4). On completion of the research project, a research paper is presented that is suitable for publication in the *Bulletin of the New Zealand National Society for Earthquake Engineering*. It is normal practice to withhold part of the Scholarship until this condition is fulfilled.

31st January is the annual closing date for applications which should be sent to:

The Administrative Secretary,
New Zealand National Society for Earthquake Engineering,
P O Box 48-046,
Silverstream,
Upper Hutt.

Projects to be Funded by the Earthquake Commission Research Programme 1999/2000

EQC Public Good Research Funding

The Earthquake Commission (EQC) funding of public good research with project topics within its natural disaster sphere of responsibility, was put on a systematic basis from early 1991. Project funding is on a biennial basis. Supported projects for 1991/92 are published in the September 1991 Bulletin of NZNSEE, 1993/94 projects in the June 1993 issue, 1995/96 projects in the June 1995 issue and the 1997/98 projects in the June 1997 issue.

For each funding round the availability of EQC funds was advertised several months before their allocation. At each round the applications for research project support had budgets which totalled several times the available funds. Within EQC budget constraints, the most worthy and appropriate projects have been funded.

The major input to the selection of research proposals for funding has been made by a panel of seven experts set up by the EQC Research Foundation. The members of the panel have been chosen to cover research fields related to EQC activities, and for their knowledge of the progress and needs of these research fields in New Zealand.

Reports on projects funded by the EQC Research Foundation have been distributed to New Zealand universities and selected libraries and are also available from the Commission. A full list of projects completed under this research grants scheme is on the Internet at EQC's web page – http://www.eqc.govt.nz

S&G 324 **PALEOENVIRONMENTAL ANALYSIS OF UPLIFTED COASTAL LAKE AND WETLAND SEQUENCES IN THE WELLINGTON REGION**
Victoria University of Wellington – Ursula Cochran, Michael Hannah and James Goff

Several lake and wetland sites around the Wellington coast have Holocene sedimentary sequences that contain a transition from saline to freshwater environments. This is likely to be the result, at least in part, of tectonic uplift of the coast over the last 7000 years. This project aims to investigate three such sites: Okupe Lagoon on Kapiti Island, Taupo Swamp north of Plimmerton and Lake Kohangatera in Fitzroy Bay. Cores from each site will be dated, levelled with respect to sea level and the relevant sediment analysed to determine depositional environment. Diatom microfossils will be used as indicators on paleosalinity to determine the change in marine influence at each site over time. The resulting paleoenvironmental and paleosalinity reconstructions will be used to estimate the amount and timing of Holocene coseismic uplift at each site.

This technique has been used successfully in a previous study at Lake Kohangapiripiri. The project is part of a PhD thesis to be carried out by Ursula Cochran under the supervision of Dr Michael Hannah and Dr James Goff.

SE 328 **SHEAR STRENGTH OF MASONRY WALLS**
New Zealand Concrete Masonry Association & The University of Auckland – Jason Ingham and David Barnard

The commentary to the current New Zealand Standard for the design of masonry structures notes in several places that criteria masonry shear strength are conservative due to insufficient data being available. In particular, masonry shear strength is to be taken as zero in potential plastic hinge regions. As a consequence of these criteria, it is effectively not possible to design for ductile masonry response, particularly for out-of-plane loading where shear reinforcement cannot be readily provided, despite the fact that testing has shown that ductile response may be developed.

It is anticipated that the masonry design standard will soon be revised to accommodate changes since made to the NZ loading code. During this revision, there will be an opportunity to update masonry shear strength criteria based upon experimental evidence accumulated over the last two decades. In addition, there will be an opportunity to conduct additional testing to clarify this aspect of response for masonry structural forms commonly used in New Zealand. Consequently, an investigation into the shear strength of masonry in plastic hinge regions is required.

SE 329 **INFLUENCE OF LOADING HISTORY ON ULTIMATE DISPLACEMENT OF CONCRETE STRUCTURES**
Cement & Concrete Association of New Zealand and University of Auckland - Jason Ingham

It has recently been proposed that displacement-based design has a major advantage over the current force-based design method as it leads to more consistent strength requirements at the ultimate limit state for a given level of damage. This permits detailing of concrete structures to be more rationally determined.

