NBSIR 80-2111-2

REVIEW AND REFINEMENT OF ATC 3-06 TENTATIVE SEISMIC PROVISIONS

REPORT OF TECHNICAL COMMITTEE 2: STRUCTURAL DESIGN

Hal Iyengar, Chairman, American Society of Civil Engineers
James Robert Harris, Secretary, National Bureau of Standards
Timothy Reinhold, Assistant Secretary, National Bureau of Standards
Howard Simpson, American National Standards Institute
Richard McConnell, Interagency Committee on Seismic Safety in Construction
Nicholas Forell, Structural Engineers Association of California
Robert Englekirk, Technical Committee 1: Seismic Risk
Joseph V. Tyrrell, Technical Committee 3: Foundations
Mark Fintel, Technical Committee 4: Concrete
Alan Yorkdale, Technical Committee 5: Masonry
William A. Sontag, Technical Committee 6: Steel
Edwin G. Zacher, Technical Committee 7: Wood
Roland L. Sharpe, Applied Technology Council
Henry L. Degenkolb, Applied Technology Council
Ajit S. Virdee, Building Seismic Safety Council
William J. LeMessurier, Building Seismic Safety Council

Prepared for use by:

BUILDING SEISMIC SAFETY COUNCIL

Sponsored by:

FEDERAL EMERGENCY MANAGEMENT AGENCY

Center for Building Technology
National Bureau of Standards
Washington, D.C. 20234

October 1980

U.S. DEPARTMENT OF COMMERCE, Phillip M. Klutznick, Secretary
Luther H. Hodges, Jr., Deputy Secretary
Jordan J. Baruch, Assistant Secretary for Productivity, Technology and Innovation
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

ABSTRACT

The Tentative Provisions for the Development of Seismic Regulations for Buildings were developed by the Applied Technology Council to present, in one comprehensive document, current state-of-knowledge pertaining to seismic engineering of buildings. The Tentative Provisions are in the process of being assessed by the building community. This report is one of a series of reports that documents the deliberations of a group of professionals jointly selected by the Building Seismic Safety Council and the National Bureau of Standards and charged with reviewing the Tentative Provisions prior to the conduct of trial designs. The report contains the recommendations and records of the committee charged with review of the general structural design and analysis provisions. The committee made 27 recommendations for revisions to the Tentative Provisions and five additional recommendations concerning subsequent activities, such as the conduct of trial designs. These recommendations were made to the parent group, the Joint Committee on Review and Refinement, and their action on these recommendations is documented in a companion report.

Keywords: building; building codes; building design; earthquakes; engineering; standards; structural engineering.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 General

The Tentative Provisions for the Development of Seismic Regulations were developed by the Applied Technology Council (ATC) in an effort that included a wide range of experts in the actual drafting of the provisions. Two external review drafts were circulated to a large portion of the interested and informed community of eventual users. However, because the Tentative Provisions were innovative, doubts about them existed. Consequently, an attempt was made to investigate these doubts and to improve the Tentative Provisions where possible before an expensive assessment of the Tentative Provisions was undertaken by conducting trial designs.

This review and refinement project was planned and conducted by the National Bureau of Standards with the advice and approval of the Building Seismic Safety Council, a private sector organization formed in 1979 with the purpose of enhancing public safety by providing a national forum to foster improved seismic safety provisions for use by the building community.

The review of the Tentative Provisions was performed using the committee structure shown in figure 1. Nine Technical Committees were formed with interests that collectively cover the Tentative Provisions. The Joint Committee on Review and Refinement consists of all voting members of the Technical Committees. The chairman of the Technical Committees form a Coordinating Committee.

Membership of each Technical Committee is made up of representatives of organizations that have particular interest in the Tentative Provisions; the participants are listed in the committee membership section of this report.

In addition to the voting members, each Technical Committee includes a non-voting member from each of the following organizations: The Applied Technology Council (ATC), the Building Seismic Safety Council (BSSC) and the National Bureau of Standards (NBS). The ATC representative was a technical resource to the committee since he was closely involved with the development of the provisions of interest to the committee. The NBS representative was the technical support throughout the effort. The BSSC representative provided a link with the Building Seismic Safety Council, which will be involved in trial designs and evaluations.

1.2 Committee Summary

Technical Committee Number 2 on Structural Design was charged with determining the adequacy, for purposes of trial design, of the following portions of the ATC 3-06 Tentative Provisions for the Development of Seismic Regulations for Buildings: Chapter 3, Structural Design Requirements, Chapter 4, Equivalent Lateral Force Procedure, and Chapter 5, Modal Analysis Procedure, and the appropriate portions of Chapter 1, Administration, and Chapter 2, Definitions and Symbols.

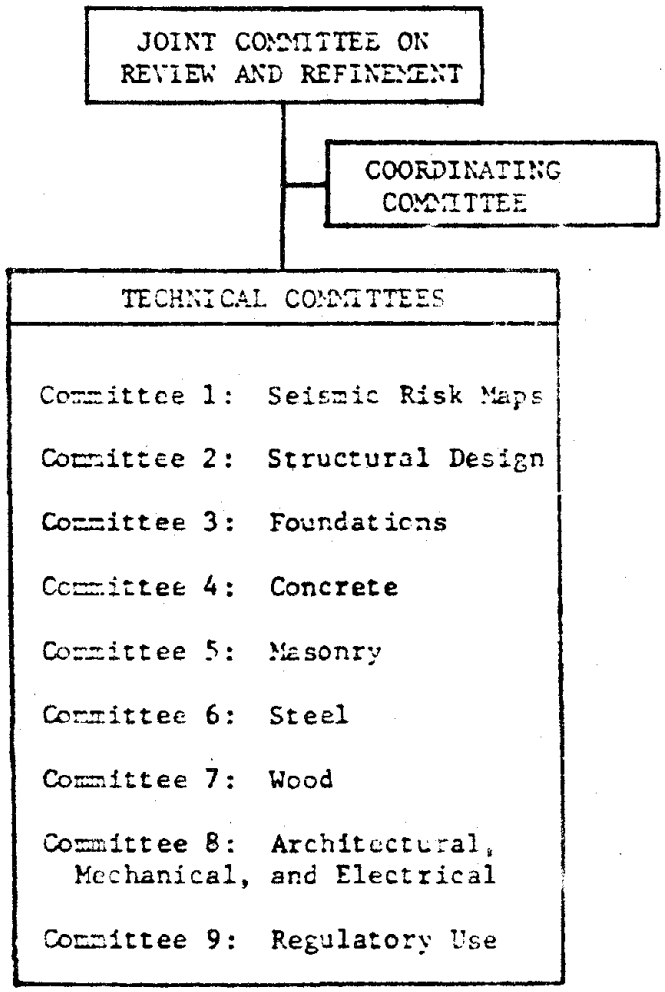

Figure 1: Committee Structure

The committee proposed 23 revisions to the provisions of ATC 3-06 (see Section 3.1). In most instances these proposals carried the committee by a unanimous ballot. Some of these proposals involve a change in the commentary as well as the provision. The committee also proposed four changes to the commentary that are relatively independent of the changes proposed for the provisions (see section 2.2). The committee also made five recommendations concerning the execution of the upcoming trial designs and the development of seismic provisions in general (see sections 2.3 and 2.4).

The committee carried out its work through a combination of correspondence and working meetings. Three meetings were held:

December 11, 1979, National Bureau of Standards, Gaithersburg, MD
February 27-28, 1980, Quality Inn/Desert Sky, Phoenix, Arizona
April 2-3, 1980, O'Hare American Inn, Des Plaines, Illinois

The minutes of these meetings are in section 3.2, and the correspondence is summarized in section 3.3. Section 3.2 contains the complete committee roster.

Nearly everyone connected with the committee felt that, on the whole, the committee carried out its charge in a responsible and professional manner, particularly considering the nature of the task of preparing for trial designs and the short time available. The committee wishes to emphasize that the provisions must be reconsidered carefully following the trial designs.

1.3 Chairman's Statement

Committee Number 2 is a well balanced committee with respect to geographical locations and professional and industrial representation. The Committee adopted the view that mid-course corrections will be made if found necessary within the original intent and philosophy of the document. The Committee assumed that trial designs are necessary for the evaluation of many critical items. It was also recognized that trial design should not be realistically relied upon to verify all items. Therefore, the Committee made corrections and revisions which were needed for which trial design results were not completely essential. The Committee also attempted to state specific recommendations for trial design and other studies when needed.

I feel the following items have a significant impact on the eventual usefulness and relevancy of ATC 3-06 and be attended to in the trial design phase and by the BSSC.

1. The relationship of seismicity index to map area (Table 1-B). The impact of imposing seismic design and detailing requirements where currently no such current application is needed should be carefully evaluated. Please refer to the Minority Report and my Closure Statement (Exhibit E and F, respectively in Section 3.3).

2. Response modification coefficients (Table 3-B). This table plays a key role in seismic design according to ATC 3-06. The Committee through one of its task groups, attempted to evaluate this table.

Because of the lack of time, data and trial design solutions, a thorough evaluation of the table was not feasible. Trial designs should focus heavily on this table not only regarding the R, C_d factors, but also with respect to definitions of systems that fit different categories.

3. There was significant discussion of coupled shear walls (which are claimed to be the best concrete system when designed with ductile linkage) and eccentric braced frames. Although some data was available, the Committee felt that additional studies are needed. A special recommendation to BSSC to formulate such a study group was stated by the Committee. Also, in this regard, a general statement on the non-linear analysis approach was included in the Commentary.

2.0 Committee Actions

2.1 Recommended Changes

The following pages contain the changes to the Tentative Provisions recommended by the committee, along with the final ballot tally for each recommendation and a comment on the proposal. For convenience, these 23 changes are listed below:

Item	Section of ATC 3-06	Short Description
1-7	2.1	Snow loads less than 30 psf
1-8	2.2	Definition of live load effect
1-9	2.2	Definition of snow load effect
1-10	3.1	Allowance for alternative analysis procedures
1-11	3.2.1	Classification of rock
1-12	3.2.3	Use of soil-structure interaction analysis
1-13	3.3.1	Name of inverted pendulum structures
1-14	3.3.2(A)	Value of R for mixed systems
1-16	3.3.4(C)	Deformational compatibility of structural components
1-17	3.7.2	Orthogonal load combinations
1-18	3.6.2(A) & 3.7.3	Consideration of strength discontinuities
1-19	3.7.4	Consideration of redundancy
1-20	3.7.5	Interconnection of building parts
1-21	3.7.9	Name of the symbol V_x
1-23	4.2	Use of simple equation C_s
1-24	4.5	Restriction on overturning moment resultant
1-25	2.2 & 4.6.2	Definition of P_x, the vertial load
2-1	2.1	Definition of shear panels
2-2	3.3.4(A)	Height limits for torsionally stiff systems
2-3	3.5	Use and limitation for alternate analyses
2-4	3.8	Exception to drift limit for certain buildings
2-5	Table 3-C	Magnitude of drift limits
2-6	4.6.2	Calculation of P-delta effect

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-7

ATC-3-06 SECTION REFERENCE: 2.1

Add the following sentence immediately following the definition of SNOW LOAD.

EXCEPTION: Where snow load is less than 30 pounds per square foot, no part of the load need be included in seismic loading.

FINAL BALLOT:

5	YES
2	NO
1	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The change introduces consistency with the model building code and simplifies computations for those locations in which only a small snow load would be considered simultaneously with seismic loads. The minority view was that the current ATC provision (use of from 20% to 70% of the full snow load, depending on the judgement of the building official) was an adequate allowance for the small probability of simultaneous occurrence of snow load and seismic load.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-8

ATC-3-06 SECTION REFERENCE: 2.2

Change the definition to read as follows:

Q_L = The effect of live load, reduced as permitted in section 2.1

FINAL BALLOT:

8	YES
0	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The added phrase clarifies the use of live load reduction based on tributary area when combining the effects of live load and seismic load.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-9

ATC-3-06 SECTION REFERENCE: 2.2

Change the definition of Q_S to read as follows:

Q_S = The effect of snow load, reduced as permitted in section 2.1.

FINAL BALLOT:
8 YES
0 NO
0 ABSTAIN
2 DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The added phrase clarifies the use of the reduction from the full design snow load when combining the effects of snow load and seismic load.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-10

ATC-3-06 SECTION REFERENCE: 3.1

Change the second and third sentences to read as follows:

The design forces, and their distribution over the height of the building, shall be established in accordance with the procedures in Chapter 4 or Chapter 5; the corresponding internal forces in the members of the building shall be determined using a linearly elastic model. An approved alternate procedure may be used to establish the seismic forces and their distribution; the corresponding internal forces and deformations in the members shall be determined using a model consistent with the procedure adopted. Individual members shall be sized . . .

FINAL BALLOT:
8 YES
0 NO
0 ABSTAIN
2 DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revisions permits the use of method incorporating inelastic models of material behavior, subject to explicit approval of the authority.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-11

ATC-3-06 SECTION REFERENCE: 3.2.1

Change the first paragraph under soil profile type 1 to read as follows:

1. Rock of any characteristic, either shale-like or crystalline in nature. Such material may be characterized by a shear wave velocity greater than 2500 feet per second or by other appropriate means of classification, or

FINAL BALLOT:
8 YES
0 NO
0 ABSTAIN
2 DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The added phrase removes the implication that shear wave velocity tests are necessary in order to class a subsoil material as rock.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-12

ATC-3-06 SECTION REFERENCE: 3.2.3

Change to read as follows:

The base shear, story shears, overturning moments, and deflections determined in Chapter 4 or Chapter 5 may be modified in accordance with procedures set forth in Chapter 6 to account for the effects of soil-structure interaction.

FINAL BALLOT:
8 YES
0 NO
0 ABSTAIN
2 DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

Two issues are involved in this item. First, the committee decided to retain the provision allowing soil-structure interaction analysis because it felt that Chapter 6, Soil-Structure Interaction, was a worthwhile component of the overall seismic design provisions. Second, the revision to the provision was made in recognition of the possible increase in force effects due to the increased P-delta effect resulting from rotation of the base of a building.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-13

ATC-3-06 SECTION REFERENCE: 3.3.1

Delete the word "Special" from the third sentence of the first paragraph.

FINAL BALLOT:
8 YES
0 NO
0 ABSTAIN
2 DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

Since a "special" inverted pendulum in nowhere distinguished from any other type of inverted pendulum, the removal of the word prevents possible confusion.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-14

ATC-3-06 SECTION REFERENCE: 3.3.2(A)

Change the first paragraph to read as follows:

R VALUE. The value of R in the direction under consideration at any level shall not exceed the lowest value of R obtained from Table 3-B for the seismic resisting system in the same direction considered above that level.

FINAL BALLOT:
8 YES
0 NO
0 ABSTAIN
2 DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revisions clarify the original intent of the provision.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-16

ATC-3-06 SECTION REFERENCE: 3.3.4(C)

Change to read as follows:

DEFORMATIONAL COMPATIBILITY. Every structural component not included in the seismic force resisting system in the direction under consideration shall be investigated and shown to be adequate for the vertical load-carrying capacity and the induced moments resulting from the design story drift, as determined in accordance with Sec. 4.6.

FINAL BALLOT:

8	YES
0	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revision has the effect of requiring a check on the ability of the seismic resisting system to maintain vertical load carrying capacity when subject to the lateral displacement of the seismic resisting system in the orthogonal direction. (For example, consider the ability of a bearing and shear wall to support vertical load when the wall is laterally supported by an unbraced frame). The provision already required such a check for structural components that were not part of the seismic resisting system.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-17

ATC-3-06 SECTION REFERENCE: 3.7.2

Change to read as follows:

ORTHOGONAL EFFECTS. In buildings assigned to Category B, the design seismic forces may be applied separately in each of two orthogonal directions.

