

Fellowship Training Report

Name of the officer: - AMEER HYDER

Name of the Department: - Pakistan Meteorological Department.

Program / Seminar Attended:- “International Training Course”.

Year / Date: - September 21 till October 23, 2009 Duration: - 33 days,

Title of Training: - “Seismology, Seismic Data Analysis, Hazard Assessment and Risk Mitigation.”

Venue: GFZ German Research Center, Potsdam Germany.

“Introduction”

i Theme:-

The GFZ German Research Center for Geosciences is running an annual five weeks international training course in the field of Seismology and Seismic Hazard Assessment. This training course is part of the educational and training program of the UNESCO in the field of geosciences and disaster mitigation. It provides theoretical fundamentals and practical training in applied seismology, especially for geoscientists and technicians from developing countries. The program is particularly useful for seismological station and network operators, data interpreters and those concerned with seismic zoning and hazard assessment.

ii Objective:-

The disastrous consequences of destructive earthquakes place a heavy burden on many societies and their economy, particularly in developing countries. In order to avoid or at least to mitigate the negative effects of such events, there is a need to develop thorough scientific knowledge of their geological, geophysical causes, structure, kinematics and dynamic characteristics. It is also important to develop capability of monitoring and analysis of such events. Societies are more vulnerable (in terms of human and economic losses) to earthquake due to rapid population growth and urbanization. Improved scientific risk assessment and effective disaster mitigation measures are required to ensure sustainable development in earthquake-prone countries and to save human life`s and to reduce economic losses.

iii Academic Experience: -

1. Course is designed for the individuals who are mainly working in the field of seismic hazard, risk assessment, earthquake zonation and microzonation, earthquake engineering and disaster management.
2. Seismologist, those responsible for the installation, maintenance, operation and data analysis at seismic station / network centers.

“FOCUSED AREA”

i Theoretical focus.

- Presentation of the Geo Forschungs Zentrum Potsdam.
- Representative German Foreign Office.
- Capacity Building International.
- Earthquake Science and its Contribution to Society.
- GITEWS – The German-Indonesian Tsunami Early Warning Project.
- Seismic Early Warning in Istanbul.
- Cross Border Seismology in Central Asia.
- Earthquake Disaster, Scourge of Nature or Man Made Disaster. Introduction into the history of the Telegrafenberg.
- Fundamentals of seismology Seismic sources and source parameters. Wave propagation, Earth's models and seismic recordings.
- Earthquake magnitudes and energy estimates.
- Manual exercise on magnitude determination.
- Introduction to and beginning of exercise on determination of fault plane solution.
- Site selection and optimal configuration of seismic networks.
- Magnitude Calibration Function An example from SE-Germany.
- Design of Seismic Sensors.
- Design of Seismic Sensors.
- Fundamentals of Signal Processing.
- Poles and Zeros, SEED Headers.
- History of Seismology.
- Coherency testing, orientation.
- Seismic Wave Propagation and Attenuation.
- Introduction to Source Parameter derived from seismic Spectra.
- Types of seismic data and formats; overview of seismic processing systems.
- Scientific presentations of the Participants (1-6).
- Basics of Fourier Analysis and Data Processing.
- Source, Path, and Site Convolution.
- Surface wave based methods for site investigation, introduction to Seismic Noise.
- Surface wave based methods for site investigation, Single Station Noise Measurements.
- Surface wave based methods for site investigation, Passive Source Arrays.

- Surface wave based methods for site investigation, Active Source Arrays.
- Trigger algorithms and parameter selection.
- Seismological networks and international exchange of parameter and waveform data.
- The GEOFON project – status report and instrumentation.
- SeisComp3 – A new tool for real time seismology.
- Exercises on local site effects, microzonation, vulnerability and risk assessment, disaster management.
- BGR in Hannover for lectures and practical work related to the operation of a network centre, seismogram analysis of data from single station, networks and arrays as well as to national and international data exchange.
- Physics of Ground Shaking site effect, Introduction.
- Physics of Ground Shaking site effect, Effects of soft surface layers.
- Physics of Ground Shaking site effect, Effects of soft surface layers.
- Hand calculation: compute the fundamental frequencies of a number of sites.
- Estimation of site effects , Non-site specific approach
- Estimation of site effects, Numerical approach and required parameters.
- Estimation of site effects, Instrumental approach – Use of earthquake recordings.
- Estimation of site effects, Instrumental approach.
- Exercise: H/V processing using the geopsy software.
- Exercise: H/V processing using the geopsy software.
- Discussion about the recording conditions and the instrumentation.
- Example case studies on estimation of ground shaking site effects.
- Liquefaction: basic physics, estimation and remediation.
- Manual exercise of estimation of liquefaction.
- Slope instabilities: basic physics, estimation techniques.
- Final wrap-up on the use of all these techniques in microzonation studies.
- Introduction to the specialized training at the BGR.
- Technical equipment of the GRF-array and the GRSN.
- Technical equipment of the BGR and data exchange.
- Localization using networks and array techniques.
- Single station, network and array calibration.
- Final discussion.
- Macroseismic and Strong Motion parameter.
- Earthquake statistics and occurrence probability.
- Methodology of seismic hazard assessment.
- Calculation of the complete seismic wavefield in a layered half space (R. Wang).
- Array Methods in Microzonation
- Strong Motion Data Analysis.
- Ground Displacement Measured by INSAR.
- Time dependent Hazard Assessment.
- Manual and computer exercise on assessing catalog completeness with time.
- Manual exercise on determination of the parameters of the Gutenberg-Richter relation.