Many tests on concrete structural elements have been conducted to assess their maximum deformation capacity, which is of different loading (displacement) sequences, with very few of these being representative of the displacement history expected in major earthquakes. One conclusion from this work is that loading history does have an important influence on the ultimate deformation that can be sustained. Consequently there is a need to establish the influence which different loading histories have on structural performance, thereby enabling tests reported in the literature to be appropriately correlated.

SC 335 **THE PERCEPTION OF EARTHQUAKE RISK AND THE PREPARATION FOR EARTHQUAKES IN WELLINGTON**

Victoria University of Wellington – Kevin Dew and Mike Lloyd

This research will examine the perception of risk of earthquake and perparedness for earthquakes amongst the population of Wellington. These variables will be related to demographic characteristics of age, gender, education and length of residence in Wellington, and also to the experience of earthquakes. It also aims to identify public and media misconceptions of the standard scientific view of risk and appropriate preparatory measures. A number of studies overseas and in New Zealand suggests that personal experience of disaster phenomena, such as earthquakes, link to increases in damage-reduction action, and that increasing age leads to a view that such phenomena are less troublesome (Simpson-Housley & Curtis, 1983, Man & Simpson-Housley, 1987). Other research shows that the media mis-report scientific research, and that the public have a distorted perception of media claims (Bell, 1991). This research will bring these two issues together to explore the relationship between earthquake preparedness, and scientific, media and public representations of risk. It will achieve this through a content analysis of Wellington newspapers and national magazines for a two year period prior to the commencement of the research, interviews with key informants who are identified as experts in the field of earthquake preparedness and earthquake risk, a survey of 200 residents in Wellington and focus groups selected from a sample of the survey replies.

S&G 337 **"THE 1848 MARLBOROUGH EARTHQUAKE: GEOLOGY AND ANALYSIS OF HISTORIC DATA"**

Victoria University of Wellington – Rodney Grapes, Euan Smith & Gaye Downs (GNS)

The 1848 Marlborough earthquake of 16 October with an estimated magnitude of M7.4 – 7.5 (Grapes et al.. 1998) was the largest earthquake experienced in central New Zealand since European settlement in 1840 prior to New Zealand's largest earthquake in 1855. Compared with all subsequent earthquakes, it caused the most damage to Wellington and resulted in at least three deaths. A study of the 1848 earthquake by George Eiby was published in 1980 (DSIR Bulletin) although much of his primary source data remains unpublished. A considerable amount of data additional to that found by Eidy has now come to light and this provides leads to further, as yet unexamined accounts of the earthquake. Newly found historical documents and a survey map have conclusively shown that the 1848 earthquake ruptured the Awatere fault (for over 100 km) and not the Wairau fault as claimed by Eidy. These new data indicate the need for a comprehensive study of the earthquake in terms of collation, transcription and analysis of historical documents and field investigations along the Awatere fault for about 150 km inland from the Marlborough coast.

GE 340 **PREDICTION OF PORE PRESSURE INCREASE BASED ON DISSIPATED ENERGY – FIELD VERIFICATION FROM DOWNHOLE ACCELERATION RECORDS.**

Soils and Seismology – R O Davis and J B Berrill

One method for predicting liquefaction potential relates dynamic pore pressure increase to the dissipated energy caused by ground motion. While considerable laboratory evidence exists to support the pore pressure-dissipated energy hypothesis, no field verification has as yet been possible.

A small number of downhole instrument arrays world-wide now measure both ground acceleration and dynamic pore pressure. Recently developed methods for computing stress and strain based on downhole acceleration records will permit direct estimation of dissipated energy time histories in natural soils subjected to real earthquakes. In those cases where pore pressures have also been measured, a direct comparison of pore pressure and dissipated energy will be possible. The proposed research will obtain relevant downhole data together with information concerning site conditions; carry out calculations for stress, strain and dissipated energy; and compare time histories of dissipated energy with measured pore pressure.