In buildings assigned to Category C and D, the critical load effect due to direction of application of seismic forces on the building may be assumed to be satisfied if components and their foundations are designed for the following combination of prescribed loads: 100 percent of the forces for one direction plus 30 percent of the forces for the perpendicular direction. The combination requiring the maximum component strength shall be used.

EXCEPTION: Diaphragms, and components of the seismic resisting system utilized in only one of two orthogonal directions need not be designed for the combined effects.

FINAL BALLOT:

7	YES
1	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The objective in revising the provision is to reduce the amount of unnecessary computation required. The committee believes that more improvement toward this objective may be possible and looks for the trial designs to provide such information.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-18

ATC-3-06 SECTION REFERENCE: 3.6.2(A) and 3.7.3

Change the second line of 3.6.2(A) to read as follows: . . .shall conform to the requirements of Sec. 2.7 (except Sec. 3.7.3 and Sec. 3.7.12). . .

Change 3.7.3 to read as follows:

For Buildings assigned to Seismic Performance Categories C or D the design of the building shall consider. . .

FINAL BALLOT:

8	YES
0	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revision removes the potential inconsistency of requiring formal consideration of strength discontinuities for buildings in which formal consideration of stiffness discontinuities is not required. Consideration of discontinuities in stiffness need not be formally considered for buildings in Seismic Performance Category B (to wit: Modal Analysis is not required for buildings in Category B with vertical irregularities).

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-19

ATC 3-06 SECTION REFERENCE: 3.7.4

Change to read as follows:

The design of a building shall consider the potentially adverse effect that the failure of a single member, connection, or component of the seismic resisting system would have on the stability of the building.

FINAL BALLOT:

7	YES
1	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

No guidance is given on just how redundancy is to be checked. The revision reduces, slightly, the magnitude of this problem.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-20

ATC-3-06 SECTION REFERENCE: 3.7.5

Change the first line to read:

All parts of the building between separation joints shall be interconnected and the connections shall be. . .

FINAL BALLOT:

8	YES
0	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revision clarifies the orignial intent of the provisions.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-21

ATC-3-06 SECTION REFERENCE: 3.7.9

Change the second line of the third paragraph to read:

. . .elements of the building attached thereto plus the portion of the seismic shear force at that level, V_x, required to be transferred. . .

FINAL BALLOT:

8	YES
0	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revision clarified the original intent of the provision.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-23

ATC-3-06 SECTION REFERENCE: 4.2

Change the last paragraph to read as follows:

The value of C_s may be determined in accordance with Formula 4-2, 4-3, or 4-3a, as appropriate. Formula 4-2 requires calculation of the fundamental period of the building as specified in Sec. 4.2.2. For low buildings, or in other instances when it is not desired to calculate the period of the buildings, C_s shall be determined using Formula 4-3, 4-3a, as appropriate.

FINAL BALLOT:

8	YES
0	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revision encourages the use of the simple equations for those situations in which the calculation of building period has no impact on the design force level.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-24

ATC-3-06 SECTION REFERENCE: 4.5

Delete the last sentence of the last paragraph.

FINAL BALLOT:

8	YES
0	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The deleted sentence had potential for creating serious design problems for those buildings using piles or piers as holddown anchors, yet no convincing argument has been forwarded for retaining the deleted sentence.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 1-25

ATC-3-06 SECTION REFERENCE: 2.2 and 4.6.2

Change the definition of P_x to read as follows:

P_x = the total unfactored vertical design load at and above level x.

FINAL BALLOT:

8	YES
0	NO
0	ABSTAIN
2	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The original deifinitions for P_x in sections 2.2 and 4.6.2 were not identical. The revised definition specifies the pertinent load for the investigation of instability.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 2-1

ATC-3-06 SECTION REFERENCE: 2.1

Delete the word "wood" from the definition of SHEAR PANEL.

FINAL BALLOT:

7	YES
0	NO
0	ABSTAIN
3	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

It is possible to design and rely on shear panels constructed from materials other than wood, for example studs with gypsum board.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 2-2

ATC-3-06 SECTION REFERENCE: 3.3.4(A)

Revise paragraph 3 to read as follows:

3. A system with structural steel or cast-in-place concrete braced frames or shear walls in which there are braced frames or shear walls so arranged that braced frames or shear walls in one plane resist no more than the following proportion of the seismic design force in each direction, including torsional effects.

   a. Sixty (60) percent when the braced frames or shear walls are arranged only on the perimeter.

   b. Forty (40) percent when some of the braced frames or shear walls are arranged on the perimeter.

   c. Thirty (30) percent for other arrangements.

FINAL BALLOT:

7	YES
0	NO
0	ABSTAIN
3	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revision explicitly recognizes the improved torsional performance of buildings with the principal seismic resisting elements located on the perimeter by relaxing the requirement for four independent lines of resistance for such buildings.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 2-3

ATC-3-06 SECTION REFERENCE: 3.5

Revise to read as follows:

This section prescribes the minimum analysis procedure to be followed. An alternate generally accepted procedure, including the use of an approved site specific spectrum, if desired, may be used in lieu of the minimum applicable procedure. The limitations upon the base shear stated in section 5.8 apply to any such analysis.

FINAL BALLOT:

7	YES
0	NO
0	ABSTAIN
3	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revision removes any implication that the provisions of chapter 5 constitute the only acceptable procedure for modal analysis and specifically allows the use of site specific design spectra, which is the current state of practice for important buildings in highly seismic areas. The precise limit on base shear given in section 5.8 is easier to understand and apply than the limit on building period given in present wording of section 3.5.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 2-4

ATC 3-06 SECTION REFERENCE: 3.8

Revise by adding the following sentence to the end of the last paragraph of the section:

Single story buildings in Seismic Hazard Exposure Group I that are constructed with non-brittle finishes and whose seismic resisting system is not attached to equipment or processes need not meet the drift requirement in table 3-C.

FINAL BALLOT:

7	YES
0	NO
0	ABSTAIN
3	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

This revision is coupled with the revision proposed for table 3-6, (item 2-5 from Committee #2) in which the footnote allowing a higher limit for certain buildings is deleted. The types of buildings described in the revised provision have performed well from a drift standpoint in past earthquakes.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 2-5

ATC 3-06 SECTION REFERENCE: Table 3-C

Remove the footnot from the table and revise the table to read:

Table 3-C

ALLOWABLE STORY DRIFT Δ_a

	Seismic Hazard Exposure Group		
	III	II	I
Δ_a	$0.015h_{sx}$	$0.025h_{sx}$	$0.025h_{sx}$

FINAL BALLOT:
6 YES
1 NO
0 ABSTAIN
3 DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The drift limitations of Sec. 3.8 of ATC 3-06 are, for many structures, considerably more restrictive than the UBC and usual current design practice. Becuase of the lack of a close relationship between story drift and either the amount of inelastic strain or the magnitude of the P-delta problems, and because damage control unrelated to safety is not a code objective, the drift limits have been increased.

The revised values were chosen to minimize the possibility of imposing drift constraints more severe than those reflected in current design practice. In specific instances, however, such as for controlling the magnitude of relative movements at joints, the designer may find it necessary or desirable to impose more restrictive limits.

REVIEW AND REFINEMENT OF TENTATIVE SEISMIC PROVISIONS

PROPOSED CHANGE

TECHNICAL COMMITTEE: #2, STRUCTURAL DESIGN COMMITTEE ITEM NUMBER: 2-6

ATC 3-06 SECTION REFERENCE: 4.6.2

Revise the second sentence of the last paragraph to read as follows:

The design story drift determined in Section 4.6.1 shall be multiplied by the factor $(\frac{0.9}{1-\theta} \geq 1.0)$ to obtain the story drift including P-delta effects.

FINAL BALLOT:

7	YES
0	NO
0	ABSTAIN
3	DID NOT VOTE

COMMENT ON PROPOSED CHANGE:

The revision explicitly defines for design use the increase in story drift due to P-delta, and by means of introducing the approximation ($0.9 \approx 1.0$), it avoids a troublesome discontinuity that would occur when $\Theta = 0.10$.

2.2 Recommendations for Commentary

The committee recommends four specific changes to the commentary of the Tentative Provisions, as follows:

C-1, for section C3.5, Analysis Procedure

It is possible with presently available computer programs to perform two dimensional inelastic analyses of reasonably symmetric structures. The intent of such analyses could be to estimate the sequence in which components become inelastic and to indicate those components requiring strength adjustments so as to remain within the required dectility limits. It should be emphasized that with the present state-of-the-art in inelastic analysis there is on one method that can be applied to all types of buildings, and further the reliability of the analytical results are sensitive to:

1. the number of and appropriateness of the time-histories of input motion

2. the practical limitations of mathematical modelling including interacting effects of nonstructural elements

3. the non-linear algorithms

4. the assumed hysteretic behavior

Because of these sensitivities and limitation the maximum base shear produced in the inelastic analysis should be not less than that required by Chapter 5 (Modal Analysis).

C-2, for section C3.3.1, Classification of Framing Systems

A large table of framing systems is to be inserted in the commentary with an indication of where each system would fall in Table 3-B.

C-3, for section C4.6, Drift Determination and P-delta Effects

The last paragraph on page 368 should be considered as a part of the acceptable P-delta analysis referred to on page 367.

C-4, for section C5.5, Modal Base Shear

A plot should be inserted in the commentary to illustrate the pattern of spectral coefficients for R and A_v.

2.3 Recommendations for Trial Design

The committee made the following recommendations for the planning and conduct of the trial designs that will be used to assess the impact of the Tentative Provisions:

R-3 The descriptions of the building systems in Table 3-B and the R factors in that table are adequate for the trial designs. They should be reexamined following the trial designs. To aid in this, the designers should be asked to make an intelligent assessment of just what the impact on cost of differing R values would be.

R-4 1) Trial designs should include examination of drift control needs for different types of building systems.
2) Trial designs should include calibration with existing standards around the country.
3) Trial designs should include examination of the impact of drift limits on life safety for different occupancies.

R-5 The trial designs and subsequent studies should examine carefully the impact of C_d and the validity of the P-delta procedure.

2.4 Other Recommendations

The committee made two other recommendations concerning the Tentative Provisions and the improvement of seismic safety provisions in general:

R-1 The committee recommends to BSSC that technical groups be established to develop standard provisions for new types of seismic resisting systems that depend on the concentration of inelastic straining in special members for good performance in earthquakes, in particular, coupled shear walls and eccentric braced frames. For coupled shear walls, the provisions should delineate the details and the stiffness and strength ratios between the shear walls and the coupling beams to assure that the inelasticity is concentrated primarily in and accounted for in the coupling beams. For eccentric brace frames, the provisions should delineate the connection details and the relative member proportions to assure that the inelasticity occurs in the flexural or shear links and does not occur in members that primarily are loaded axially.

R-2 Following the approval of any recommended changes to the ATC 3-06 provisions, the Commentary and the Guide to Use of ATC 3-06 should be carefully reviewed for any needed revision.

3.0 Committee Records

3.1 Minutes of Meetings

Three meetings were held:

December 11, 1979, in Gaithersburg, Maryland
February 27-28, 1980, in Phoeniz, Arizona
April 2-3, 1980, in Des Plaines, Illinois

The minutes for these meetings follow this page, except that none of the attachments mentioned in those minutes are included in this section. One important attachment to the minutes of the second meeting, the response of the ATC representative to the proposed changes is included in section 3.3.

Minutes of First Meeting

Technical Committee 2 - Structural Design

Review and Refinement of Tentative Seismic

Provisions (ATC-3-06)

at

National Bureau of Standards

December 11, 1979

The meeting was convened at 12:00 noon in the Green Auditorium of the National Bureau of Standards by James Harris of NBS, the committee secretariat, with the following members present:

Richard McConnell, representing the Interagency Committee on Seismic Safety in Construction.

Nicholas Forell, representing the Structural Engineers Association of California.

Rene Luft, the alternate representative for the American National Standards Institute.

William Ayer, temporarily representing the American Society of Civil Engineers.

Roland Sharpe of the Applied Technology Council.

James Harris of the National Bureau of Standards.

Tim Reinhold, also of NBS

Members not present or organizations not represented were:

Ajit S. Virdee of the Building Seismic Safety Council

Mr. Ayer stated that the ASCE representative for the committee would be Mr. Hal Iyengar of Skidmore, Owings and Merrill of Chicago, Illinois.

Procedures for conduct of the project were discussed. The requirement for a 2/3 majority of the joint committee to pass a proposal as a recommended change was criticized by some, the feeling being that the provisions are too tentative to require such a backing for a change, that the issues are too technical for such wide agreement, and that the technical committees would be wasting time working on proposals that would not pass the final ballot. Others felt that the 2/3 majority rule is appropriate. General agreement

was not reached on the 2/3 majority rule, but it was agreed that unsuccessful proposals should be retained in the eventual report to the Building Seismic Safety Council. It was also agreed that recommendations for the conduct of test and trial designs would be appropriate output from the committee, in addition to the primary output, namely, recommended changes to the ATC-03-06 seismic provisions.

The committee recessed at 1:00 p.m. and reconvened by Harris at 1:30 p.m. in the NBS cafeteria with the following additional members in attendance:

Joseph Tyrrell, representing Committee 3: Foundations

Mark Fintel, representing Committee 4: Concrete

Alan Yorkdale, representing Committee 5: Masonry

William Sontag, representing Committee 6: Steel

Edwin Zacher, representing Committee 7: Wood.

Robert Englekirk, representing Committee 1: Seismic Risk Maps[1/]

Edward Pfrang of NBS, observer.

The first item of business was the election of a chairman. As the nominations were opened, discussion ensued concerning the desirable qualifications for a chairman. Zacher, seconded by Sontag, then nominated Simpson for chairman and Iyengar for vice-chairman, both subject to their acceptance. McConnell, seconded by Yorkdale, nominated Forell for chairman. After the nominations were closed, Forell withdrew. No additional nominations were forthcoming, and the committee approved Simpson and Iyngar, subject to their acceptence. [2/]

After comparing the scheduled meeting dates for the other committees, it was decided to hold the next meeting on the days immediately preceding the BSSC Executive Board meeting, which is in Phoenix on February 29. Luft was then designated acting chairman for the duration of the meeting. The committee recessed at 2:00 and reconvened at 2:30 in the Green Auditorium with the same members as were present at the 12:00 noon session.

Harris introducted a list of areas in which the committee might receive proposals for change, based on his reading of the external review comments received by ATC in 1976 and 1977:

- The factor R for modification of the elastic response: Both changes and additions are possible.

- The formulas for approximate period of vibration.

[1/] Englekirk was a visitor at this meeting. The BSSC subsequently approved the representation of Committee 1 on Committee 2, and Englekirk is now a member of Committee.

[2/] Both gentlemen were contacted by phone later in the day. Simpson declined the offer, and Iyengar accepted the offer, thus succeeding to the chairmanship of the committee.

- The load combinations, especially the 0.5 factor for dead load for brittle components.

- The orthogonal load combination.

- The design spectrum for buildings with very short periods and high values of R.

- The design spectrum for modal analysis in the low frequency range.

- The lower limits on base shear and the upper limits on calculated periods.

- The height limits for various building types.

- The seismic performance categories

- The calculation of the value Θ for use in determining the need for P-delta analysis.

- A simpler method of analysis

- The provisions requiring modal analysis for certain buildings.