- Computer exercise: assigning catalogue completeness with time and its influence on the Gutenberg-Richter parameters.
- Computer exercise: Influence of fore-and aftershocks on the parameters of the Gutenberg-Richter parameters.
- Methodology of seismic hazard assessment.
- Introduction into seismic risk and loss assessment methods: Empirical (intensity-based) approach versus analytical (spectral displacement) approach, Capacity spectrum methods (ATC-40, FEMA 440), Classification of physical building damage.
- The seismic risk and loss assessment tool SELENA: Theoretical background, Comparison with HAZUS-MH .The seismic risk and loss assessment tool SELENA: Theoretical background, Comparison with HAZUS-HM.

ii Practical focus

- Phase interpretation and methods of event location by using local network data.
- Exercise on fault plane solution.
- Exercise; Magnitude determination.
- Teleseismic phase interpretation and 3-component event location; animation of seismic ray propagation.
- Fundamentals of Signal Processing. Filter demonstration.
- Installation and Shielding.
- Demonstration of different digital data acquisition systems together with seismometers for mobile and stationary use (short-period, broadband and strong-motion recordings. and display of the collected data) of shielding and installation.
- Sensor Calibration.
- Demo on Sensor Calibration.
- Exercise on Sensor Calibration
- Measuring Noise.
- Introduction to SEISAN and exercise on the installation of SEISAN.
- Exercise on data base manipulation, on the use of parameter data from internal and external sources and on the presentation of results.
- Exercise on phase picking and location of local seismic events based on 3-component and network records.
- Exercise on phase picking and localization of local seismic events based on networks records.
- Exercise on phase picking and localization of Teleseismic events based on network records.
- Exercise on amplitude picking and magnitude determination.
- Exercise on amplitude spectra calculation and moment magnitude determination. Exercise on determination of fault-plane solutions.
- Exercise on spectral source parameter determination.
- Exercises on seismogram analysis based on digital data. Source, Path, and Site Convolution.
- Exercise on Data Analysis.

- Exercise on Spectral Ratios.
- Exercise on Array Data.
- Global Seismology.
- SOSEWIN Installation and Analysis.
- Software of the BGR (SHM).
- Seismological routine data processing and communication.
- Data processing at single stations, networks and arrays.
- Exercise: First practical steps and data pre-processing.
- Exercise: Data processing at single stations. Exercise: Localization using networks and arrays techniques.
- Identification of depth phases and “later phases”.
- Exercise: Identification of depth phases and “later phases”.
- Manual exercise on the validity of the Poisson distribution.
- Special exercise Hazard Assessment.
- Installation, Test, Integration of Broadband Sensors.
- Manual Exercise on seismic hazard assessment: A simplified approach.
- Computer exercise: SELINA handling and generation of input and inventory files, Building classification, Site and subsoil classification (international earthquake codes), Provision of seismic demand (scenario events and design spectra), Compilation of a logic tree computation scheme

iii Main aspect of training. –

To Transfer skill from the senior expert or pioneer people in field of earthquake, especially to nationals from develop countries for benefit of participants from earthquakes prone developing countries like Pakistan. This course, program aims at those developing interdisciplinary problem understandings. Acquaintance with the theoretical fundamentals and basic features of modern instrumentation, commonly used models and algorithms as well as practical skill in data evaluation also analysis.

“Relevance with Pakistan”

i Comparison with Practice in Pakistan:-

- In Pakistan no institution is conducting trainings in the area of seismic hazard mapping.
- The Pakistan seismic networks require capacity building.
- Human resource development to manage Tsunami early warning center . .
- To meet requirements newly built seismic technology in Pakistan.
- To establish multidisciplinary task-force mission in the area, which is stuck by devastating geological events with aim to collect first hand data about damage.

- No such awareness and education is available to compute vulnerability , aftershock data or other post event activity , local underground effects seismotectonic condition.
- There is no opportunity in megacity research, and assessment hazard , vulnerability and risk in Pakistan.

ii. Lesson learnt:-

Following areas needs to be focused for improvement:

- Phase interpretation and methods of event location by using local network data. Teleseismic phase interpretation and 3-component event location, seismic ray propagation.
- Fundamentals of Signal Processing
- Filter demonstration.
 - Installation of seismic equipment and Shielding.
 - Digital data acquisition systems together with seismometers for mobile and stationary use (short-period, broadband and strong-motion recordings. and display of the collected data)
 - Sensor Calibration.
 - Measuring Noise.
 - SEISAN exercise.
 - Phase picking and location of local seismic events based on 6-component and network records.
 - Phase picking and localization of local seismic events based on networks records. Teleseismic events based on network records. Amplitude picking and magnitude determination. Magnitude determination. Exercise on determination of fault-plane solutions.
- Data Analysis.
- Array Data.
- Global Seismology.

iii Suggestion & Recommendations:-

- Modern facilities, equipment and logistic are required for earthquake observatories.
- There is a need to develop research base in the field of earthquake hazard map including satellite imagery.
- There is a need to develop close cooperation with universities within the framework of international collaboration, training, expertise and equipment to other neighboring countries.
- Faculties are required for hazard analysis and Microzonation..

- Needs to build permanent department for research on earthquake on science and divesting , geological event with aim to collect first hand data about damage , vulnerability, aftershock or other post event activity, local underground effect, seimotectonic condition

“Conclusion”

End note: - The seismic training was very important and beneficial to improve knowledge and skill for future planning with regard to improve capability of Pakistan Meteorological Department, newly build state-of-art National Seismic Monitoring Centre and its allied stations/network for the Tsunami Early Warning, as well as disaster management, hazard analysis & risk assessment etc.

List of the Ministries and department with the report may be shared:-

1. PAKISTAN METEOROLOGICAL DEPARTMENT.
2. UNESCO ISLAMABAD.

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DEPUTY DIRECTOR
PAKISTAN METEOROLOGICAL DEPARTMENT
KARACHI.