S&G 341 **HIGH RESOLUTION DATING OF PAST ALPINE FAULT RUPTURE IN SOUTH WESTLAND**

University of Otago – Richard Norris, Alan Cooper and Kelvin Berryman

Results from recent fault trench excavations at Haast and Okuru River localities on the Alpine Fault (Berryman et al. 1998) and the acquisition of a single slab from an apparently disturbed tree growing on the fault trace have demonstrated the importance of these sites in obtaining precedent information on past great earthquakes on the Alpine Fault. Radiocarbon dating results at these sites enable the confident assessment that three great earthquakes, each with about 8 m

of dextral displacement and about 1 m of vertical displacement have occurred on this section of the fault in the past since about 1000AD. Radiocarbon samples that were collected from the trenches in early 1998 have not been able to provide close definition of the timing of the last or second to last events.

This proposal seeks support to:

1) excavate 1 or 2 trenches to seek suitable datable material from the Okuru and/or Haast sites to provide a better estimate of the timing of these events;
2) collect discs from stumps of trees felled in the 1950's and 1960's that were growing near the trace of the Alpine fault between the Okuru and Turnbull Rivers for analysis of growth patterns and dating of disturbances.

Growth rated disruptions have been observed in trees growing in proximity to fault scraps in central and north Westland. The correlation between direct, but imprecise, dating of fault rupture events from fault trenches and the precise dating of periods of disruption to forest growth in the vicinity of the fault, has been the basis for exciting advances in establishing very precise estimates of the timing of faulting events further north (Wright et al. 1997, 1998; Yetton et al. 1998; Wells et al. 1998).

Results of the project will test the model that the last rupture of the Alpine fault in south Westland was in about 1720AD, and whether the prior event matches the events at 1620AD or 1450AD (or neither) proposed for the northern section of the fault (Yetton 1998). The on-fault earthquake record at Haast is excellent. Determination of timing so as to allow detailed correlation with the northern section of the fault is crucial to developing hazard models for the South Island.

GE 345 **ESTIMATION OF SHEAR MODULUS SOFTENING BASED ON DOWNHOLE ACCELERATION DATA**

Soils and Seismology – R O Davis and J B Berrill

Acceleration records from downhole arrays provide valuable insight into the propagation and amplification of seismic waves. Interpretation of data from these events frequently involves estimation of shear modulus for the soils involved. While estimates for small strain elastic deformations are usually reliable, softening due to non-linear soil behaviour introduces unwanted complications in any modulus calculation. The proposed research will investigate a method to overcome the problems associated with softening caused by strong shaking. It is proposed to use the cross-correlation of two downhole records as a tool to analyse the softening process. The cross-correlation lag time for two records will be maximised by non-linear compression of the time scale of one of the records. The amount of time compression is directly related to the amount of softening experienced by the soil column contained between the two instruments. A complete history of modulus softening should be obtainable.

SE 347 **PRECAST FLOORS IN DUCTILE MOMENT RESISTING FRAME BUILDINGS**

University of Auckland – Richard Fenwick, Les Megget, Barry Davidson & David Lau

Elongation of a ductile frame, due to the formation of plastic hinges in a severe earthquake, can have several significant effects on the seismic performance of structures. In this project it is proposed to look at two of these. The first involves the support of precast rib and fill flooring where elongation or spalling destroys the nib support. This situation has been investigated for hollow core type units but not for pretensioned rib units. It is these that we plan to investigate as part of this project. The second relates to the strength enhancement, which may arise when elongation subjects the prestressed units to tension. This situation is particularly significant in an appreciable number of ductile frame structures which rely on perimeter frames for their seismic resistance. In these the precast prestressed floor units generally span two or more bays of the perimeter frame. Preliminary calculations indicate that elongation of these floors may result in a very significant increase in the strength or the beam to the extent that plastic hinging may be forced into some of the columns, or the ductility of the beams may be severely reduced. Currently this source of potential strength enhancement is overlooked, see 1998 Red Book!