- The reduction in the overturning moment at the base of a structure.

Sharpe then added the following:

- The factor C_d for amplification of elastic deflections.

- The drift limits.

McConnell added that the section for an intermediate level of ductility for reinforced concrete needs simplification and editing.

Forell then contributed several points of concern (only the additional ones are listed)

- Load factor design

- Lack of provision for horizontal irregularity

- Restraints on certain combinations of seismic resisting systems (are lacking in ATC)

- The provision for disconinuity in a vertical sense

- The formula for the distribution of base shear to story forces

- The applicability of the torsion provision to wood diaphragms

- The provisions implying that plastic analysis be used for unbraced steel frames.

- The use of single degree of freedom per node modal analysis instead of a three degree of freedom method.

- R values for large flexible diaphragms

- Resolution of forces in the foundations, particularly for systems with low values for R.

The committee was joined during the session by William Sontag, the representative of Committee 6 and by William LeMessurier, the BSSC liaison for Committee 1. LeMessurier indicated an intent to participate in the meetings of this committee.

Sontag stated a concern with the requirements for the use of rolled steel sections qualified for plastic design in all "special moment frames," which effectively prohibit the single story rigid frame "metal building" in the highest seismic zones.

Luft questioned the use of lightgage cold rolled sections for earthquake resistance.

Considering the wide range of possible proposals, the committee decided to allow two days for the next meeting. The next meeting will be on February 27 and 28 in Phoenix, Arizona, exact time and place to be announced.

Respectfully submitted,

James Robert Harris
Secretary

Minutes of Second Meeting

Technical Committee 2 - Structural Design
Review and Refinement of Tentative Seismic
Provisions (ATC-3-06)

at

Quality Inn/Desert Sky, Phoenix, AZ
February 27-28, 1979

The meeting was convened at 9:00 am, February 27th in the Summit Room of the Quality Inn/Desert Sky by Hal Iyengar, the committee chairman. The following voting members were present:

Mark Fintel - representing Committee 4: Concrete
Nicholas Forell - representing SEAOC
Hal Iyengar - representing ASCE
Richard McConnell - representing the Interagency Committee on Seismic Safety in Construction
Howard Simpson - representative for ANSI
William Sontag - representing Committee 6: Steel
Joseph Tyrrell - representing Committee 3: Foundations
Alan Yorkdale - representing Committee 5: Masonry
Edwin Zacher - representing Committee 7: Wood
Robert Englekirk - representing Committee 1: Sesimic Risk Maps, arrived at noon on the 27th.

The following nonvoting members were present:

Representing ATC: Roland Sharpe
Henry Degenkolb

Representing the BSSC Overview Committee:

Aiit Virdee
William LeMessurier

NBS Secretariat: James Harris
Timothy Reinhold

Several observers were also present:

William Ayer - with ASCE
Mario Catani - with PCA, attended only on the 27th.
Harry Mejdell - with WSCSEA (Western States Conference of Structural Engineers Associations)
Avi Singhal - with Arizona State University, attended only on the 27th
Jesse Wyatt - with PCA - Phoenix

Mr. Iyengar opened the meeting with a discussion of the agenda. He proposed that lengthy discussions be postponed to the second day.

The minutes of the first meeting held December 11, 1979 at NBS were reviewed. McConnell noted that a correction should be made to page 3 of the minutes to indicate that he had stated that the section on ductility for reinforced concrete needed much simplification and editing. He pointed out that he had not suggested a need for an intermediate level of ductility for reinforced concrete. A motion to approve the minutes of the December 11th meeting, as corrected by McConnell, was made, seconded, and passed. The remainder of these minutes are arranged by topic rather than by strict chronology.

Table 1-A and 1-B. With regard to the changes to table 1-A proposed by the masonry committee, Yorkdale noted that the transcript contained an error. The masonry committee was not suggesting that the seismic performance category for exposure group I and seismicity index 2 be changed to A but rather that it remain B. The effect of their proposal was only to change the performance category from A to B for seismicity index 1 and exposure group III. This proposal would in effect require some specific design considerations for all buildings in exposure group III. The proposed change was considered by some of the members to be contingent upon approval of changes in table 1-B which would reduce the seismicity index for several map areas.

Sharpe responded by noting that originally ATC was under pressure to eliminate design requirements wherever possible. ATC felt that the requirement that building components be tied together, as required for category A, was adequate.

At this point the discussion shifted to consider of proposed changes in Table 1-B. Sharpe prepared a table on the chalkboard to indicate the proposed changes to table 1-B and to illustrate the effects of the changes on the performance categories. The table is reproduced below.

		Seismicity Indices				Performance Categories		
Map #	A_v	Current ATC	Masonry	Fintel	CRSI	III	II	I
7	0.40	4	4	4	4	D	C	C
6	0.30	4	4	4	4	D	C	C
5	0.20	4	3	3	3	D(C)	C	C(B)
4	0.15	3	2	2	2	C(B)	C(B)	B
3	0.10	2	1	1	2	B(A or B)	B(A)	B(A)
2	0.05	2	1	1	1	B(A or B)	B(A)	B(A)
1	0.05 (0.00)	1	0	1	1	A(?)	A(?)	A(?)

Sharpe further noted that changes in table 1-B impacts all the other chapters and that provisions are interwoven in the various chapters. Harris reported Ted Algermissen, the chairman of Committee #1, suggested that it might be more appropriate to change the actual requirements that depend on the seismicity indices, than to change the indices.

Fintel stated that seismicity indices are used to correlate ground accelerations to detailing requirements and that the real question concerns the level of ductility required for intermediate levels of acceleration. He suggested that for acceleration levels of 0.05g, to perhaps levels as high as 0.10g, buildings can be expected to respond elastically. For accelerations of 0.10g to 0.20g a better understanding is needed of the ductility requirements. He felt the provisions should not call for greater ductility than is provided in current design.

A lengthy discussion followed on the pros and cons regarding the level of detailing required with various members relating personal observations of buildings that had experienced earthquakes of different levels to back up their arguments. Iyengar summarized the committee's dilemma by noting that there were strong opinions supporting changes in table 1-B, strong opinions against making changes and strong opinions that a wider study is needed in order to define ductility requirements.

Yorkdale suggested that the committee recommend the trial designs be conducted using both the current and proposed seismicity indices. Simpson noted that trial designs are very expensive and care must be taken to minimize the number of cases to be studied. Sharpe suggested that it might be possible to recommend consideration of alternative values of the seismicity index for certain buildings or specific types of buildings rather than considering the alternative values for all cases in the trial designs.

Simpson suggested that changes in the seismicity indices should not be made unless there was a strong reason for the change and that the people wanting the change must bear the burden of providing the strong documentation.

It was decided to place the proposed changes on the letter ballot as individual items for each map area. Also, it was decided to place the suggested change in Table 1-A on the ballot. Sontag and Yorkdale indicated that the proposed change in table 1-A should be contingent on changing the seismicity indices in table 1-B as proposed, at least for accelerations of 0.1 and below.

Section 1.6 Quality Assurance:

Three proposed changes to this section were considered briefly. Harris and Iyengar suggested that the proposals be considered by the appropriate material committees, particularly since Committee #9 did not plan to discuss those particular items. A motion was made, seconded and passed that the proposed changes to the quality assurance provisions be returned to the material committees.

Section 2.1 Definitions:

Sontag's proposal to change the definition of snow loads to effectively eliminate consideration of snow loads when computing seismic effects for areas where the snow load is less than 30 psf was considered. Sontag noted that UBC and other codes contained that exemption. He felt that it would

account for the small probability of maximum earthquake and maximum snow load occuring simultaneously.

Zacher responded by noting that the ATC provisions are adequate since they do allow a reduction from the maximum snow load. Furthermore he indicated that the new version of ANSI may propose dropping the exception from 30 psf.

Tyrrell noted that the real question of whether snow loads and earthquakes loads occur simultaneously requires knowledge of the duration of snow loads and not on the maximum value.

Forell moved that the proposal by Sontag be included on the ballot since he felt that members needed more time to think about the issue. The motion was second and passed.

(Secretariat's note: Inadvertently, the proposal by Sontag concerning the definition of a Shear Panel was not discussed. It will be considered at the next meeting.)

Chapter 3

Section 3.1 Design Basis:

Forell's proposed change to the first paragraph which would make it possible to obtain exceptions to the drift limitations in table 3-C was considered. Zacher suggested that the intent of the proposal could be better achieved by adding a second footnote to table 3-C. Forell agreed. The proposal was changed to read:

> [2] In accordance with section 1.5, the Regulatory Authority may approve deformation limits exceeding these where it can be demonstrated in an acceptable manner that the deformation limits used provide equivalent performance, strength and safety.

Committee members appeared to be in general agreement concerning this footnote. Forell noted that it might be possible to avoid the footnote by changing section 1.5 to be closer to UBC provisions. Zacher and Sharpe agreed and noted that section 1.5 needed to be changed. (Secretariats note: no explicit change for section 1.5 was considered at the meeting.)

Fintel's proposal to change the first paragraph to allow for alternative approved methods of design was considered. Fintel felt that there should be a mechanism for allowing alternative design procedures and especially to allow inelastic methods which could be used to reduce internal forces. Simpson and Iyengar agreed. Forell and Sharpe noted that elastic methods are inherent in all the ATC provisions and that a separate sentence was needed to insure that consistent procedures were used in the analysis and in sizing individual members. Zacher, Sharpe and Fintel volunteered to write out alternative wording for the second and third sentence of 3.1 over lunch.

When the topic was taken up again after lunch, the alternative wording was further modified, resulting in:

> The design seismic forces, and their distribution over the height of the building, shall be established in accordance with the procedures in Chapter 4 or Chapter 5; the corresponding internal forces in the members of the building shall be determined using a linearly elastic model. An approved alternative procedure may be used to establish the seismic forces and their distribution; the corresponding internal forces and deformations in the members shall be determined using a model consistent with the procedure adopted. Individual members shall be sized...

A motion was made, seconded, and passed, to add the above change to the ballot.

Section 3.2.1 Soil Profie Type:

McConnell's proposal for removing part of the definition of rock was considered. McConnell felt that inclusion of the reference characterizing rock by a shear wave velocity greater than 2500 feet per second would effectively legislate that soil consultants would have to make shear wave velocity tests. He pointed out that there are other ways to determine whether a site can be classified as rock.

After a brief discussion, Iyengar suggested that the sentence under Soil Profile Type S_1, No. 1 be changed to read:

> ... Such material may be characterized by a shear wave velocity greater than 2500 feet per second or by other means of classification, or

Zacher moved that the above clause be added to the ballot as a possible revision rather than McConnell's original suggestion. The motion was second and passed.

Section 3.2.3 Soil Structure Interaction:

Zsutty's proposal that section 3.2.3 and Chapter 6 be deleted was considered. Tyrell supported the proposal by noting that Committee 3, Foundations wanted to delete Chapter 6 also. Sharpe replied that use of the chapter is voluntary and is a step forward because it recognizes soil structure interaction effects. Degenkolb stated that he had originally opposed inclusion of Chapter 6 because he felt is was striving for accuracy that in fact was not possible, but no longer opposes it.

Iyengar asked whether the chapter reflected the state of the art in soil structure interaction and whether inclusion of Chapter 6 was a step forward for the profession. McConnell noted that any model of the soil behavior can change in 2 years or so especially if a new building is built nearby. He felt that it was conservative not to use soil structure interaction. Singhal mentioned that he had worked through the method and liked it but that use of the method could lead to increased forces for some structures.

As the discussion proceeded it was suggested that the problem really centered on section 3.2.3 where it is stated that the base shear, story shears and overturning moments may be reduced. The feeling was that owners would require use of Chapter 6 because of the implied reduction. Forell and Zacher proposed that the problem be handled by changing the wording to read:

> The base shear, story shears, overturning moments and deflections determined in Chapter 4 or Chapter 5 may be modified in accordance with ...

It was moved, seconded and passed that the above proposed revision appear on the ballot.

Section 3.3.1 Classification of Framing Systems:

In response to McConnell's question concerning what is meant by a special inverted pendulum-type structure it was decided to include on the ballot a proposal that the word "special" before inverted pendulum-type structure be deleted.

Section 3.3.3 Combination of Framing Systems:

a) McConnel requested a sample defintion of a supported structure. Considerable discussion followed with a variety of definitions, including piping, mechanical systems, machinery, non-structural systems, mezzanines, structure within a structure, penthouses, etc.

It was noted that the commentary provided some help in defining the meaning of a structure within a structure. No specific change was suggested.

b) Forell's suggested change to include provisions for combinations of framing systems at the same level was considered. Forell cited the use of moment frames and shear wall or bearing walls in orthogonal horizontal directions as an example. He felt that stiffness compatibility was desirable between the systems especially where they joined together at corners. Zacher suggested that the problem could be considered in section 3.3.4 (c) and volunteered to develop a specific provision with Forell.

The discussion did bring out the fact that several members were confused by the language in section 3.3.2(A). Harris suggested changing the words "any direction" to "the direction under consideration" and changing "in the direction considered above the level" to "in the same direction considered above that level". It was moved, seconded and passed that the suggestion be added to the ballot as a possible revision.

The committee meeting was recessed for lunch at 12:30 pm and reconvened at 1:30 pm.

3.3.4(A) Seismic Resisting Systems [Height Limits for Performance Category C]:

Three comments were received on this section and quite a long discussion resulted, at the end of which no specific proposal for change appeared to be acceptable to the committee. It was decided to set up a task committee to study the issues and prepare specific language for changing the section.

Degenkolb, and Fintel and Zacher where appointed to the committee, with Degenkolb acting as chairman.

The next few paragraphs document some of the major points raised in the discussion. Forell requested clarification of what was intended by the requirement that braced frames or walls in any plane resist no more than 33% of the seismic design force including torsional effects. Iyengar and Englekirk expressed concern that the language used might eliminate certain shape buildings.

Zacher responded that the requirement does not prohibit unconventional shapes, it only requires redundancy. Several numbers agreed with that concept, but felt that the provision was arbitrary.

Degenkolb commented that he wanted the provision to make it possible to lose an element and still have the structure remain standing. He felt that, with real world practice in mind, there was a need to apply restrictions.

The comments by Sheppard and Fintel concerned removing the 240 foot height limitation for buildings described in paragraph (A) 3 and defining coupled shear walls as a new system. Professor Bertero's response to these proposals is attached to these minutes.

Fintel suggested that height limits should be maintained for buildings using regular shear walls but should not be applied to coupled shear wall buildings, since the inelastic response is concentrated in the horizontal members rather than the vertical load carrying members. Harris noted that adding a new system would require changes in other chapters, for example, for items such as coupling beams.

Zacher advocated arbitrary limits to keep from extending designs beyonds our knowledge. Forell and Degenkolb echoed this idea by noting that design of buildings that exceed certain limits requires special analysis which is beyond the capabilities of many average engineers. They felt that the provisions should protect the public and the profession from buildings with less than special analysis in such situations.

Iyengar responded by asking whether it would be possible to soften the requirements to allow cases where sophisticated analysis and design are conducted. Sharpe suggested that would require a review committee, because most building officials would not have the time, resources or capabilities to review special methods of analysis and design.

McConnell remarked that what Sharpe was suggesting sounded like a variance committee. Iyengar and Yorkdale responded that a variance committee would not suffice and that what would be needed is a strong technical review committee. Simpson added that establishing a review committee would not be simple and would necessitate providing specific requirements for the review committee.

