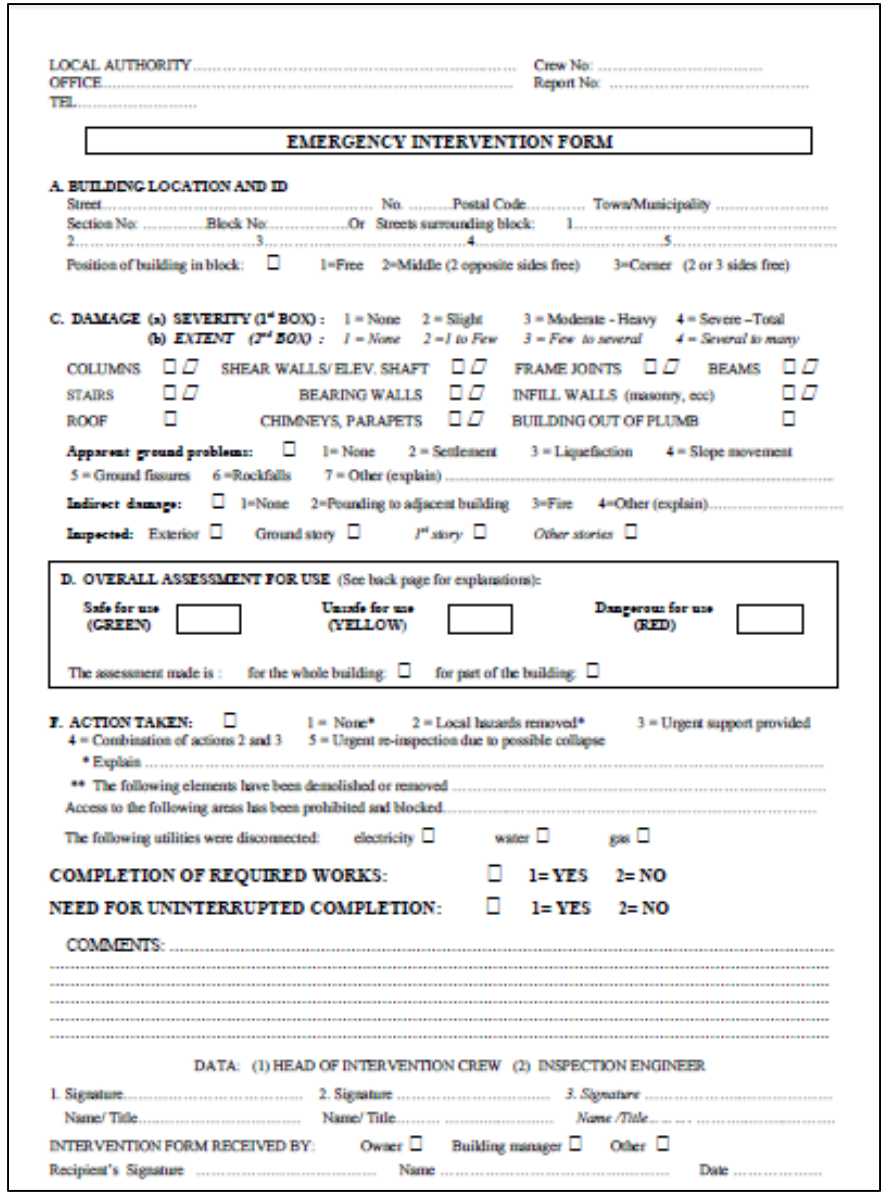
Inspected: Exterior ☐ Ground story ☐ *1st story* ☐ *Other stories* ☐

D. OVERALL ASSESSMENT FOR USE (See back page for explanations):

Safe for use (GREEN)		Unsafe for use (YELLOW)		Dangerous for use (RED)	

The assessment made is : for the whole building: ☐ for part of the building: ☐

F. ACTION TAKEN: ☐ 1 = None* 2 = Local hazards removed* 3 = Urgent support provided
4 = Combination of actions 2 and 3 5 = Urgent re-inspection due to possible collapse



LOCAL AUTHORITY..... Crew No: .....
OFFICE..... Report No: .....
TEL.....