SE 348 **DISPLACEMENT BASED DESIGN**

University of Auckland – Richard Fenwick, Barry Davidson & Hayder J Judi

A new method of seismic design, **displacement based design**, has been proposed and prompted as a procedure that results in structures with a more predictable seismic performance than those resulting from our current **force based** design method. In the proposed research, the basic assumptions inherent in both the force and displacement based methods of design will be assessed and compared. The relative reliability of these two approaches will be investigated by subjecting designed structures to time history analyses. A number of structural forms will be investigated using the range of hysteretic load deformation responses which are appropriate to the form being considered. Earthquake ground motions with different characteristics will be used. This will enable the potential advantages and disadvantages of the two methods to be assessed. We note that to date the displacement based design method has been calibrated using the Takeda hysteretic model, which is only applicable to a restricted range of structures, such as reinforced concrete walls and bridge piers. Other forms of hysteretic model, which are appropriate to other structures, need to be considered.

S&G 353 **PALEOSEISMIC INVESTIGATION OF THE NORTH ALPINE AND WEST WAIRAU FAULTS**

University of Canterbury & Geotech Consulting Ltd – Mark Yetton

The northern section of the Alpine Fault is thought to become progressively less active as it approaches the Nelson Lakes area and the transition into the Wairau Fault. This may be the case but in many ways the most important question is the date of the last large earthquake rupture. If the approximate date of the last event is known then this information in conjunction with the average slip rates can be used to assess the likelihood of a further significant earthquake. Recent paleoseismic investigation we have carried out further south demonstrates the last Alpine Fault earthquake south of the Ahaura River was around 1600 AD. To investigate the paleoseismic history of this area we now propose to extend our local mapping and trench work further north to four more trench sites between the Ahaura River and the Branch River in the Wairau Valley.

S&G 373 **MODELLING REALISTIC RUPTURES ON THE WELLINGTON FAULT**

Institute of Geological & Nuclear Sciences Ltd – Terry H Webb & Rafael Benites

Because of an earlier EQC grant we have been able to develop the capability to model the strong motions from moderate earthquakes using the finite computer code of Benites. To apply this technique to large earthquakes, such as a rupture on the Wellington fault, we need to know a realistic slip distribution for the fault, so our prediction of relatively high frequency (few Hz) ground motions will be accurate. In a recent overseas study, 15 large crustal earthquakes have been used to characterise the degree of fault heterogeneity (or roughness, especially in terms of variability of slip), including asperities (strong patches that produce large slip). In addition, the Benites code has been modified to allow heterogeneous ruptures, so we are now ideally placed to model a realistic rupture of the Wellington fault, producing synthetic seismograms at relatively high frequencies for sites located on paths that can be adequately modelled with horizontally layered velocity models. The model can be tested against results from a current study modelling a Wellington fault rupture using the summation of small events.

V 377 **EFFECTS OF THE 1995/96 RUAPEHU ERUPTIONS: HAS THE SEISMICITY CHANGED?**

Institute of Geological and Nuclear Sciences – Carol Bryan & Steven Sherburn

The characteristics of volcanic seismicity are used for the real-time assessment of activity and hazards at New Zealand volcanoes. If an eruption at a volcano results in changes to the internal structure of that volcano, the characteristics of the seismicity may change, requiring fine-tuning of systems, particularly those which are automated, which depend upon the characteristics. We propose to examine seismic data from before and after the 1995/96 eruptions of Mt. Ruapehu to determine if these eruptions resulted in changes to the long-term seismicity of Ruapehu, and consequently, to the internal structure of the volcano.

GE 380 **SEISMIC CONE PENETRATION TEST IN STRONG SOILS**

Institute of Geological & Nuclear Sciences Ltd – P R Barker & W R Stephenson

There are sites where the seismic CPT test would work but for the presence of impenetrable layers. The proposed project will seek to overcome this by using a new technique which lies in cost between SCPT and downhole propagation methods. This will be tested at Parkway, Wainuiomata, by drilling a hole to about 30m and then back-filing it with stiff bentonite slurry. Then an SCPT test will be conducted down the bentonite-filled hole. This will enable shear wave velocities to be measured below the depth where a previous SCPT probe met refusal.