Section 3.3.4(B) Interaction Effects:

McConnell requested clarification of this section. The discussion was postponed until a specific change was suggested by Zacher and McConnell. The following alternate wording for the first sentence appears on the ballot:

> Moment resisting space frames which are enclosed by or, adjoined by, more rigid elements, whose proportionate stiffnesses preclude their consideration as part of the seismic resisting system, shall be designed so that the action or failure of those elements will not impair the vertical load and seismic force resisting capability of the space frame.

Section 3.3.4(C) Deformation Compatibility:

Forell's concern for insuring compatibility in the response of two dissimilar seismic systems in the horizontal plane, raised during the discussion of section 3.3.2, was accounted for in this section. After some discussion, Simpson suggested the following wording which was approved for inclusion in the ballot.

> DEFORMATION COMPATIBILITY. Every structural component, whether or not it is part of the lateral force resisting system for the direction under consideration, shall be investigated and shown to be adequate for the vertical load-carrying capacity and induced moments resulting from the design story drift, Δ, as determined in accordance with section 4.6.

Zsutty's comment was noted but no specific proposal for a change could be developed.

Section 3.3.5 Seismic Performance Category D

Suggestions to delete the height limitations were referred to the task committee created to study height limits specified in section 3.3.4(A).

Section 3.4 Building Configuration

Forell's request that words such as "nearly" and "approximately" be replaced by more specific definitions was not acted upon because no one could provide specific definitions.

Section 3.4.2 Vertical Configuration

McConnell's request for a more specific definition than "significant" was withdrawn because no specific language could be suggested.

Sections 3.5 Analysis Procedures and 3.6 Design and Detailing Requirements

Proposed changes to these sections were received from Committee 5: Masonry. However, the proposals were considered to fit better in Chapter 12 on Masonry rather than in Chapter 3. The committee decided to refer the proposals back to the masonry committee for their consideration and their determination of whether to include the changes in Chapter 12.

Section 3.5.1 Seismic Performance Category A (Analysis Procedure)

McConnell questioned the philosophy behind not requiring analysis for the seismic forces for the building as a whole. He pointed out that most other codes include wind effects, which controls the design in low seismicity areas. Wind is not included in the ATC provisions, and therefore some level of seismic analysis might be necessary for category A. Zacher responded that while analysis is not required in ATC, certain details and ties are required that will provide the necessary strength. The comment was withdrawn.

Section 3.5.3 Seismic Performance Categories C and D (Analysis Procedures)

McConnell's requested clarification of the implications of this section with regard to modal analysis. Sharpe noted that the second sentence in the section requires special analysis which considers the dynamic characteristics of all irregular buildings. Thus, modal analysis or some other technique is required. However, the last sentence notes that the procedures in Chapter 5 are only adequate for vertical irregularities. McConnell's comment was withdrawn.

Zsutty's comment was considered. Zacher noted that the second sentence covers the case described by Zsutty in general terms and recommended that the commentary to the section be extended to include Zsutty's comment.

Section 3.7.1 Combination of Load Effects

See the written comment by Forell to the effect that the load factor approach is undesirable and the response by ATC. Iyengar pointed out that many groups are moving ahead in the area of load factor design and that discrepancies must exist for now. No specific proposal for a ballot item came out of this discussion.

McConnell had a question about the definition of Q and recommended that symbols and special terms be defined where they are first used. Sharpe responded by noting that the symbols are defined in section 2.2.

Sontag's proposal to change equation 3.1 was also considered. However, it was suggested that the loads used in the equation were intended to be reduced

loads so that the k factor proposed was already included. The committee concluded that the proper place to clearify the issue was in the definitions in section 2.2. Consequently it was moved, seconded, and passed that the definitions of Q_L and Q_S in section 2.2, page 42 be changed by adding the phrase, "reduced as permitted in 2.1," after each of the definitions.

3.7.2 Orthogonal Effects

Several comments and proposals for alternate wording were received for this section. The major concern with the section was that it required a tremendous amount of busy work on the part of designers, yet many special configurations make it difficult to write a general provision. A subcommittee composed of Zacher, Simpson and LeMessurier recommended the following alternative wording on the morning of the 28th:

> 3.7.2 ORTHOGONAL EFFECTS
>
> In buildings assigned to category B, the design seismic forces may be applied separately in each of two orthogonal directions.
>
> In buildings assigned to category C and D, the critical load effect due to direction of application of seismic forces on the building may be assumed to be satisfied if components and their foundations are designed for the following combination of prescribed loads: 100 percent of the forces for one direction plus 30 percent of the forces for the perpendicular direction. The combination requiring the maximum component strength shall be used.
>
> > EXCEPTION: Diaphrams, and components of the seismic resisting system utilized in only one of two orthogonal directions need not be designed for the combination effects.

A motion was made, seconded and passed that the above alternative wording for section 3.7.2 be added to the letter ballot.

3.7.3 Discontinuities in Strength of Vertical Resisting System

McConnell felt that the problem was a question of relative stiffness between stories rather than strength. The ATC response indicated that the section was primarily designed to flag the potential adverse effects that could occur during inelastic response. Forell requested that the section be more than a flag and actually prohibit discontinuities in strength.

Iyengar responded that the problem can't be controlled easily by a general statement. He pointed out that the commentary contains guidance on how to consider the problem. Degenkolb stated that the commentary is enforced along with the code in some areas.

LeMessurier raised a concern about requiring consideration of strength discontinuities in ares where there are no current requirements for considerating discontinuities in stiffness. He pointed out that requiring these

considerations for buildings in category B would add considerable work for buildings designed in a large portion of the U.S. A number of members indicated a belief that the section was not originally supposed to apply to category B structures.

It was agreed to place an item on the ballot which would change section 3.7.3 to indicate that it only applied for categories C and D. While many members felt that a stronger statement should be included to warn against discontinuities in strength, it was felt that the committee could not produce the wording at the meeting.

Presentation of Inelastic Analysis Method by Mark Fintel

Consideration of specific proposals ended at 5:00 pm and a presentation on the advantages of introducing an inelastic method was given by Fintel. Many of the points raised in his presentation are briefly outlined in his written proposal to add a section describing an alternative inelastic procedure.

The meeting adjourned for the day at 5:30 pm.

The meeting was reconvened by Chairman Iygenar at 8:00 am, February 28th. Again the meeting took place in the summit room of the Quality Inn/Desert Sky. All committee members were present. Only two observers, as noted earlier, did not return for the second day.

The first item of business was consideration of the alternate wording for section 3.7.2: Orthogonal Effects. This has been included with the notes from the 27th on section 3.7.2.

Section 3.7.4 Nonredundant Systems

McConnell felt that this section needed rewriting or removal. Fintel agreed stating that in its present form the section gives the design engineer responsibilities he can't handle. Sharp responded that the intent of the section is to provide redundancy. Degenkolb added that experience shows that damage will occur in a severe earthquake and the section reflects the desire to prevent collapse. After deciding that the redundancy was only necessary for the seismic resisting system, the following alternate wording was placed on the ballot.

> The design of a building shall consider the potentially adverse effect that the failure of a single member, connection or component of the seismic resisting system would have on the stability of the building.

Section 3.7.5 Ties and Continuity

McConnell suggested that the definition of all parts of the building be expanded to note "or units between expansion joints" as is indicated in the commentary, page 350. The proposed wording that came out of the discussion is:

All parts of the building between expansion joints shall be interconnected and ...

Section 3.7.6 Concrete and Masonry Wall Anchorage

McConnell's request for a reference for the provision with relation to bending was withdrawn after it was pointed out that the provision is identical to one in the UBC.

Section 3.7.8 Collector Elements

McConnell's suggestion to add the words "where analysis requires," after the word "provided" was dropped. There was confusion concerning the definition of a collector element. No agreement could be reached on any specific modification and the problem seems to be an editorial one.

Section 3.7.9 Diaphrams

McConnell requested a parenthetic reference for V_x to define it. Zacher suggested the following wording for the 3rd paragraph:

> A minimum force equal to 0.5 A_v times the weight of the diaphram and other elements of the building attached thereto plus the portion of the seismic shear force at that level, V_x, required to ...

The proposed alternate wording was approved for inclusion on the ballot.

Section 3.7.11 Inverted Pendulum - Type Structure

McConnell's suggestion to waive this provision if analysis has considered the effect of the rotational inertia of the mass was withdrawn following a short discussion. ATC felt the provision should remain as is and that the commentary on page 351 makes the situation clear.

Section 3.8 Deflection and Drift Limits

Zsutty's comment indicated that he considered the drift limits to be too restrictive and about twice as stringent as UBC. A number of committee members agreed, suggesting that the drift limits might be from 2 to 4 times more restrictive than other codes. ATC stated that it was recognized that the drift limits needed to be further evaluated and that the effects of varying the limits should be studied in the trial and test designs.

Several questioned why drift limits were included in ATC-3-06. Sharpe noted that the SEAOC originally did not include drift limits, but that they do now. Zacher added that after every major earthquake there has been considerable public reaction to the extensive damage that has occurred and there has been a growing demand for damage control.

Simpson noted that while it may be economically feasible and politically desirable to have damage control in areas where earthquakes occur frequently,

the concern in areas with a low probability of an earthquake occurrence is for life safety, because there is no economic basis for requiring damage control. Simpson and LeMessurier asked for an indication of what level of drift corresponded to requirements of life safety, which could not be answered. Tryell noted that response of mechanical systems and nonstructural elements can impact life safety.

Iyengar suggested that findings of the trial designs may lead to establishing exceptions to the drift limits, where special precautions are taken. Zacher noted that an exception was originally considered but it does not appear in the ATC-3-06. Forell commented that the problem arises because a dual spectrum approach is not used.

Iyengar suggested that the committee's feelings on the question of drift limits should be combined to produce recommendations for the trial designs. Some concern was raised that a few design cases can't cover the possibilities well. There also was some feeling that too much was being left to the trial designs. Sharpe responded that the trial designs are the only way to evaluate the values of R and C_d. Englekirk felt that recommendations for the trial designs should include questions for the engineer performing the design such as (1) does the drift limit improve the design? (2) what is the impact of the drift provisions?

A summary of the recommendations is:

1) Trial designs should include examination of drift control needs for different types of building systems

2) Trial designs should include calibration with existing standards around the country

3) Trial designs should include examination of impact of drift limits on life safety for different occupancies.

It was decided that each member should come to the next meeting with more information based on individual studies. A task group consisting of LeMessurier, Sontag, Zacher and Englekirk was also set up to study the problem and bring recommendations for the trial designs to the next meeting. Englekirk was appointed chairman of the task group.

New Section 3.9 Alternative Inelastic Design Procedure

Fintel recommended that a new section be added which would allow an alternative inelastic design procedure. He felt that the means are now available to do economical inelastic design and that such design would provide a method for reducing internal forces and insuring that hinges form in beams rather than in columns.

Zacher and Sharpe responded that description of such a procedure might be included in the commentary. They strongly objected to the section being

added to the provisions. They pointed out that section 3.1 does not preclude use of an alternative method. McConnell felt that if the inelastic procedure is included in the commentary that a strong statement should be added to point out the severe limitations of nonlinear analysis.

Sontag felt that a specific alternative design procedure should not be included in the commentary since other procedures should be considered as well.

A task group consisting of Fintel, McConnell and Sharpe was established to study the feasibility of adding the alternative inelastic design procedure to the commentary. Fintel was appointed chairman of the task group.

Table 3-A Soil Profile Coefficient

Virdee requested an explanation of why profile S_2 is used in section 3.2.1 to describe soil of unknown character rather than type S_3. In response it was pointed out that S_2 actually provides the largest forces for small buildings because of the difference between equations (4-3) and (4-3a) and that soils so soft as to be S_3 would be easily indentifiable.

Table 3-B Response Modification Coefficients

The comments on table 3-B related to the definitions of the varius categories and to actual values of R and C_d that were chosen.

Several questions were raised concerning where a specific structural system would fit within the table and a concensus appeared to form that some clarification was needed. It was suggested that the clarification might best fit within the commentary. A suggestion was made that a long list of systems might be given in the commentary together with a guide on where each system fell within table 3-B.

Sharpe and Degenkolb indicated that such a table had been created several years ago and agreed to reproduce it and distribute it to the committee members. Sharpe also indicated that he would send a matrix of the proposed trial designs to the committee. (These items are attached to the minutes).

Considerable discussion took place concerning the values given in table 3-B. It was generally suggested that the values are arbitrary and need study. Fintel requested on explanation of how the values were determined.

Degenkolb gave a brief review of the sequence and history of the committee work to develop the R factors. Work began with a list of framing systems. Test data and information gained from experience was combined with available information on damping values and ductility. People on the committee and on the steering committee had input and the actual table of values went through at least four cycles. In the end there was surprising agreement among the committee members. Sharpe added that lots of different values were suggested at the outset of the process but that as discussions proceeded the results converged.

Iyengar asked whether there was much research into procedures for determining R and C_d values. Sharpe responded by noting that there is little specific work, what is required is full scale tests. He added that there is the possibility of using some Japanese work and some shaking table work but that research has not been specifically aimed at determining R values.

Iyengar suggested that a procedure is needed for establishing R values. Degenkolb responded that a procedure may be possible for clean concrete or steel structures but probably not for wood or composite materials. Sharpe indicated that ATC hopes that it will be possible to upgrade values as knowledge is gained in the future but that he feels that the values given are an improvement over the K values given in UBC. He noted that the trial designs will be one step in improving the values.

It was suggested that BSSC is responsible for periodic improvement to the ATC document, but that a method for change has not yet been set up. Zacher moved that the committee recommend to BSSC that a method be established for updating the ATC document as new information becomes available. Iyengar added that the motion suggest that R values be verified by the trial designs and that a consistent criterion be developed for establishing reasonable R values. No specific wording was worked out for the motion.

Englekirk and Fintel suggested that the inelastic time history analysis be used in the trial designs. The feeling was that comparing against existing codes was not sufficient and that the R values should be compared with the results of nonlinear time history analysis in order to establish bench marks.

No action was taken on the various proposals for changing table 3-B. A task committee consisting of Simpson, Forell and Le Messurier with Simpson as chairman was established to delineate the problem, collect all the comments on the R factors into an intelligent unit, and to consider what recommendation should be made to BSSC concerning the trial designs and establishing a method for updating the ATC document.

Fintel wanted the committee to consider a method for coming up with rational R values. He expresed willingness to do work on reinforced concrete and wanted someone to look at steel systems. It was decided that any specific work would be done on an individual basis and would constitute a second step beyond the immediate charge of the task group.

Table 3-C Allowable Story Drift Δa

The proposal by Sontag to change the footnote to exempt one story metal buildings was not considered at any length. It is expected that the task group on drift limits, see minutes for Section 3.8, will make some recommendation concerning this proposal.

Section 4.2 Seismic Base Shear

Forell's request that a statement be added to section 4.2.1 to note that Formula 4-3 will generally apply for short buildings was handled by proposing a change to the last paragraph in section 4.2. Zacher suggested the following wording:

> The value of C_s may be determined in accordance with Formula 4-2, 4-3, or 4-3a, as appropriate. Formula 4-2 requires calculation of the fundamental period of the building as specified in section 4.2.2. For low buildings, or in other instances when it is not desired to calculate the period of the building, C_s shall be determined using Formula 4-3 or 4-3a, as appropriate.

A motion was made seconded and passed that this revision be included on the ballot.

Section 4.2.2 Period Determination

McConnells proposal that an exception be allowed to the limit of $T = 1.2\ T_a$ was dropped after some discussion, although he felt that an exception should be provided for well analyzed special structures with long periods. Forell noted that SEAOC feels that the limit is very necessary.