EMERGENCY INTERVENTION FORM

A. BUILDING LOCATION AND ID
Street..... No. .....Postal Code..... Town/Municipality .....
Section No: .....Block No:.....Or Streets surrounding block: 1.....
2.....3.....4.....5.....
Position of building in block: ☐ 1=Free 2=Middle (2 opposite sides free) 3=Corner (2 or 3 sides free)

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COLUMNS	☐☐	SHEAR WALLS/ ELEV. SHAFT	☐☐	FRAME JOINTS	☐☐	BEAMS	☐☐
STAIRS	☐☐	BEARING WALLS	☐☐	INFILL WALLS (masonry, ecc)			☐☐
ROOF	☐	CHIMNEYS, PARAPETS	☐☐	BUILDING OUT OF PLUMB			☐

Apparent ground problems: ☐ 1= None 2 = Settlement 3 = Liquefaction 4 = Slope movement
5 = Ground fissures 6 =Rockfalls 7 = Other (explain) .....
Indirect damage: ☐ 1=None 2=Pounding to adjacent building 3=Fire 4=Other (explain).....
Inspected: Exterior ☐ Ground story ☐ *1st story* ☐ *Other stories* ☐

D. OVERALL ASSESSMENT FOR USE (See back page for explanations):

Safe for use (GREEN)		Unsafe for use (YELLOW)		Dangerous for use (RED)	

The assessment made is : for the whole building: ☐ for part of the building: ☐

F. ACTION TAKEN: ☐ 1 = None* 2 = Local hazards removed* 3 = Urgent support provided
4 = Combination of actions 2 and 3 5 = Urgent re-inspection due to possible collapse
* Explain .....
** The following elements have been demolished or removed .....
Access to the following areas has been prohibited and blocked.....
The following utilities were disconnected: electricity ☐ water ☐ gas ☐

COMPLETION OF REQUIRED WORKS: ☐ 1= YES 2= NO
NEED FOR UNINTERRUPTED COMPLETION: ☐ 1= YES 2= NO

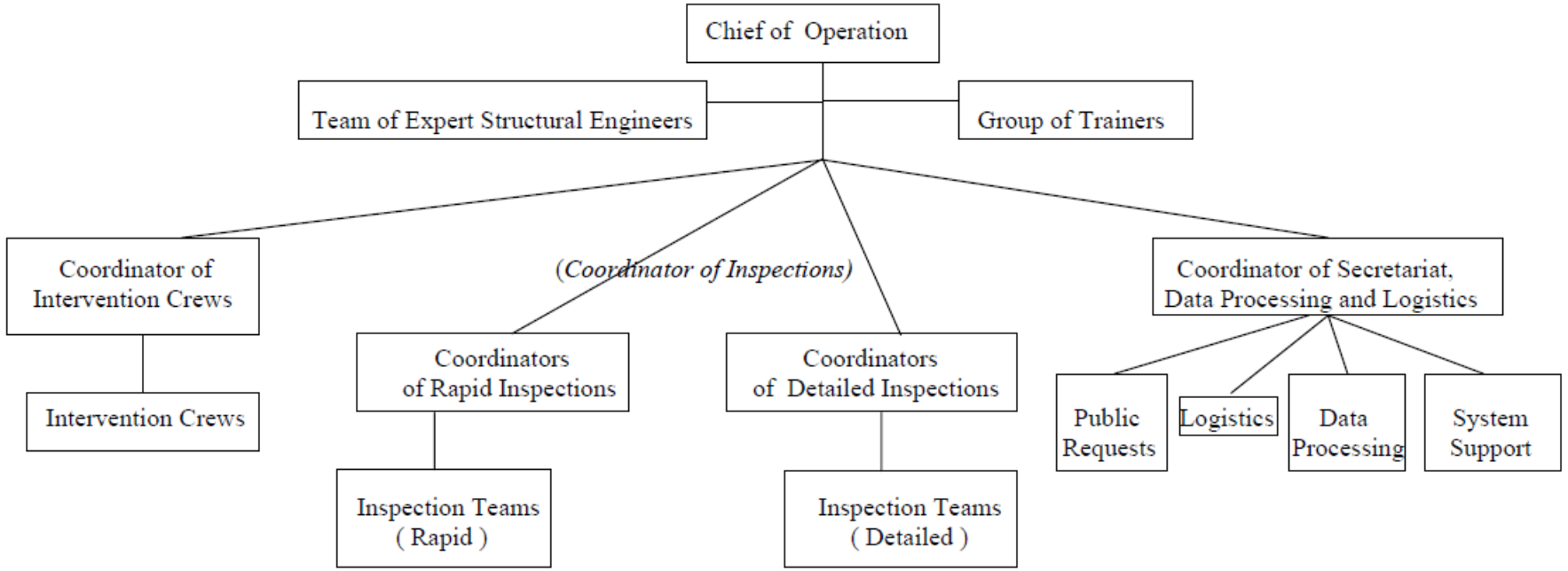
COMMENTS: .....