Parkway is an important site because its seismic response has been evaluated with a dense network of seismographs. However this seismic response has not been able to be reconciled with modelling because of a lack of shear wave velocity profiles.

S&G 386 **PORTERS PASS FAULT PALEOEARTHQUAKES** *Institute of Geological & Nuclear Sciences Ltd & University of Canterbury – A Nicol & J R Pettinga*

The Porters Pass Fault is a prominent element of the Porters Pass to Amberely fault zone (PPAFZ) which, at ca 60 km from Christchurch, represents the closest source of large magnitude earthquakes to this city. Sparse temporal data from rock avalanches and two exposures of active fault planes indicate two possible surface-rupturing earthquakes in the PPAFZ at 500-700 and 2200-2450 years B.P. (Crown et al. 1996). The timing of these events is poorly constrained by comparison to paleoseismically important faults elsewhere in New Zealand (eg Wellington Fault), while current estimates for the length of surface ruptures, the amount of slip per event and the magnitude of paleoearthquakes are based largely on inference. To better understand the frequency and magnitude of earthquakes on the Porters Pass Fault we propose to combine trenching of sag ponds along the trace with detailed mapping of landforms offset by the fault. These data will allow us to build a more complete picture of the recurrence intervals, rupture length, displacement per event and magnitude of earthquakes on this fault over the last ca 10 kyr.

S&G 388 **PROBABILITY OF RUPTURE OF THE ALPINE FAULT ALLOWING FOR UNCERTAINTIES**

Institute of Geological & Nuclear Sciences Ltd – D A Rhoades and R J Van Dissen

Recent investigations of fault traces, forest ages, tree rings, and lichen growth in the vicinity of the Alpine Fault have greatly improved information on the times of rupture of segments of the fault over the past thousand years. Geological and geodetic observations and associated modelling have helped to improve estimates of the long-term slip rate. Statistical modelling of recurrence, aimed at estimating the current and future probability of rupture, has taken account of some of the new information, but has not formally allowed for the uncertainties in the data, including dates of rupture and long-term slip rate and magnitude of events, or parameters of the recurrence time models adopted. Estimates of the current hazard may thus be higher than the data justify. A methodology for incorporating uncertainties was developed by Rhoades et al (1994), and will be used in the present study to bring together both data and parameter uncertainties into a single estimate of the time-varying probability of rupture of segments of the fault. Separate estimates will be produced using the lognormal, exponential/Poisson and Weibull recurrence-time models.

S&G 389 **TIMING AND SIZE OF LARGE PREHISTORIC EARTHQUAKES ON THE WAIRAU FAULT, SOUTH ISLAND**

Institute of Geological & Nuclear Sciences Ltd – Judith Zachariasen, Kelvin Berryman

The right-lateral Wairau Fault is the northernmost segment of the Alpine fault system. It passes within a few km of Bleheim and may continue offshore, on strike with the east side of Kapiti Island, passing within 25 km of central Wellington. On land in the South Island, its location has been mapped, and some work has been done to identify displaced Quaternary markers (Lensen, 1976). Cumulative displacement of Quaternary terraces indicates an average slip rate for the fault of 4 ± 1 mm/yr (Berryman et al., 1992). Displacement of Holocene beach ridges and other markers suggest a possible single-event displacement of about 6 m, but this is not well constrained (Grapes and Wellman, 1986). Calculations using the above slip rate and the estimate of single event displacement yield an estimated earthquake recurrence interval of 1000-2300 yrs. However, no direct evidence of the timing of surface rupturing earthquakes has been gathered. The most recent event is probably older than about 800 years since the fault does not displace 800-yr beach ridges at the coast (Grapes and Wellman,. 1986).

If the Wairau Fault does slip in 6 m events, it could produce a Mw 7.4-7.7 earthquake (Wells and Coppersmith, 1994). Because of the fault's proximity to Blenheim and because it is on strike with the greater Wellington region and the Kapiti coast, rupture of the Wairau Fault could generate significant damage from surface rupture or ground shaking in those communities. Thus, it is important in terms of earthquake hazard mitigation to ascertain an accurate estimate of slip per event and the likelihood of recurrence of such events. This study is designed to address those issues with direct paleoseismic evidence of single-event displacement and timing of past events.

