additional benefit of raising the neutral plane will be a reduction in energy losses as wet insulation dries out. The design and installation of a venting stack should also make provisions for the addition of a heat recovery device or automatic exhaust control to further reduce losses if required in the future.

The recommendation for installing a venting stack should be accompanied by a further recommendation to mount external sidings on furring strips which are sealed at the top. The siding should also be sealed vertically at certain intervals to inhibit air movement from the centre of the wall to the outside edges. This additional recommendations should prevent any undesirable side effects which may occur as a result of wind driven rain.

6.0 SCHEDULING

Figure 2, is barchart showing an outline of the expected scheduling based on the project descriptions presented in Appendix 1. As shown in this diagram the program is scheduled to start August 1981 with completion in two years. Major milestones of the program will be:

1. a report on the extent of the problem in NHA housing completed by March 1982.

2. a report discussing the mechanisms involved in the problem to be completed by December 1982.

3. a final report documenting the findings of the program and recommendation for solutions to be completed by December 1983.

7.0 COST

The total cost of the program is estimated to be about $685,000. This figure is based on the estimates presented in the project descriptions in Appendix 1. A summary of the project costs is presented in Table 1. The anticipated expenditures on the program by year are:

1981: $192,500
1982: $295,000
1983: $177,500
1984: $ 20,000

Table 1
Summary of Project Costs

	Estimated Cost ($)	Breakdown by Year (%) 1981	1982	1983	1984
Stream A					
Project 1A	15,000	100%	-	-	-
1B	40,000	100%	-	-	-
2A	25,000	100%	-	-	-
2B	50,000	50%	50%	-	-
3	15,000	-	100%	-	-
4	75,000	-	50%	50%	-
Total Stream A	220,000				
Stream B					
Project 1	40,000	100%	-	-	-
2A	150,000	-	50%	50%	-
2B	60,000	-	100%	-	-
2C	50,000	-	100%	-	-
3	30,000	-	100%	100%	-
Total Stream B	330,000				
Stream C					
Project 1	40,000	100%	-	-	-
2a	30,000	25%	75%	-	-
2b	20,000	-	50%	50%	-
3	15,000	-	-	100%	-
4	30,000	-	-	33%	66%
Total Stream C	135,000				
Total Program	685,000				