DATA: (1) HEAD OF INTERVENTION CREW (2) INSPECTION ENGINEER

1. Signature..... 2. Signature..... *3. Signature* .....
Name/ Title..... Name/ Title..... *Name /Title*.....
INTERVENTION FORM RECEIVED BY: Owner ☐ Building manager ☐ Other ☐
Recipient's Signature ..... Name ..... Date .....

Example from Greece

Organizational structure for a large scale emergency damage inspection operation



Development of Computer Program in Greece : Post Earthquake Assessments of Damaged Buildings (PEADAB)

- To support the planning of the post-earthquake emergency inspections operation by storing the available resources (human and material), which will be needed to set up the operation after the earthquake strikes (changes in the planning may be introduced also during the execution of the operation).

- To support the execution of the operation by processing the data of the inspection and intervention forms, checking the agreement of the recorded damage with the given posting (colour) classification, and by providing reports on various aspects of the operation in progress.

- To provide information concerning the progress of the operation, inclusive of daily lists of the buildings requiring emergency intervention.

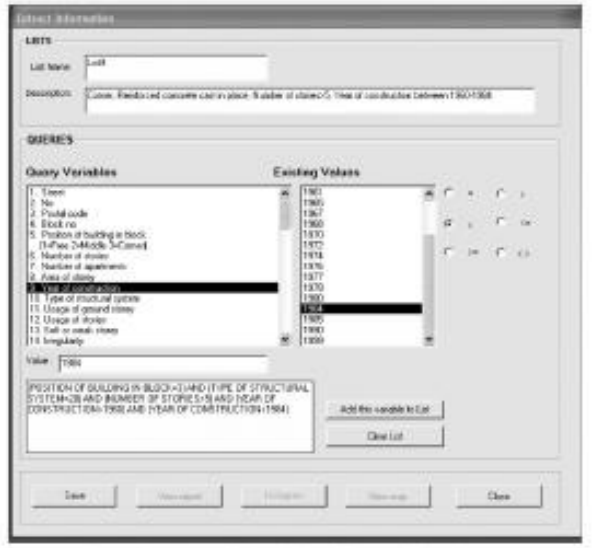
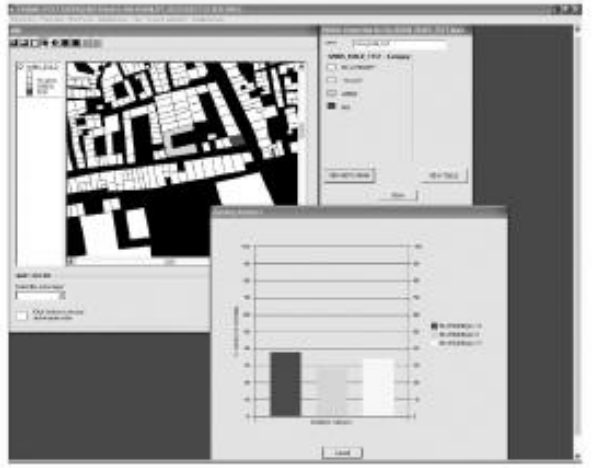


Fig. 5. PEADAB screen for the selection of attributes defined by the user.



Thank you for your attention

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