SE 402 **REPAIR AND REINSTATEMENT OF EARTHQUAKE DAMAGED HOUSES**

Building Research Association of New Zealand (BRANZ) - Andrew King

The first phase of this project involves the preparation of a damage catalogue of damage experienced during recent earthquakes within New Zealand. It will specifically focus on the behaviour of houses during the Edgecombe earthquake (March 1987) and the Weber earthquake (May 1990). Information sources will include the BRANZ records of these events, NZNSEE records and EQC damage records. Data will be catalogue according to the location of the damaged components within the dwelling. It will include an estimate of the ground motion at the specific site and comment as to changes in construction practices over time (ie relate construction practice to the specific damage incurred).

The second and dominant phase of the project involves the construction of up to 7 replica systems within BRANZ structural testing laboratory representing the damage commonly observed or that which is more severe. Each specimen will be subjected to varying intensity of lateral distortion with resistance/stiffness being recorded and damage development observed. Construction personnel from within BRANZ and from our sources and contacts within the building industry will be involved in developing alternative repair strategies and preferred repair procedures are to be identified. The specimens will be repaired according to those preferred techniques and the effectiveness of those repairs assessed by repeat loading while the exact mix of this phase is dependent on the level of funding available, and allowance for the testing an evaluation or two foundation and five wall configurations is included within the budget.

SE 411 **ALTERNATIVE LOAD PATHS FOR FLOOR DIAPHRAGMS IN BUILDINGS**

University of Canterbury – Jose I Restrepo, Desmond K Bull & Robert Park

New Zealand, like many other countries overseas, made extensive use of cast-in-place monolithic structures during the first three quarters of this century. However, during the boom years of building construction in New Zealand, in the mid to late 1980's there was a significant increase in the use of precast concrete. This came about because the incorporation of precast concrete elements has recognised advantages of high quality control, speed of construction, reduction in site formwork and labour and for increasing overall economy. The use of precast concrete in the 1980's required a great deal of innovation. The then current New Zealand concrete structures standard, NZS 3101:1982, contained comprehensive provisions for the seismic design of cast-in-place concrete but lacked provisions for the seismic design of buildings incorporating precast concrete elements. Precast concrete is nowadays the preferred construction

method in New Zealand. Up to 75% of the suspended floor systems employ precast concrete proprietary systems.

The main concern when using precast concrete suspended floor systems is the seismic performance of the diaphragm that carries in-plane inertia forces to the primary earthquake resisting beams and columns. This concern was highlighted by a Study Group which was formed with the aims of summarising and presenting data on precast concrete design and construction, identifying special concerns, suggesting recommended practices and recommending topics requiring further research. The deliberations of the Study Group resulted in the publication of a manual entitles "Guidelines for the Use of Structural Precast Concrete in Building". Unresolved issues on the seismic behaviour of floor diaphragms are (1) the effects of accumulated elongation in the plastic hinges of deep beams of perimeter frames, which may lead to the loss of support and partial collapse of the precast concrete floor units, and (2) the effects of long precast prestressed concrete floor units passing through intermediate columns of perimeter frames. The latest issue has never been the focus of any research work anywhere in the world.

The Department of Civil Engineering at the University of Canterbury has for a number of years been looking at connection details between precast concrete suspended floor systems. Past research work carried out at the University of Canterbury has looked at the behaviour of isolated assemblies that give a relative seismic performance of the connection details. It is now felt that there is the need to extend knowledge into the seismic behaviour of diaphragms built with precast concrete suspended floors in a more holistic manner through the experimental verification on large structural assemblages.

SE 422 **METHODOLOGY FOR THE ASSESSMENT OF FACE LOADED UNREINFORCED MASONRY WALLS UNDER SEISMIC LOADING.**
Opus International Consultants – E L Blaikie & R A Davey

A previous research project funded by EQC titled "Earthquake Vulnerability of Existing URM Buildings" established that the post-cracking experimental seismic behaviors of face loading Unreinforced Masonry (URM) walls could be adequately modelled using inelastic dynamic analysis techniques.