The CRSI proposal to revise equation 4.4 was dropped. The committee saw no point in using a less sophisticated equation that didn't account for story height.

Section 4.3 Vertical Distribution of Seismic Forces

McConnell and Forell both had comments on the exponent k, which were withdrawn after a short discussion, see the ATC response and commentary on page 364.

Section 4.4 Horizontal Shear Distribution and Torsion

The proposals by Forell and Zacher were discussed together. Several committee members including Simpson and Degenkolb were concerned about the difficulties in coming up with specific numbers for the rigidity of the horizontal and vertical sytems. After some discussion the proposals were withdrawn and no ballot items were suggested.

Inadvertently, the Masonry task group's proposal was not considered. It will be taken up at the Chicago meeting.

Section 4.5 Overturning

Comments by Forell and Zacher were considered. Forell and Zacher noted that the formula suggested higher overturning than actually exists. Englekirk pointed out that the real problem for design lies in the last sentence where the resultant of the seismic forces and vertical loads is not allowed to fall

outside of the middle 1/2 of the base. Zacher felt that the provisions were inadequate but could not suggest a better wording.

It was decided to add an item to the ballot which would drop the last sentence from the provision.

Section 4.6.2 P-Delta Effects

This section was originally taken up in the morning of the 28th to allow LeMessurier to present a proposal. It was also brought up again in the afternoon and a question was raised that the committee decided it wanted LeMessurier to consider.

LeMessurier's proposal would change the last paragraph as follows:

> When θ is greater than 0.10 for any story, the story shear for that story shall be multiplied by the amplification factor a_d, where
>
> $$a_d = \frac{0.9}{1-\theta}$$
>
> a_d shall not be less than 1. The overturning moments, deflections, and drifts shall be redetermined corresponding to the amplified story shears.

LeMessurier's proposal was accepted for inclusion on the ballot.

A question was also raised concerning the definition of W_i used in the equation for P_x. It was agreed that P_x should be redefined as the total unfactored vertical design load at and above level X. This item was also accepted for inclusion on the ballot.

McConnell requested instructions indicating that the computations were not needed for short buildings. Englekirk wanted similar instructions for short and medium period buildings. It was noted that such instructions would require determination of a cutoff level, which would vary according to the zone, for use of the provision. McConnell agreed to look at the possibility of setting such a cutoff. No action was taken at the meeting.

Degenkolb raised the question of whether C_d should appear in the denominator of equation 4-10. It was decided that Sharpe and Degenkolb would study this question and that it would be referred to LeMessurier for comment.

Section 5.2 Modeling

After some discussion of semantics, McConnell's comment was withdrawn. See the ATC response.

Section 5.3 Modes

The answer to McConnell's question question is that modal analysis can be helpful for irregular structures. The comment was withdrawn.

Section 5.4 Periods

McConnell asked whether soil modeling was completely ruled out. The answer given was that it was not ruled out. The analysis procedure does require starting with a fixed base but the last sentence in section 5.5 allows consideration of soil-structure interaction.

Section 5.5 Model Base Shear

McConnell recommended that a plot be included in the commentary to ilustrate the pattern of spectral coefficients for R and A_v. Sharpe responded that such a plot could be added.

It was moved seconded and passed that a recommendation be made requesting such a plot be added to the commentary.

Next Meeting

The next meeting was set for April 2 and 3 in the Chicago area.

Minutes of Third Meeting

Technical Committee 2 - Structural Design
Review and Refinement of Tentative Seismic
Provisions (ATC 3-06)

at

O'Hare American Inn, Des Plaines, Illinois
April 2-3, 1980

The meeting was convened at 9:10 a.m., April 2nd by chairman Hal Iyengar. The following voting members were present:

Mark Fintel, representing Committee 4: Concrete
William Holmes, alternate for Nicholas Forell, representing SEAOC
Hal Iyengar, representing ASCE
Richard McConnell, representing the Interagency Committee
Howard Simpson, representing ANSI Committee A58
William Sontag, representing Committee 6: Steel
Joseph Tyrrell, representing Committee 3: Foundations
Edwin Zacher, representing Committee 7: Wood
Robert Englekirk - representing Committee 1: Seismic Risk Maps, attended on April 3.
Alan Yorkdale, the representative of Committee 5: Masonry, did not attend.

The following nonvoting members were present:

Representing ATC: Roland Sharpe, on April 2 only
Henry Degenbolb

Representing the BSSC Overview Committee:
Ajit Virdee
William LeMessurier

NBS Secretariat: Jim Harris

The following guests attended at various times:

A.K. Gosh, from the Portland Cement Association
Jerry Neville, also from Portland Cement Association

Mr. Iyengar open the meeting with a discussion of the agenda, noting that the nature of the meeting would be different than the previous one; extented discussion would focus on the problems assigned to the four task groups.

The minutes of the second meeting were reviewed and approved subject to several corrections in spelling and grammar and the following changes of substance:

page 5, last line of first paragraph under Section 3.2.3: extend the sentence thus: ". . ., but he no longer opposes it."

page 6, third line of paragraph b) under Section 3.3.3: change "opposite" to "orthogonal."

page 7, second line of fifth paragraph: change "a plane" to "an element."

Mr. Reinhold was praised for the accuracy and completeness of his minutes.

The following items were distributed to those present:

1. Letter from Neil Hawkins, representing the Post Tensioning Institute, dated February 26, 1980.

2. Letter from Nicholas Forell, dated March 31, 1980.

3. Letter from William Sontag, dated April 1, 1980

4. Suggested wording for section 3.7.2 from Ed Zacher.

5. Suggested wording for section 4.6.2 from Ed Zacher.

6. Deflection limitation calculations by Ed Zacher.

7. Letter to the task group on drift limits from Hal Iyengar, dated March 25, 1980.

8. Letter from Henry Degenbolb, dated March 26, 1980, with five attachments, including a letter from Mark Fintel, dated March 19, 1980, and a letter from Henry Degenbolb, dated March 10, 1980.

9. Suggested wording for section 3.7.2 from Bill Holmes (handwritten).

Ballot #1

The ballots of the eight voting members present on the first day were collected and tabulated, and the reservations and negative ballots were discussed with the following results (nonvoting members also balloted for purposes of discussion during the meeting, but their votes are not in the tabulation; they were generally in agreement):

Ballot Item	Initial Tally* yes	Initial Tally* no	Final Tally* yes	Final Tally* no	Remarks Following
1. S. Perf. Category	5	3	0	8	a
2. S. Index, Area 5	3	5	2	6	a
3. S. Index, Area 4	2	6	2	6	a
4. S. Index, Area 3	2	6	2	6	a
5. S. Index, Area 2	4	4	2	6	a
6. S. Index, Area 1	2	5	0	7	a
7. Snow Load	5	2	5	2	
8. Q_L definition	8	0	8	0	
9. Q_S definition	8	0	8	0	
10. Alt. Analysis	8	0	8	0	
11. Rock Classification	8	0	8	0	b
12. Soil-struct. Int.	8	0	8	0	
13. Inverted Pendulum	8	0	8	0	c
14. Combined R Value	8	0	8	0	
15. Frame Interaction	6	2	3	5	d
16. Drift Compatibility	8	0	8	0	e
17. Orthogonal	7	1	7	1	f
18. Vert. discontinuity	7	0	8	0	
19. Redundancy	7	1	7	1	g
20. Expansion joints	8	0	8	0	h
21. Name for V_x	8	0	8	0	
22. Drift Exception	5	3	0	8	i
23. C_s Calculation	8	0	8	0	j
24. Overturning	7	0	8	0	k
25. P_x definition	8	0	8	0	
26. P-delta	7	0	0	8	l

* Note: "yes with reservation" is counted as "yes" and is addressed in the following remarks.

Notes on the ballot items:

a. Harris pointed out that further consideration of the discussion in Phoenix convinced him that item 1 should have been contingent on item 6 alone. The committee agreed. None of the changes proposed for the seismicity index carried on the initial tally, and the sentiment of the committee shifted somewhat towards recommending no change for the purpose of trial design. Iyengar felt that item 5, changing the seismicity index for map area 2 from a 2 to a 1 was quite important; he felt that many locations in that map area would unilaterally decide to ignore seismic provisions such as those included for seismicity index 2.

b. Zacher had a reservation about the suggested wording for item 11. His proposed change was dropped in favor of changing the phrase ". . . other means of classification. . ." to " . . . other <u>appropriate</u> means of classification. . ."

c. McConnell had a reservation about the lack of a reference to a definition for inverted pendulums, but the committee decided no reference was necessary. Discussion indicated a range of opinion as to just what the propoer definition was. The ATC intent is indicated in the commentary.

d. The term "proportionate stiffness" was attacked as the wrong term for description of the situation section 3.3.4(B) is addressing. The committee could not agree to better wording than is in the ATC-3 document, and thus decided to defeat the ballot item (number 15).

e. Holmes and Zacher proposed that the change be reworded to exclude consideration of the seismic resisting system in the direction under consideration. The committee agreed, and section 3.3.4 (C) is now to read as follows:

> DEFORMATIONAL COMPATIBILITY. <u>Each</u> structural <u>component not included in the design as a part of the seismic force resisting system in the direction under consideration</u> shall be investigated and shown to be adequate for . . ."

f. Zacher and Holmes both suggested alternate wording for the orthogonal combination provision (see handouts 4 and 9). Their intent was to reduce the amount of calculation, but the committee doubted that their suggestions accomplished the purpose. The proposed change stands as balloted, but the committee expects that it may be reworded following the trial designs.

g. Virdee questioned how redundancy might be checked. No answer was forthcoming.

h. It was decided to change the word "expansion" to "separation" for ballot item 20.

i. The drift question was deferred until Thursday, at which time the task group on drift reported. That discussion resulted in the replacement of item 22 with a new ballot item for ballot #2.

j. Holmes thought the term "low buildings" was meaningless.

k. Sharpe felt that some limit on overturning is necessary, but could not offer a specific suggestion. Many others agreed, but no change in the ballot item was made.

l. Zacher withdrew his proposed text (handout 5). LeMessurier stated that the minutes of the previous meeting did not contain his recommendation for coordination with the ACI code. He felt that ACI is more conservative and that the conflict created between section 4.6.2 and chapter 11's reference to the ACI code should be resolved. He noted that chapter 10 (Steel) manages to avoid a similar conflict with the AISC design specification. The problem will be referred to committees 4 and 6. Degenbolb, Sharpe, and Harris questioned the use of C_d in section 4.5.2. The issue was taken up again on Thursday and resulted in a new ballot item to replace ballot item 26. (See subsequent item in these minutes).

Height Limits

The task group on height limits (section 3.3.4) held a breakfast meeting on April 2. Their report to the committee recommended:

1. the height limit be retained
2. the provisions for a minimum number of planes for shear walls or braced frames be revised so that paragraph 3.3.4(A)3 reads as follows:

   "3. A system with structural steel or cast-in-place concrete braced frames or shear walls in which there are braced frames or shear walls so arranged that braced frames or shear walls in one plane resist no more than the following proportion of the seismic design force in each direction, including torsional effects:

      a. Sixty (60) percent when the braced frames or shear walls are arranged only on the perimeter.

b. Forty (40) percent when some of the braced frames or sheer walls are arranged on the perimeter

c. Thirty (30) percent for other arrangements

This system is limited to buildings not over 240 feet in height."

3. A recommendation be forwarded to BSSC that provisions be defined for coupled shear walls.

The committee agreed to ballot the recommended revision to paragraph 3.3.4(A)3. Fintel desired to see a paragraph addressing coupled shear walls for inclusion in the commentary. McConnell held that the commentary is not tutorial, but that the purpose is to explain the provisions. Iyengar thought that the recommendation to BSSC would be more effective then a commentary. Holmes, McConnell, and Zacher agreed and suggested that excentric braced frames be included in this recommendation. Sontag cautioned that the committee should not imply that such systems are unfit for present use. Fintel was charged with writing his recommendation, and he and Harris presented the following wording to the committee on the morning of April 3:

> "The committee recommends to BSSC that technical groups be established to develop standard provisions for new types of seismic resisting systems that depend on the concentration of inelastic straining in special members for good performance in earthquakes, in particular, coupled shear walls and eccentric braced frames. For coupled shear walls, the provisions should delineate the details and the stiffness and strength ratios between the shear walls and the coupling beams to assure that the inelasticity is concentrated primarily in and accounted for in the coupling beams. For eccentric braced frames, the provisions should delineate the connection details and the relative member proportions to assure that the inelasticity occurs in the flexural or shear links and does not occur in members that primarily are loaded axially.

The committee approved the recommendation.

Inelastic Analysis Procedures

The task group on inelastic analysis held a luncheon meeting on Wednesday and reported to the committee on Wednesday afternoon. Task group chairman Fintel proposed to add material to the commentary on section 3.5, Analysis Procedures. Task group members McConnell and Sharpe did not agree with the proposal, however, and following discussion among the entire committee, the task group was charged with drafting a compromise proposal. That proposal was presented on Thursday. Following discussion, the committee decided to adopt the proposal that the following paragraph be inserted in the commentary following the fourth paragraph on page 342:

"It is possible with presently available computer programs to perform two dimensional inelastic analyses of reasonably symmetric structures. The intent of such analyses could be to estimate the sequence in which components become inelastic and to indicate those components requiring strength adjustments so as to remain within the required dectility limits. It should be emphasized that with the present state-of-the-art in inelastic analysis there is no one method that can be applied to all types of buildings, and further the reliability of the analytical results are sensitive to:

1. the number and appropriateness of the time-histories of input motion

2. the practical limitations of mathematical modelling including interacting effects of nonstructural elements

3. the nonlinear algorithms

4. the assumed hysteretic behavior

Because of these sensitivities and limitations the maximum base shear produced in the inelastic analysis should be not less than that required by chapter 5 (Model Analysis)."

R Factors

The task group on the R factors and building system description held a luncheon meeting on Wednesday and reported to the committee on Wednesday afternoon. Their findings were:

1. The descriptions in table 3-B are adequate for the trial designs, although they should then be re-examined. The trial designs would be aided by the incorporation of an amplified table in the commentary.

2. The discussion of the method for establishing values for R contained in the commentary is as good as can be done, thus, for now no explicit procedure for establishing R values can be recommended.

3. No changes to the present R values can be recommended. With respect to varying the R values during the trial designs to estimate marginal costs, the task group felt that it would be too expensive to do so, but that the designers should be asked to make an intelligent assessment of just what the impact on cost of differing R values would be.

The committee agreed with each of the recommendations. Chairman Iyengar charged Sharpe with preparation of the amplified table of building systems based on the 12/10/76 draft of table 2C distributed with the minutes of the previous meeting. Committee members are to send suggestions for that table to Sharpe as soon as possible.

Drift

The task group on drift held a breakfast meeting on Thursday and reported to the committee on Thursday afternoon. Task group chairman Englekirk reported that:

1. Drift limits control the design of many structures over the strength limit, thus are quite important.

2. The drift limits seem to be 30% to 60% more severe than the UBC.

3. Two options exist: adjust the limit or delete the requirment. The task group favors adjusting the limit for Seismic Hazard Exposure Groups I and II upward to 0.025 h_{sx} in areas where A_v = 0.4g and to 0.040 h_{sx} in areas where A_v = 0.05g.

Iyengar reviewed the data offered as a comparison:

1. Englekirk's data showed a 30% to 40% increase in stiffness for two buildings (about 17 stories).

2. Skidmore-Owings-Merrill's San Francisco office found a 15% to 60% increase would be required for five recently designed buildings ranging from 5 to 50 stories.