8.0 INVOLVEMENT OF OTHERS

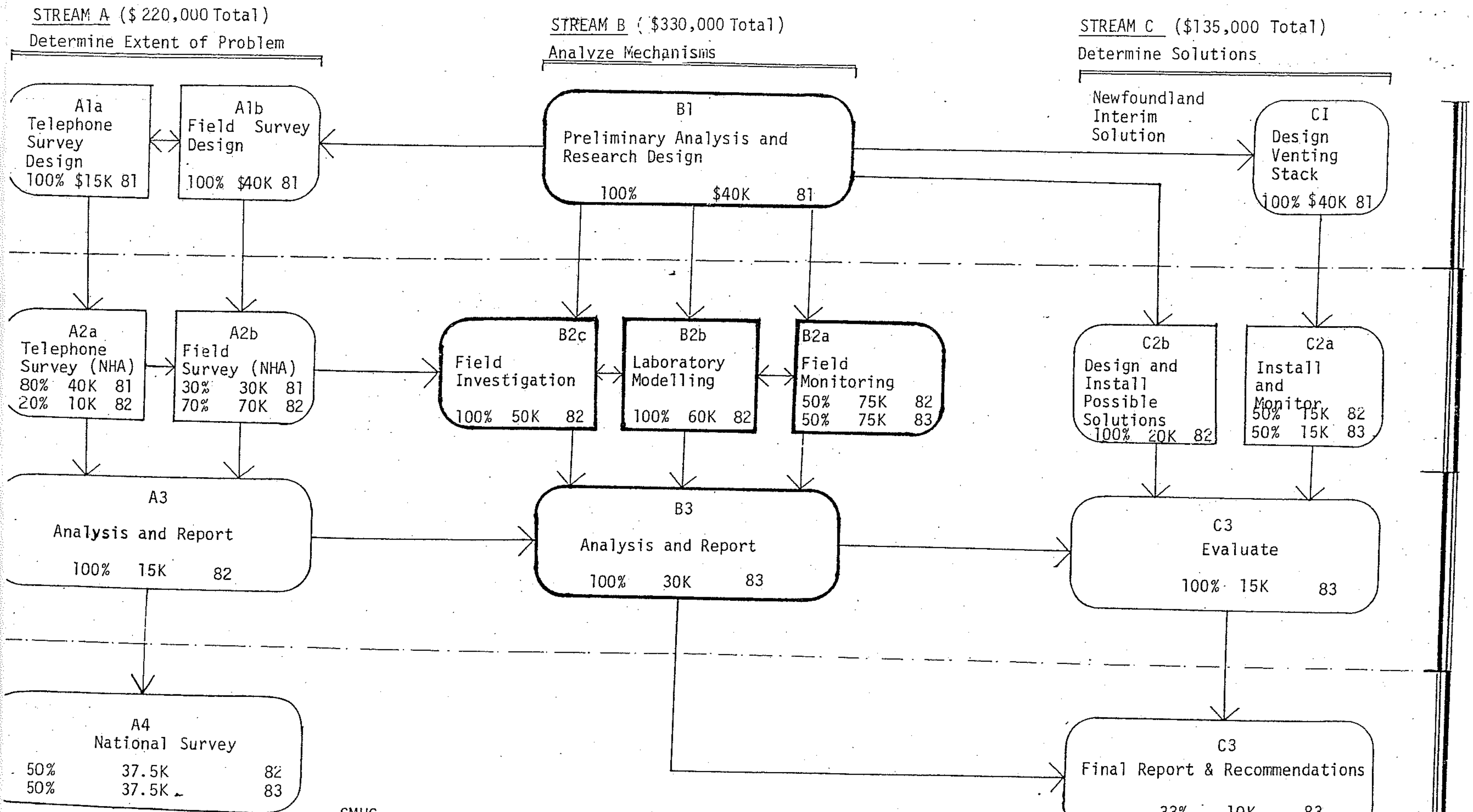
It is recommended that an advisory committee be formed immediately consisting of representatives of groups with vested interests in the problem. The group will be drawn from internal departments of CMHC and external agencies. The groups within CMHC which should be included in this advisory committee are:

- Technical Research Division
- National Office Support Centre
- Technical Services Division and
- Regional Offices.

The groups external to CMHC which should be included are:

- HUDAC
- Canadian Electrical Association
- Energy, Mines and Resources, Canada
- NRCC/DBR
- NRCC/REGIONAL Offices
- Canadian Siding, Soffit and Raingoods Manufacturers Association
- Public Works Canada
- Department of Indian and Northern Development
- Forintek.