The Project also resulted in the development of an improved methodology for assessing the seismic resistance of face loaded URM walls. However, further research is required to develop and refine the methodology before it can be used with confidence by practising Engineers.

A simple laboratory test on a face loaded wall sample is proposed to establish appropriate damping values and to help calibrate the inelastic computer models that will be used to further study the behaviour of face loaded URM walls.

It is also proposed to use the methodology to produce design charts that can be used to assess the seismic stability of face loaded URM walls with minimal design office effort.

GE 423 **DESIGN OF FOUNDATIONS TO RESIST BASE SHEAR DURING EARTHQUAKES**
University of Canterbury – Kevin McManus & Des Bull

During the Kobe earthquake, many buildings in the Kobe area were founded on piles and many were damaged by shear acting at the base of the structure. The exact mechanisms resisting base shear are not well understood but include base friction (which may disappear because of relative settlement of the soil), passive resistance of foundation beams and walls (but this is a relatively soft mechanism), and passive resistance of the piles. Each of these mechanisms has different load-displacement characteristic which may lead to overload of the piles in shear in certain cases.

Each of the three base shear-resisting mechanisms will be studied experimentally at full scale for typical NZ designs. Then, analytical models will be used to examine the likely interaction of these different shear-resisting mechanisms for a range of different structure/foundation scenarios.

The output will be recommendations to designers for a more rational approach to designing foundations to resist base shear.

SE 424 **NEAR SOURCE BEHAVIOUR OF SEISMICALLY ISOLATED STRUCTURES**
University of Auckland – Barry Davidson, Tam Larkin and Ian Buckle

Many seismically isolated structures have been designed to resist large conventional earthquakes, earthquakes that do not exhibit near source characteristics. In a number of cities around the world (including Wellington) these seismically isolated structures are now found to be located in a near source regime. As the possible structural damage that can be caused by a near source earthquake has become apparent over the last decade, as emphasised by the devastation resulting from the Northridge and Kobe earthquakes, it is important to reassess the response of isolated structures to these earthquakes.

The proposed research will investigate the generic response of conventionally designed isolated structures to near source type earthquakes. Specifically it will to describe the characteristics of the near source earthquakes that are critical to the isolated structure. As a second stage in the research, preferred retrofit options to the isolation devices will be investigated. These will be prescribed from existing technology and will attempt to ensure a number of objectives are met. Firstly, that the structure when subjected to a "critical" near source event, will not exceed the allowable displacements of the existing device while limiting the accelerations of the superstructure. Secondly, the response of the optimally retrofitted structure will also meet its response criteria to the non-near source event.

EARTHQUAKE COMMISSION REPORTS

Graham Quirke, the Administrative Secretary has recently received copies of the following EQC Research Reports:

"The Design of Permanent Slopes for Residential Building Development" by SA Crawford, PJ Millar, (Tonkin & Taylor), *EQC funded report 95/183- May 1998.*

"Earthquake-Induced Landsliding in New Zealand and Implications for MM Intensity and Seismic Hazard Assessment" by GT Hancox, ND Perrin, GD Dellow (IGNS), *EQC funded report 95/196- December 1997.*

"Seismotectonics of the Arthur's Pass Earthquake of 18 June 1994" by R Robinson, RE Abercrombie, TH Webb, PJ McGinty, T Arnadottir, JJ Mori, RJ Beavan, M Reyners (IGNS), *EQS funded report 95/197- July 1998.*

"Evaluation of Wells and Coppersmith (1994) Earthquake and Fault Relationships in the New Zealand Context" by Mark Stirling, David Rhoades, Kelvin Berryman (IGNS), *EQC funded report 97/249- December 1998.*

"Ash Predictions, How Successful Were they?" by AW Hurst and BJ Scott (IGNS), *EQS funded report 97/268- October 1998.*

These reports may be borrowed by applying to the NZSEE Administrative Secretary, PO Box 48 086, Silverstream, Upper Hutt.