3. Sontag's data showed a 5% to 40% increase for single story buildings.

4. Zacher's data showed a 33% to 67% increase for various story heights of a 20 story steel frame.

There was significant sentiment in the committee to drop the limit entirely because of its obvious relation to damage control. However, most present felt that this was a major change of intent, not a mid-course correction. Therefore, the option of adjusting the limit was selected. The option of making the limit vary inversely with A_v was suggested as a means to provide more damage control in those locations where damaging earthquakes of less than the design amplitude are likely to occur. In the end, a simpler change was adopted by the committee as a new ballot item, it being to change table 3-C to:

	Seismic	Hazard	Exposure Group
	III	II	I
Δ_a	$0.015h_{sx}$	$0.025\ h_{sx}$	$0.025\ h_{sx}$

Among the items discussed were the questions of whether the calculated drift, Δ, was very close to actual drift in an earthquake, with Englekirk feeling that Δ overestimated the real drift and Degenbolb feeling that it was about right (and thus that the C_d values were about right). The problems of separation joints functioning at the higher drift levels were also discussed, with most feeling that some joints would be so expensive or difficult as to economically justify a more stringent drift limit for certain buildings. It was decided that a special commentary was needed for the revised drift limits, and Simpson was charged with drafting it. The commentary agreed to is:

> "The drift limitations of Sec. 3.8 of ATC 3-06 are, for many structures, considerably more restrictive than the UBC and usual current design practice. Because of the lack of a close relationship between story drift and either the amount of inelastic strain or the magnitude of the P-delta problems, and because damage control unrelated to safety is not a code objective, the drift limits have been increased.
>
> "The revised values were chosen to minimize the possibility of imposing drift constraints more severe than those reflected in current design practice. In specific instances, however, such as for controlling the magnitude of relative movements at joints, the designer may find it necessary or desirable to impose more restrictive limits."

Following the decision to revise the drift limits, the committee decided to withdraw the previous ballot item 22. Sontag suggested a revised exception to the drift limits, and the following ballot item was agreed to:

> Delete footnote number 1 from table 3-C and revise section 3.8 by adding the following sentence to the end of the second paragraph: "Single story buildings in Seismic Hazard Exposure Group I that are constructed with non-brittle finishes and whose seismic resisting system is not attached to equipment or processes need not meet the drift requirement in table 3-C."

Other Proposals for Change

Section 2.1, definition of "Shear Panel:" It was decided to delete the word "wood" from the definition. Discussion centered on the distinction of shear panel from shear wall, but no recommendation for clarification or change could be formulated.

Section 3.5, Analysis Procedures: As a result of the discussion about inelastic analysis procedures and about the implications that chapter 5 constitutes the only acceptable procedure for model analysis, it was decided to modify the section to read as follows:

> "This section prescribes the minimum analysis procedure to be followed. An alternate generally accepted procedure, including the use of an approved site specific spectrum, if desired, may be used in lieu of the minimum applicable procedure. The limitations upon the base shear stated in section 5.8 apply to any such analysis."

It was felt that the precise limit on the base shear given in section 5.8 was easier to understand and apply than the limit on building period given in the present section 3.5.

Section 3.7.12, Vertical Seismic Motions: The proposed modification submitted by Professor Hawkins through committee 4 was considered. Harris questioned whether the proposed really stated what Hawkins really meant. Holmes speculated that the intent was to apply an upward seismic force of $0.2Q_D$, not an upward net force of $0.2Q_D$. Iyengar pointed out that the stated reason did not correspond to the recommended change. The proposal was tabled and Fintel was charged with contacing Hawkins prior to the Thursday session. Fintel was unable to contact Hawkins, and the proposal received no further consideration.

Section 4.2.2, Period Determination: The proposed modification for flat slab structures submitted by Professor Hawkins through committee 4 was considered. Zacher pointed out that the intent of ATC-3 was to provide an appropriate formula for building period that predicted periods of about 70%, on the average, of the actual periods measured in strong ground shaking, and that is why the coefficient 0.025 was used for concrete frame structures rather than 0.035. The committee decided to turn down Hawkins' proposal for this section. At this time, the committee discussed the remainder of Hawkins' proposals for concrete flat slab structures in Seismic Performance Category B. Degenbolb stated that ATC's intent was that flat slab structures could be used as frames in Category B. He further stated that Hawkins' proposed changes to section 11.6.1 (items A, B, C, and D on page 10 of Hawkins' proposal) appeared to be acceptable if some continuous reinforcement is provided top and bottom and if the shear and movement transfer problem at the column head is adequately considered. He cited the PCA report by Hanson and Hanson (cited by Hawkins as reference 1 on page 9 of his proposal) as an excellent discussion of the problem at the column head. The committee decided that Hawkins' proposals for flat slabs should be considered by committee 4, and they generally agreed with Degenbolb's comments. The letter from Jacob Grossman concerning flat slab structures (dated November 19, 1979, and distributed on January 17, 1980) was also considered at this time. Iyengar pointed out that the issue was as much a problem of zoning (seismicity index and seismic performance categories) as it was a problem of detailing.

Section 4.4, Torsion: The porposal of the masonry task group to make the assumed torsion a minimum value rather than an additive value was considered. (This proposal was inadvertently skipped at the previous meeting.) The committee decided against the proposal.

Section 4.6.2, P-Delta Effects: Considerable discussion took place without arriving at a true resolution of opinion. LeMessurier maintained that the elastic model for the amplification factor θ is a very adequate prediction for the ultimate strength, and cited studies by Professor Yura as evidence. Harris argued that the inelastic multiplier C_d should be considered when calculating the P-delta moment. LeMessurier felt that doing so would require tremendous increases in the stiffness of ordinary buildings. Degenbolb stated that the commentary on page 367-368, if read very carefully, seemed to indicate that the factor θ should be calculated on an elastic basis and that the inelastic amplification should be included when calculating other effects. Three points of agreement were reached. First, ballot item 26 would be discarded and replaced by the following change: the second sentence of the last paragraph of section 4.6.2 shall be modified to read as follows:

> "The design story drift determined in Sec. 4.6.1 shall be multiplied by the factor $\frac{0.9}{1-\theta} \geq 1.0$ to obtain the story drift including P-delta effects."

Second, the committee recommended a change in the commentary for section 4.6.2 to state: "The last paragraph on page 368 should be considered as a part of the acceptable P-delta analysis referred to on page 367." Third, the committee recommends that the trial designs and subsequent studies should examine carefully the impact of C_d and the validity of the P-delta procedure.

Other Discussion

Several other topics were discussed during the meeting and are briefly summarized here.

Sharpe mentioned that some of the other committees seemed to be taking different approaches to this review and refinement task, citing the steel and concrete committees as two extremes. Iyengar and Harris agreed and stated that committee 2 seemed to be progressing well within the original guidelines.

Sharpe pointed out that it must be made clear that we are not pushing for adoption now and that this review is for the purpose of trial designs. He cited a letter from the chairman of the steel committee to the members of that committee which reflects the notion that ATC and NBS are pushing for adoption now. Sharpe recommended that any such notions be dispelled.

Holmes and Iyengar suggested that the "Guide to Use" and the "Commentary" of ATC-3-06 be thoroughly reviewed for consistency following the incorporation of any changes resulting from this project. The committee agreed to the recommendation.

Iyengar raised the issue of looking for some mechanism to pull together the work of the committee. Harris is to compile all proposed changes together with a commentary for each one and all the committee recommendations for circulation to the committee. Following written comment, this package will be submitted to the coordinating committee at their next meeting. It was confirmed at this time that other committees were making recommendations for the conduct of the trial designs.

It was decided that no meetings of committee 2 appeared necessary until the joint committee meeting, which is tentatively set for July. The meeting was adjourned at approximately 1:30 p.m., Thursday, April 3.

3.2 Roster

American National Standards Institute

Dr. Howard Simpson
Simpson Gumpertz & Heger Inc.
1696 Massachusetts Ave.
Cambridge, MA 02138

Phone: 617-491-8300

Alter: Dr. Rene W. Luft
(send mail c/o Howard Simpson)

American Society of Civil Engineers

Mr. hal Iyengar (Chairman of the Committee)
Skidmore, Owings & Merrill
30 West Monroe St.
Chicago, Illnoise 60603

Phone: 312-246-6161

Interagency Committee on Seismic Safety in Construction

Dr. Richard D. McConnell
Veterans Administration (085A)
810 Vermont Avenue, N.W.
Washington, D.C. 20420

Phone: 202-389-3103 or 2394

Structural Engineers Association of California

Mr. Nicholas Forell
Forell/Elsesser Engrs.
631 Clay St.
Third Floor
San Francisco, CA 94111

Phone: 415-397-2768

Representative from Committee 1 (Seismic Risk)

Dr. Robert Englekirk
3242 West 8th Street
Los Angeles, CA 90005

Phone: 213-385-9487

Committee 2 (continued)

Representative from Committee 3 (Foundations)

Mr. Joseph V. Tyrrell
Director, Civil/Struc. Div.
Naval Facilities Engineering Comnd.
200 Stoval Street
Alexandria, VA 22332

Phone: 703-325-0064

Representative from Committee 4 (Concrete

Mr. Mark Fintel
Portland Cement Association
Engineering Development Department
5420 Old Orchard Road
Skokie, ILL 60077

Representative from Committee 5 (Masonry)

Mr. Alan Yorkdale
Brick Institute of America
1750 Old Meadow Lane
McLean, VA 22101

Phone: 703-893-4010

Representative from Committee 6 (Steel)

Mr. William A. Sontag
Pascoe Steel Corporation
P. O. Box 2628
Pomona, CA 91766

Phone: 714-623-1411

Representative from Committee 7 (Wood)

Mr. Edwin G. Zacher
H. J. Brunier Associates
55 New Montgomery
Suite 608
San Francisco, CA 94105

Phone: 415-781-0370

Committee 2 (continued)

Applied Technology Council

Mr. Roland L. Sharoe
Executive Director
Applied Technology Council
480 California Ave., #205
Palo Alto, CA 94306

Phone: 415-326-4029

Mr. Henry J. Degenkolb
H. J. Degenkolb & Associates
350 Sansome St.
San Francisco, CA 94104

Phone: 415-392-6952

Building Seismic Safety Council

Mr. Ajit S. Virdee
Associate Professor
Dept. of Civil Engineering
Californiz State University
Sacramento, CA 95819

Phone: 916-446-6128

Mr. William J. LeMessurier
Sippican Consultants International
1033 Massachusetts Ave.
Chambridge, MA 02138

Phone: 617-868-1200

National Bureau of Standards

Dr. James Harris
Secretariat
Committee 2, Structural Design
National Bureau of Standards
Rm. B-168, Bldg. 226
Washington, D.C. 20234

Phone: 301-921-2170

Dr. Tim Reinhold
Secretariat
Committee 2, Structural Design
National Bureau of Standards
Rm. B-168, Bldg. 226
Washington, D.C. 20234

Phone: 301-921-2186

3.3 Selected Committee Correspondence and Applied Technology Council Comments

Following is a complete list of all correspondence concerning technical issues. Some of the items are reproduced in this report, as noted in the list. All of the items are on file with the secretary of the committee.

I. Initial Proposals for Change:

Date*	Author	Remarks
1/15/80	Sontag#	transmitted directly by author
1/17	SEAOC: Forell, Zsutty, Zacher	
	Sheppard (PCI)	via Comm. #4 (Concrete)
	Fintel	
	Grossman	via ACI 318
1/22	Comm. #5 (Masonry)	
1/25	Fintel	transmitted directly by author
1/31	McConnell	
2/8	CRSI	via Comm. #4 (Concrete)

* date transmitted from NBS, unless sent directly by author

\# the secretariat wishes to note that one of Sontag's proposals, concerning the inspection of welding in the shop of an approved fabricator, was inadvertently not considered by any of the technical committees. It should be considered following the trial designs.

II. Handouts and Attachments to Minutes at Second Meeting:

Summary list of comments by section of the provisions (NBS)
ATC response to the proposals for change -- <u>included in this report as Exhibit A</u>
Report of the MUTO Institute
Changes by Englekirk
Response by Bertero to proposals concerning coupled shear walls
Early ATC drafts of tables for the R value (Degenkolb)
Proposed matrix of trial designs (Sharpe)

III. First letter ballot (26 items) -- <u>included in this report as Exhibit B</u>
The results of the ballot are included in the minutes of the third meeting (see section 3.1 of this report).

IV. Correspondence among the four task groups operating between the second and third meetings (the task groups were on the Height Limits, Nonlinear Analysis, the Drfit Limits, and the R Value):

Date	Author and Group
3/3	Chairman Iyengar to each group on their charge (four letters)
3/12	Degenkolb to Height Limit group
3/19	Fintel to Height Limit group
3/19	Fintel to Nonlinear Analysis group
?	Englekirk to Drift Limit group

3/25	Iyengar to Drift Limit group
3/26	Degenkolb to Height Limit group

V. Handouts at the Third Meeting:

Hawkin's proposals concerning design of flat plate/slabs and vertical motions
Forell's letter commenting on the R value, drift limits, etc.
Sontag's letter commenting on drift limits
Zacher's proposals for the orthogonal effect and P-delta provisions
Zacher's comparisons concerning drift limits
Iyengar's letter of 3/25 to the Drift Limit Task Group
Degenkolb's letter of 3/26 to the Height Limit Task Group
Holmes' proposal for the orthogonal effect provision

VI. Second letter ballot (six items) -- included in this report as Exhibit C
Each item on this ballot passed, and the vote talley is included for each recommendation in section 2 of this report.

VII. Dissenting Views of Committee Actions with Closure by Chairman Iyengar

Date	Author and Subject
5/29	Fintel on the R value - included in the report as Exhibit D*
5/29	Fintel and Yorkdale on the Seismicity Index - included in this report as Exhibit E
6/12	Iyengar on the Seismicity Index - included in this report as Exhibit F

* see the Chairman's Statement, section 1.3 of the report, for closure on Fintel's comment regarding the R value.

COMMITTEE 2 STRUCTURAL DESIGN
ATC RESPONSE TO COMMENTS

The comments submitted on ATC-3-06 are far-reaching and varied. It is apparent that considerable effort and care have been expended in developing them. Many are quite helpful, all require serious consideration, and some need to be addressed as to whether they fall within the scope of the present program.

It is our understanding that the scope and intent of the NBS effort is to review the provisions for inconsistencies, errors and ambiguities, and to develop "mid-course adjustments" such that the provisions will be appropriate for use in making comparative test designs. It is on this basis that the following responses are being made. The responses are made by chapter and section and include chapters which have significant impact on the design.

Chapter 1 Administration

Table 1-A Seismic Performance Category

A task group of Committee 5 recommended:

"1. For Seismicity Index 2, SHE Group I, change Category B to A.

2. For SI 1, SHE Group III, change Category A to B.

For 1, it is felt that based on performance history SHE Group I buildings in SI 2 need not be required to be reinforced masonry. For 2, it is felt that SHE Group III buildings should be investigated and analyzed, even for SI 1."

Item 1, SI 2 includes areas with Aa and Av values ranging from 0.05 g to greater than 0.1 g; the ATC's Committee's opinion, based on its review of available data (research and historical), was that some reinforcing should be provided for structures subjected to Aa or Av in the 0.1 g range.

Item 2, the ATC Committee considered this type of requirement, but felt that the requirement for building components to be tied together was adequate.