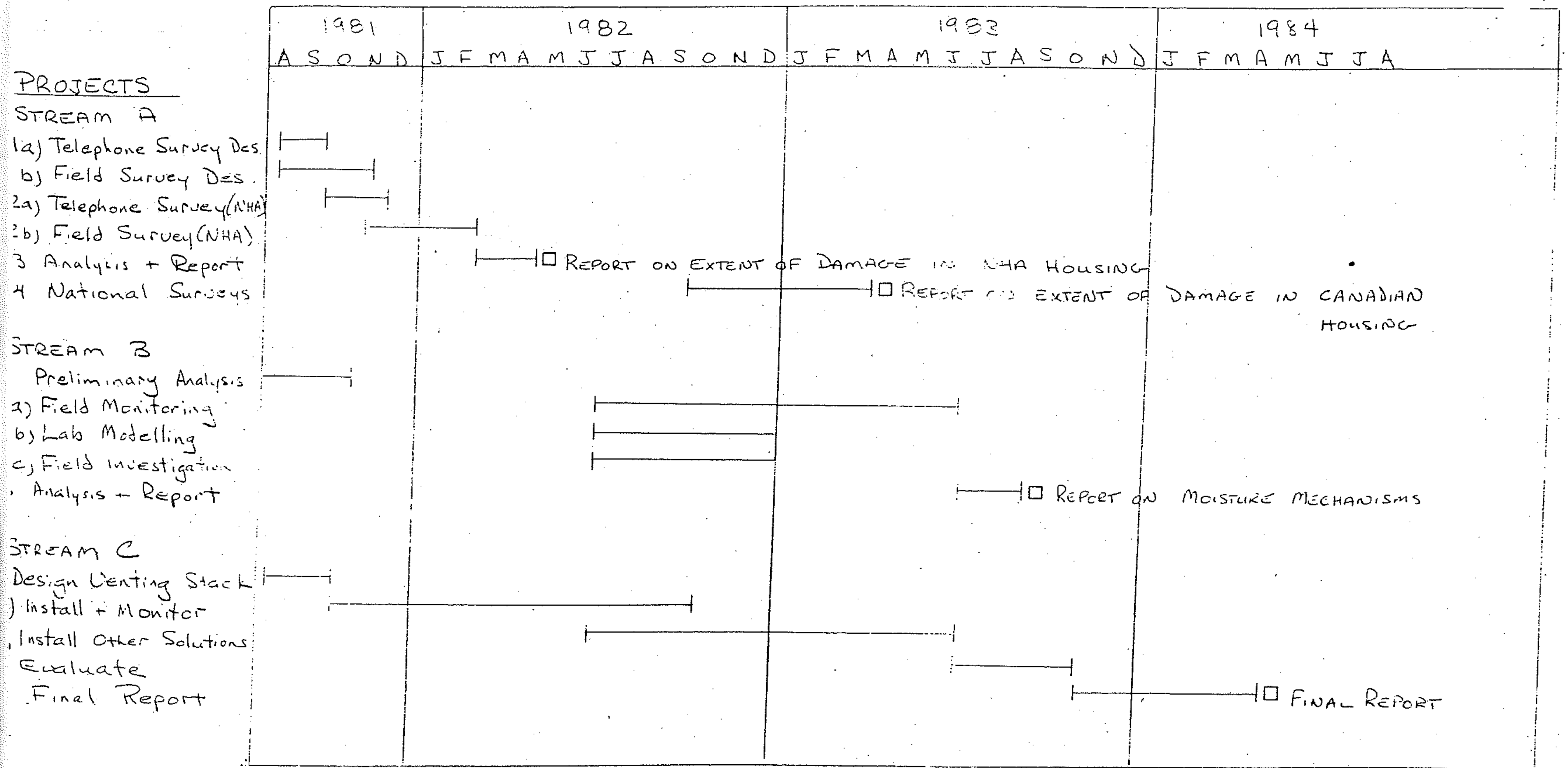
The purpose of the committee will be to provide input to the research program and review its progress through to completion. It is recommended that the advisory committee include people who have first hand experience with the problem.



CMHC
Technical Research Division
July 1981

FIGURE 1

FIGURE 2
PROJECT SCHEDULING



APPENDIX 1

PROJECT DESCRIPTIONS

Stream A

Research Objective 1: To determine the extent of the problem in existing housing in Canada.

Project A1 - Survey Design

Project Objectives

a) to design a survey to identify reported cases of moisture induced structural damage in houses in Canada.

b) to design a field survey of housing in Canada to determine the incidence of apparent moisture damage.

Project A1(a) - Telephone Survey Design

Outputs

1. A questionnaire for use in a survey of agencies to identify reported cases of structural moisture damage.

2. A list of contacts to whom the questionnaire in (1) will be directed.

3. A procedure for verifying reported cases of moisture problems and information to be obtained.

Work Plan

1. Review reports and take input from preliminary analysis of problem in Stream B.

2. Determine information required to identify cases of moisture damage.

3. Determine techniques to verify reported cases such as field testing a sample of cases.

4. Outline survey organization.

Scheduling

Start: 15 August 1981.

Complete: 30 September 1981.

Cost

$15,000.