Table 1-B Coefficients Aa and Av and Seismicity Index

Aa	Map Area	Av	Seismic Index
0.40	7	0.40	4
0.30	6	0.30	4
0.20	5	0.20	~~4~~ 3
0.15	4	0.15	~~3~~ 2
0.10	3	0.10	~~2~~ 1 (2) CRSI
0.05	2	0.05	~~2~~ 1
0.05	1	0.05	1

PCA (Fintel) also recommended the above changes in S.I. values. CRSI had similar comments except for Aa and Av of 0.10." The ATC Committee notes in the commentary "a minimum value of Aa and Av of 0.05 was used throughout and designated as Map Area 1. Where the seismic risk procedure produces values of 0.05 the map area value is changed to 2 and the SI becomes 2. The response to what the listed values of Aa and Av mean is the province of Committee 1, however, it should be noted that the ATC Structural Design Committee after lengthy consideration recommended the SI values of 4 for Aa and Av values of 0.20 or larger, and the corresponding values for lower Aa and Av values. The structural design, analysis, detailing, and materials requirements are all carefully interwoven with the Seismic Performance Categories. The categories as listed represent appropriate requirements. As additional data becomes available and further studies are made these listings may be modified.

Chapter 3 Structural Design Requirements

Comments on this chapter were made by Forell (SEAOC), Fintel (PCA), Sheppard (PCI), CRSI, McConnell (ICSSC), and Committee 5 Task Group. The responses to comments on each section are grouped together.

Section 3.1 Design Basis

(Forell) "Proposes increased deformation if it can be demonstrated the resulting design provides equivalent performance, strength and safety." There is the difficulty of the code official being able to determine the equivalency. Also see Section 1.5 Alternate Materials and Methods of Construction.

Section 3.2.1 Soil Profile Types

(McConnell) "Delete shear wave velocity." The shear wave velocity provides a quantitative definition, it is not a mandatory requirement. There is considerable variation in meaning given to the term "rock", hence the definition was provided.

Section 3.2.3 Soil-Structure Interaction

(Zsutty) "Delete this section."

This section is optional; deleting would not permit the designer to consider SSI.

Section 3.3.1 Classification of Framing Systems

(McConnell) "Need inverted pendulum definition." Sec. 3.7.11 defines inverted pendulum-type structures.

Section 3.3.2 Combinations of Framing Systems

(McConnell) "Need definition of supporting systems." A definition would be helpful.

(Forell) "Enlarge section to include dissimilar systems in horizontal plane. Add "In buildings where moment resisting frames are used in

combination with bearing wall systems in different horizontal axes or planes, the lowest value of "R" and the corresponding value of "C_d" shall be used in the design of all resisting elements and components." This addition has merit and should be discussed by Committee 2.

Section 3.3.4 (A) 3 Seismic Resisting Systems

(Forell) "In last line before semicolon insert: "resisting elements shall be arranged in no less than four different planes". The added words are an improvement.

Section 3.3.4 (B) Interaction Efforts

(McConnell) "What if rigid elements "not considered" become, in reality, the primary lateral resisting system?" The provision is intended to cover this situation, but perhaps clarifying wording could be added.

Section 3.3.4 (A) 3 Seismic Resisting Systems

(PCA) (PCI) "Delete height limitation of 240 feet. The ATC committee discussed the height limitation at length and there was disagreement; however, the height limitations were agreed upon. It was also agreed further studies were needed.

(PCI) "Add new type (A) "Coupled shear wall systems with primary inelastic action along these vertical coupling elements providing energy dissipation." This should be discussed by Committee 2; see Bertero and Degenkolb comments.

Section 3.3.4 (C) Deformational Compatibility

(Zsutty) "Need additional commentary (as per SEAOC Blue Book) to show how to verify the stability of the non-seismic system."

Additional commentary would be helpful.

Section 3.3.5 Seismic Performance Category D

(PCI) (CRSI) "delete height limitation."

See 3.3.4 (A) 3 above and Degenkolb comments.

Section 3.4 Building Configuration

(Forell) "Definitions need to be improved. Adjectives such as "approximately" and "nearly" do not clarify but will lead to controversy."

These or similar adjectives are needed to allow flexibility in design; deleting them would make the provision extremely restrictive.

Section 3.4.2 Vertical Configuration

(McConnell) "Word "significant" is too ambiguous. Specific information should be given."

See 3.4 above.

Section 3.5.1 Seismic Performance Category A

(McConnell) "This is opposite to philosophy of other codes."

What part is in conflict with other codes?

Section 3.5.3 Seismic Performance Categories C and D

(McConnell) "Is this saying "modal analysis," in general, is inadequate for horizontal irregularities."

The intent - Chapter 5 modal analysis procedures are only adequate for vertical irregularities (they are not 3-D).

(Zsutty) "Consideration or "evaluation" of the dynamic characteristics (mode shapes and periods) may be difficult for short (two- or three-story) irregular plan (and elevation) shear wall structures. In these complex but common cases, the use of separation joints, or a conservative static force torsional analysis, may be the only practical means of evaluating the element stresses and deformations."

Good comment. Clarifying language would be helpful.

Section 3.7.1 Combination of Load Effects

(Forell) "The concept of a load factored design based on yield strength is, at this time, undesirable."

The ATC committees adopted the concept of load factored design because they felt this concept will be adopted in future codes. There was not universal agreement on this approach as many engineers do not agree with the load factor design approach.

(McConnell) Define "Q".

See definitions on page 42.

Section 3.7.2 Orthogonal Effects

(McConnell) "Is the total force-vector requirement commensurate here with the map acceleration levels of Chapter 1?"

The intent was to be consistent with Tables 1-A and 1-B. This provision needs further work, see below.

(Forell) "This provision implies a lot of busy work. The concern is with corner columns and other load carrying elements."

See response to Zacher below, improvement is needed.

Section 3.7.2 Contd.

(Zsutty) "Eliminate this section and replace it with either:

1. An additional load combination in 3.7.1 for vertical members (columns and their foundations) with a load factor of 1.2 for Q_E.
2. Use a $\phi = 0.5$ for concrete columns if we do not want to punish steel design."

The 1.2 Q_E does not fully satisfy the intent of 3.7.2.

(Zacher) Replace wording:
"Seismic effects can be imposed on a building from any direction. These effects will be considered to be satisfied when the building is designed for the prescribed forces assumed to act non-concurrently in the direction of two axes of the building perpendicular to each other.

Exception: Vertical components of the lateral force resisting system having horizontal flexural components of the lateral force resisting system framing to them from two or more directions shall be designed to resist the seismic force from the direction requiring the greatest strength. This may be satisfied by combining the effects on the members of 100 percent of the forces acting along one axis with 30 percent of the forces acting along the other axis. The combination requiring the greater component strength shall be used."

The proposed wording seems to be an improvement and should be given careful consideration.

Section 3.7.3 Discontinuities in Strength of Vertical Resisting System

(McConnell) "I find this ambiguous. The problem in the initial elastic response is one of variations in stiffness. Only in the inelastic range will variations of strength and/or ductility also be of concern."

The provision says the potential adverse effects ---- shall be considered. See Commentary page 349.

(Forell) "This paragraph needs to be strengthened. It attempts to deal with problems such as Olive View and Imperial Valley failures but does not do so adequately. The best solution would be to not permit the kind of discontinuity described."

There was extensive work on this subject of discontinuities of strength, but no solution acceptable as a regulatory requirement could be developed. The "soft story" concept is one part of the problem, see Commentary.

Section 3.7.4 Nonredundant Systems

(McConnell) "How does one make a transfer girder fail-safe? This needs rewriting or removal."

The intent of the provision is to call attention to the need for considering redundancy. See Commentary.

Section 3.7.5 Ties and Continuity

(McConnell) "Include here the commentary on "units" within joints."

It is not clear what is intended by this comment.

Section 3.7.6 Concrete or Masonry Wall Anchorage

(McConnell) "Give reference for requirements in regard to "bending"."

UBC 76 page 130, Sec. 2310 and SEAOC Blue Book.

Section 3.7.8 Collector Elements

(McConnell) "Add after "provided", the words "where analysis requires"."

The collector element would be sized based on the analysis.

Section 3.7.9 Diaphragms

(McConnell) "Provide parenthetic references for V_x." This could be added as part of format. Definitions are given in Chapter 2.

Section 3.7.11 Inverted Pendulum-Type Structures

(McConnell) "This should only be required if analysis has not considered the contribution of rotational inertial mass."

The ATC committee felt, for code purposes, this requirement should be stated, see Commentary page 351.

Section 3.8 Deflection and Drift Limits

(Zsutty) "For a K = 100, R = 5.5 system, the base shear used to compute ATC-3 drift is about 7 times the base shear value of UBC for drift calculation. However, the allowable ATC drift (0.015 h_{sx}) is only 3 times the UBC allowable drive of 0.005 h_{sx}. Therefore, ATC calls for a structure to be about 7/3 more rigid than UBC. I believe that this can very much affect design comparisons between these provisions and is in error. The values given in Table 3-C should be doubled, since they represent drift in the structure due to the major earthquake (PGA = 0.4 g) event. Or, if we want to keep the Table 3-C values, then the corresponding calculated drift should be for $C_d/2$ in order to represent the moderate (or damage control) earthquake having PGA = 0.2 g."

It was recognized that the drift limits need to be evaluated further. The effects of varying the limits should be studied in the trial test designs.

New Section 3.9 Alternative Inelastic Design Procedure

(PCA) An alternative inelastic design procedure is proposed.

The state of the art does not justify inclusion of an inelastic procedure such as that proposed. See Bertero comments to Committee 4 and Degenkolb comments.

Table 3-B Response Modification Coefficients

(CRSI) "Revise Table 3-B:

Type of Structural System	Coefficients R	Coefficients C_d
Bearing Wall System	4	4
Building Frame System	6	4
Moment Resisting Frame System	8	6
Dual System	7	5
Inverted Pendulum Structures	2-1/2	2-1/2

The response modification factors, R, are out of necessity arbitrary. These numbers will have significantly greater impact on the construction industry than the current K values because of the more detailed breakdown of systems and materials. It is obvious these values must be determined by a rational means and not arbitrarily selected. Until such time as this can be done it is suggested that the R coefficients for the type of structural system be selected similar to the method used for the current K values rather than R values for individual systems and materials."

Simplifying the R values as proposed would be a step backward because there is a lot more data available (including observation of earthquake damage) upon which to make judgments than there was when the K values were developed. See Bertero comments and Degenkolb letter.

(PCA) "A procedure is proposed to develop rational R values."

See Bertero comments and Degenkolb letter.

(Forell) "Although much concern has been expressed about the magnitude of the "R" and "Cd" values, a re-evaluation should be postponed until the

completion of trial designs. Further editorial work is needed to clarify the systems described. This could be accompanied in the Commentary with the aid of illustrations. ----------. As this section reads now, the use of an insignificant shear wall or bracing element will permit use of a higher R value."

Recommend acceptance of the above suggestion.

Chapter 4 Equivalent Lateral Force Procedures

Section 4.2.1 Calculation of Seismic Coefficient

(Forell) "A statement "for low buildings with short fundamental periods of vibration, Formula (4-3) will generally apply" would be helpful."

Recommend acceptance.

Section 4.2.2 Period Determination

(McConnell) "Exceptions should be permitted where adequately analyzed and justified."

The provision does allow calculation of the period other than the empirical formulas given.

(CRSI) "Revise equation (4-4) as follows:
Ta = 0.10N
Recommended for two reasons: simplicity and C_T affects base shear out of proportion to its significance. For example, the period for a 15 story frame affects the base shear twice as much as the response modification factor. This great of an impact on the base shear is not warranted."

The formula (4-4) was developed based on the analysis of numerous records, see Commentary. T = 0.1N has been shown to be erroneous for

many buildings. Recommend leave (4-4) as is until further data is developed.

Section 4.3 Vertical Distribution of Seismic Forces

(Forell) "The introduction of an exponent into this procedure creates undue design effort on all but very tall structures. Consideration should be given to the traditional method of vertical distribution for buildings under an agreed upon height, or the cut off point for k = 1 should be raised to 1 second or higher."

The vertical distribution resulting from formulas (4-6) and (4-6a) is considered to be more accurate than the distribution represented by a concentrated force at the top plus the summation of lateral forces at each level, see Commentary page 364.

(McConnell) "'k' seems unnecessary except for tall buildings, which would probably have a modal analysis anyway."

See response above.

Section 4.4 Horizontal Shear Distribution and Torsion

(Forell) "Add statement to last sentence excluding structure using flexible diaphragms where lateral forces are distributed to resisting elements by tributary area method."

See Zacher comments below.

Section 4.4 contd.

(Zacher) "Introduce new Section 4.3 ahead of "Vertical Distribution of Seismic Force". Renumber following sections and eliminate from present Section 4.4 the "and Torsion" from the title and the last paragraph."

"Section 4.3 Torsion. The design shall provide for the effects of torsion whenever the rigidity of the horizontal lateral force resisting system is equal to or greater than the rigidity of the vertical lateral force resisting system. The effects may be satisfied by using a design torsional moment equal to that resulting from the location of the building masses, M_t, plus the torsional moment, M_{ta}, caused by assumed displacement of the mass each way from its actual location by a distance equal to five percent of the dimension of the building perpendicular to the direction of the applied forces.

When the rigidity of the horizontal force resisting system is equal to 50 percent, or less, of that of the vertical lateral force resisting system, no torsional effects need be considered. For intermediate conditions, reduced torsional moments may be used."

New wording should be studied carefully. The new text answers many of the questions raised, but the 50 percent limitation should be evaluated together with the reduction for intermediate conditions. The new section might better fit as a new Section 4.4 and then renumber.

Section 4.5 Overturning

(Forell) "Additional work is desperately needed. Definitions of "k" make no sense."

(Zacher) "The seismic ---------- where torsional forces are present, the force, V_x, ---------- When torsional forces need not be considered, the force, V_x, shall be distributed to the various vertical components of the seismic resisting system below level x on a tributary basis."

Editorial work is needed--any suggestions? Zacher comment is not clear.

Section 4.6.2 P-Delta Effects

(McConnell) "This appears to be unjustified except for tall buildings. Simplify instructions as to when to use to avoid unnecessary computations."

Low buildings if flexible could be subject to P-delta effects. Any suggestions on simplifying the instructions?

Chapter 5 Modal Analysis Procedure

(Forell) "Time did not permit a review of this section; however, the general consensus appears to be that this section requires a complete and careful restudy and rewrite."

Who is the general consensus? The ATC committees started out with a very detailed modal analysis procedure, but backed off considerably because of the many regulatory-enforcement type questions raised.

(Zsutty) "Dynamic analysis needs to be completely redone."

See above comments. It is difficult to modify a section based on general criticisms as above.

Section 5.2 Modeling

(McConnell) "One degree of freedom is technically incorrect. There will probably be few times when rotary inertial mass is included but the rotational displacement degree of freedom is vital."

The analysis procedure presented is 2-D.

Section 5.3 Modes

(McConnell) "Why do modal for less than three stories?"

If the structure is quite irregular vertically a modal analysis would be helpful.

Section 5.4 Periods

(McConnell) "Have you completely ruled out soil modeling?"

Exhibit B

ATC Review and Refinement
Committee #2: Structural Design

Proposals for change to be balloted
March 1980

1. Table 1-A: change the Seismic Performance Category for Seismic Hazard Exposure III buildings located in areas with a Seismicity Index of 1 from A to B.

2. Table 1-B: change the Seismicity Index for Map Area 5 from 4 to 3.

3. Table 1-B: change the Seismicity Index for Map Area 4 from 3 to 2.

4. Table 1-B: change the Seismicity Index for Map Area 3 from 2 to 1.

5. Table 1-B: change the Seismicity Index for Map Area 2 from 2 to 1.

6. Table 1-B: change the Seismicity Index for Map Area 1 from 1 to 0.

7. Section 2.1: Add the following sentence immediately following the definition of SNOW LOAD.

   EXCEPTION: Where snow load is less than 30 pounds per square foot, no part of the load need be included in seismic loading.

8. Section 2.2: change the definition to read as follows:

   Q_L = The effect of live load, reduced as permitted in section 2.1.

9. Section 2.2: change the definition of Q_S to read as follows:

   Q_S = The effect of snow load, reduced as permitted in section 2.1.

10. Section 3.1: change the second and third sentences to read as follows:

    The design seismic forces, and their distribution over the height of the building, shall be established in accordance with the procedures in Chapter 4 or Chapter 5; the corresponding internal forces in the members of the building shall be determined using a linearly elastic model. An approved alternate procedure may be used to establish the seismic forces and their distribution; the corresponding internal forces and deformations in the members shall be determined using a model consistent with the procedure adopted. Individual members shall be sized. . .

11. Section 3.2.1: change the first subparagraph under soil profile type 1 to read as follows:

    1. Rock of any characteristic, either shale-like or crystalline in nature. Such material may be characterized by a shear wave velocity greater than 2500 feet per second or by other means of classification, or

12. Section 3.2.3: change to read as follows:

    The base shear, story shears, overturning moments, and deflections determined in Chapter 4 or Chapter 5 may be modified in accordance with procedures set forth in Chapter 6 to account for the effects of soil-structure interaction.

13. Section 3.3.1: delete the word "Special" from the third sentence of the first paragraph.

14. Section 3.3.2(A): change the first paragraph to read as follows:

    R VALUE. The value of R in the direction under consideration at any level shall not exceed the lowest value of R obtained from Table 3-B for the seismic resisting system in the same direction considered above that level.

15. Section 3.3.4(B): change the first sentence to read as follows:

    Moment resisting space frames which are enclosed by, or adjoined by, more rigid elements, whose stiffnesses preclude their consideration as part of the seismic resisting system, shall be designed so that the action or failure of those elements will not impair the vertical load and seismic force resisting capability of the space frame.

16. Section 3.3.4(C): change to read as follows:

    DEFORMATIONAL COMPATIBILITY. Every structural component, whether or not it is part of the lateral force resisting system for the direction under consideration, shall be investigated and shown to be adequate for the vertical load-carrying capacity and the induced moments resulting from the design story drift, as determined in accordance with Sec. 4.6.

17. Section 3.7.2: change to read as follows:

    ORTHOGONAL EFFECTS. In buildings assigned to Category B, the design seismic forces may be applied separately in each of two orthogonal directions.

    In buildings assigned to Category C and D, the critical load effect due to direction of application of seismic forces on the building may be assumed to be satisfied if components and their foundations are designed for the following combination of prescribed loads: 100 percent of the forces for one direction plus 30 percent of the forces for the perpendicular direction. The combination requiring the maximum component strength shall be used.

    > EXCEPTION: Diaphragms, and components of the seismic resisting system utilized in only one of two orthogonal directions need not be designed for the combined effects.

18. Section 3.7.3: change to read as follows:

    For buildings assigned to Seismic Performance Categories C or D the design of the building shall consider. . .

    Note: Section 3.6.2(A) would be changed editorially to be consistent with this.

19. Section 3.7.4: change to read as follows:

The design of a building shall consider the potentially adverse effect that the failure of a single member, connection, or component of the seismic resisting system would have on the stability of the building.

20. Section 3.7.5: change the first line to read:

All parts of the building between expansion joints shall be interconnected and the connections shall be. . .

21. Section 3.7.9: change the second line of the third paragraph to read:

. . .elements of the building attached thereto plus the portion of the seismic shear force at that level, V_x, required to be transferred. . .

22. Table 3-C: add a footnote to the entire table, as follows:

[2]In accordance with Section 1.5, the Regulatory Authority may approve deformation limits exceeding these where it can be demonstrated by an acceptable manner that the deformation limits used provide equivalent performance, strength, and safety.

23. Section 4.2: change the last paragraph to read as follows:

The value of C_s may be determined in accordance with Formula 4-2, 4-3, or 4-3a, as appropriate. Formula 4-2 requires calculation of the fundamental period of the building as specified in Sec. 4.2.2. For low buildings, or in other instances when it is not desired to calculate the period of the buildings, C_s shall be determined using Formula 4-3 or 4-3a, as appropriate.

24. Section 4.5: Delete the last sentence of the last paragraph.

25. Section 4.6.2: Change the definition of P_x to read as follows:

P_x = the total unfactored vertical design load at and above level x.

Note: the corresponding definition in Section 2.2 would be changed to agree with this.

26. Section 4.6.2: change the last paragraph to read as follows:

When θ is greater than 0.10 for any story, the story shear for that story shall be multiplied by the amplification factor for P-delta effects, a_d, where

$$a_d = \frac{0.9}{1 - \theta}$$

a_d shall not be less than 1. The overturning moments, deflections and drifts shall be redetermined corresponding to the amplified story shears.

Note: this would also change the word "incremental" to "amplification" in the definition for a_d in Section 2.2.

Exhibit C

ATC Review and Refinement
Committee #2: Structural Design

Proposals for change to be balloted (Ballot #2) April 1980

1. Section 2.1: Delete the word "wood" from the definition of SHEAR PANEL.

2. Section 3.3.4(A): Revise paragraph 3 to read as follows:

   A system with structural steel or cast-in-place concrete braced frames or shear walls in which there are braced frames or shear walls so arranged that braced frames or shear walls in one plane resist no more than the following proportion of the seismic design force in each direction, including torsional effects:

   a. Sixty (60) percent when the braced frames or shear walls are arranged only on the perimeter

   b. Forty (40) percent when some of the braced frames or shear walls are arranged on the perimeter

   c. Thirty (30) percent for other arrangements

   This system is limited to 240 feet in height.

3. Section 3.5: Revise to read as follows:

   This section prescribes the minimum analysis procedure to be followed. An alternate generally accepted procedure, including the use of an approved site specific spectrum, if desired, may be used in lieu of the minimum applicable procedure. The limitations upon the base shear stated in section 5.8 apply to any such analysis.

4. Section 3.8: Revise by adding the following sentence to the end of the last paragraph of the section:

   Single story buildings in Seismic Hazard Exposure Group I that are constructed with non-brittle finishes and whose seismic resisting system is not attached to equipment or processes need not meet the drift requirement in table 3-C.

5. Table 3-C: Remove the footnote from the table and revise the table to read:

TABLE 3-C
ALLOWABLE STORY DRIFT Δ_a

	Seismic Hazard Exposure Group		
	III	II	I
Δ_a	$0.015h_{sx}$	$0.025h_{sx}$	$0.025h_{sx}$

6. Section 4.6.2: Revise the second sentence of the last paragraph to read as follows:

   The design story drift determined in Sec. 4.6.1 shall be multiplied by the factor $\left(\frac{0.9}{1.0} \begin{matrix} > \\ = \end{matrix} 1.0 \right)$ to obtain the story drift including P-delta effects.

Exhibit D

PORTLAND CEMENT ASSOCIATION
5420 Old Orchard Road, Skokie, Illinois 60077 Area Code (312) 966-6200

May 29, 1980

Mr. H. Iyengar
Skidmore, Owings and Merrill
30 W. Monroe
Chicago, Il. 60603

Dear Hal:

I feel the subject of Response Modification Coefficients, R, deserves more consideration than it has received during our committee meetings on February 27-28 in Phoenix and on April 2 and 3 in Chicago. Response Modification Factors, R, as introduced in ATC 3-06, present a significant conceptual change in the overall design approach and a drastic departure from the previous K-values. This change will have a serious impact on the seismic resistance of structures and on the construction industry. The concept of response modification factors, R, ranging from 1¼ to 8, to account for energy dissipation due to inelasticity and damping of the various structural systems and materials has been explained in only a cursory manner in the Commentary; the R-factors have not been clearly defined in either the body of ATC 3-06 or its Commentary.

The method using R-factors seems generally simple and easy to apply and represents a significant improvement over the presently used K-factors. However, the apparently arbitrary selection of R-factors in Table 3B, without a background study of the energy dissipation implications and of the effects on member ductilities, makes utilization of the concept questionable at this time. Since the overall underlying approach is aimed at attaining a balance between strength and ductility, a lack of correlation between R-factors and actual member ductilities makes these values as inadequate as the previously used K-values. A major uncertainty regarding the arbitrarily selected R-factors is the question whether the member ductilities actually available always meet the ductility demands generated during an earthquake. Viable "R" values which answer this question can only be derived by means of inelastic response studies.

The suggestion made at the Committee meetings in Phoenix and Chicago that the upcoming comparative test designs would validate the chosen R-factors of Table 3B does not seem to hold much promise. Considering all the changes in the design process incorporated into ATC 3-06, the possibility seems remote that the comparative test designs would provide the answers to all the questions.

To evaluate the suggested Response Modification Coefficients, R, of various structural systems and materials by comparing them with the previous "K" values seems pointless and an exercise in syllogism, since the earlier values were also adopted arbitrarily 40 years ago, without substantiating evidence.

Exhibit D

PORTLAND CEMENT ASSOCIATION

The objective of comparative studies should be not only to assure that the new approach does not deviate too much from the present one, but also to establish a baseline founded on rationality, to be able to check the technical viability of the new approach.

The behavior of some structures in the earthquakes in San Fernando (1971) and El Centro (1979) have not verified the validity of the present philosophy based on K-factors. On the contrary, they have opened up very serious questions as to the actual implementation of the energy dissipation approach. The drastic increases in the base shear during the 1970s which followed observations in recent earthquakes, is an "inflationary policy" which has resulted primarily in an increase in internal response forces and has not improved the energy dissipation process upon which we have been relying for the safety of our structures. The degree to which the overall seismic safety of our buildings has been improved by the increase in base shears is an open question.

Studies to determine R and C_d values rationally must be carried out for the various structural systems listed in Table 3B. The value of R can be derived from response history analyses as the ratio of base shear for the undamped elastic system to the base shear for the damped inelastic system, with both systems representing the same structure and being subjected to a properly selected ground motion. The inelastic response history analysis of the damped inelastic system (designed by the R-factor approach) would yield the required member ductilities corresponding to the assumed R-factor. If these required ductilities are attainable with the specified detailing, then the R-factor is realistic; otherwise, it needs revision.

The total effort required to determine realistic numbers for R is extensive. However, it must be undertaken and systematically carried out, if the proposed ATC 3-06 design provisions are to be based on a firm foundation. The effort could begin with establishing a definition for R, and developing a methodology to determine the response modification factors, and then carrying out the inelastic response studies for the various structural systems and materials. The profession has the necessary tools to carry out such studies.

Sincerely,

Mark Fintel

Mark Fintel
Director
Advanced Engineering Services

cc: Jim Harris, NBS

Exhibit E

PORTLAND CEMENT ASSOCIATION
5420 Old Orchard Road, Skokie, Illinois 60077 Area Code (312) 966-6200

May 29, 1980

To: Coordinating Committee

From:
Mark Fintel, Member Committee 4 (Portland Cement Association)
Alan Yorkdale, Member Committee 5 (Brick Institute of America)

Re: MINORITY REPORT - Revision of Table 1-B of ATC 3-06

The following suggested changes to the Seismicity Index of Table 1-B were defeated 6 to 2 at the Committee 2 (Design) meeting on April 3, 1980:

TABLE 1-B

Coefficients A_a and A_v and Seismicity Index

Coeff. A_a Figure 1	Map Area Number	Coeff. A_v Figure 2	Seismicity Index
0.40	7	0.40	4
0.30	6	0.30	4
0.20	5	0.20	~~4~~ 3
0.15	4	0.15	~~3~~ 2
0.10	3	0.10	~~2~~ 1
0.05	2	0.05	~~2~~ 1
0.05	1	0.05	1

Table 1-B as incorporated in ATC 3-06 will require additional detailing in beams, columns and connections in vast areas of the United States where such details have not previously been required. In cities like New York and Chicago, such requirements for additional seismic details based largely on judgment would increase construction costs and should not be introduced without adequate background evidence that such changes are needed.

The seismicity indices were introduced as a device to relate the seven map areas (acceleration intensities) with the various levels of detailing requirements, as classified in the four seismic performance categories (A, B, C and D). The indices and the performance categories have been apparently arbitrarily interrelated with the seismic hazard exposure groups (Table 1-A).

Exhibit E

PORTLAND CEMENT ASSOCIATION

To: Coordinating Committee
page 2
May 29, 1980

MINORITY REPORT - Revision of Table I-B of ATC 3-06

There is little question about the extent of detailing requirements for the highest seismicity index (4), as required in California, and for the lowest seismicity index (1), for Texas, Florida, Wisconsin, etc. However, detailing requirements for seismicity index levels of 2 and 3 remain questionable without adequate background information. It is not acceptable to arbitrarily require the same level of ductility detailing for acceleration levels of .40 (map area 7) as for acceleration levels of 0.15 (map area 4).

Buildings located in map areas 1 and 2, subjected to acceleration levels of 0.05, will undoubtedly respond within the elastic range, requiring no additional ductility details. The acceleration level of 0.10 (map area 2) will, in all probability, create an elastic response in buildings designed in conformity with modern reinforced concrete and steel codes.

For buildings located in map areas 4 and 5, with acceleration levels of 0.15 and 0.20, the major question is which structural members will be yielding and how much ductility should be required in them. It should also be considered that designs using current codes (i.e., ACI 318) basically result in ductile members, as provisions over the last 20 years have been devised to eliminate brittleness. To suddenly require additional detailing (also adding 30% of forces in perpendicular direction) in cities like New York and Chicago seems questionable, particularly since the requirement is based largely on judgment and is not supported by adequate background studies. Added ductility requirements should be imposed only if seismicity vs ductility correlation studies for map areas with acceleration levels of 0.10, 0.15 and 0.20 indicate levels of ductility demands requiring such detailing.

In view of the interest expressed by other committees on this subject, it is requested that this item be included in the Coordinating Committee ballot, and in test designs.

Exhibit F

Skidmore, Owings & Merrill

June 12, 1980

To: Coordinating Committee

From: H. Iyengar H. Iyengar
Chairman, Committee No. 2

Re: Closure Statement regarding Minority Report on Table I-B, ATC 3-06, filed by Messrs. M. Fintel and A. Yorkdale

Each of the changes in the seismicity indices included in the Minority Report was debated in the two meetings of Committee No. 2 (Phoenix and Chicago). Each map area was separately balloted with the end result that all the proposed changes were defeated by a vote of 6 to 2, with the exception of the last line relating to map area 1, which was defeated by a vote of 7 to 0. These are part of the Minutes of the Commitee. All the points of view expressed in the Minority Report were aired and briefly discussed. The nature of the discussion cannot be construed as thorough or exhaustive simply because of the lack of time available and the lack of specific data to evaluate the impact of a certain provision. It is my feeling that the Committee Members relied on their experiences and judgments in reaching conclusions rather than on any substantive data.

Since this issue has a significant impact on a large portion of the country that does not currently use any type of earthquake design, it would be ideal if this issue can be addressed by a broader group. I believe other committees have recommendations on this table as well. All things considered, I would support the idea of the entire group balloting and, therefore, support the idea of this being included in the Coordinating Committee Ballot.

/rcp

cc: J. Harris