Project A1(b) - Field Survey Design

Outputs

1. The organization of a national field survey including survey techniques, forms, selection of survey teams, training manuals and overall coordination.

2. A sample of houses to be tested using techniques such as thermographic scanning, moisture probing, etc. The sample should reflect geographical distribution of houses, age, heating systems and types of houses, if possible.

Work Plan

1. Determine the tests required to establish the presence of excessive moisture in housing structures.

2. Develop survey techniques.

3. Select sample of houses to be surveyed.

4. Test survey techniques most probably in Newfoundland.

5. Finalize survey design.

6. Prepare training manual for survey teams.

Scheduling

Start: 15 August 1981.

Complete: 15 November 1981.

Cost

$40,000.

Project A2 - Surveys

Project Objectives

a) To identify and verify reported cases of moisture induced damage in NHA housing.

b) To survey a sample of NHA houses across Canada to determine the incidence of moisture accumulation in the structure.

Project A2(a) - Telephone Survey

Identify Report Cases.

Outputs

1. A list of agencies contacted.
2. A list of reported cases.
3. A list of verified reported cases.
4. A list of other houses in the immediate area of reported cases and an indication of extent of moisture accumulation, if any.

Work Plan

1. Use survey techniques designed in 1(a) to contact agencies and record reported cases.

2. Verify a sample of reported cases through field inspection and record data.

3. Check surrounding houses for cases of excessive moisture accumulation.

4. Document findings.

Scheduling

Start: October 1981.

Complete: December 1982.

Cost

$25,000.

Project A2(b) - Field Surveys

Determine incidence of excessive moisture accumulation in NHA housing.

Output

1. A distribution of NHA houses with excessive moisture accumulation.

Work Plan

1. Training and coordination of survey teams.

2. Conduct survey.

3. Compile data.

This survey could be completed province by province or region by region. Newfoundland will be covered initially when the survey techniques are tested.

Scheduling

Start: November 1981.

Complete: February 1982.

Cost

$50,000.

Project A3 - Analyze and Report Results of Surveys

Project Objectives

1. To determine the extent of moisture induced structural damage in NHA housing based on reported cases and field surveys.

2. To make projections of future growth based on market trends in housing.

Output

1. An estimate, based on statistical sampling, of the extent of moisture problems in NHA housing, with correlations to geographic location, type of heating system, age and type of dwelling and trends in housing market.

2. A correlation between the number of reported cases and actual incidence.

This information will play a significant role in determining the future course of studies. It will also establish the need for involvement of other groups such as CEA, EMR and HUDAC in terms of relating the extent of the problem to the concerns of these groups.

Work Plan

1. Assemble data collected in Projects 2(a) and 2(b) as well as data concerning trends in the housing market.

2. Statistical analysis of data.

3. Present results.

Scheduling

Start: March 1982.

Complete: April 1982.

Cost

$15,000.

Project A4 - Surveys of Canadian Housing

Project Objectives

1. To determine the extent of moisture induced structural damage in housing through telephone and field surveys.

Output

1. An estimate, based on statistical sampling, of the extent of moisture damage in Canadian housing, with correlations to geographic location, type of heating system, age and type of dwelling and trends in housing markets.

2. A correlation between the number of reported cases and actual incidence.

Work Plan

1. Use the telephone survey and the field survey techniques designed in A1 and optimized in A2.

2. Train and coordinate survey teams.

3. Conduct Surveys.

4. Assemble data, analyze and report results.

Scheduling

Start: October 1982.

Complete: March 1983.

Cost

$90,000.

If the decision is made after the completion of project C3 to proceed with this project C4 it is probable that additional funding if necessary can be obtained from other sources.

Stream B

Research Objective 2: Identify and understand the major mechanisms involved in the problem.

Project B1 - Preliminary Analysis and Research Design

Project Objectives

1. To identify the major mechanisms involved in moisture induced structural damage in housing.

2. To assemble the experience of other countries.

3. To perform a preliminary analysis based on known principles of the mechanisms, making assumptions concerning worst case and best case conditions.

4. To postulate relationships between the mechanisms and provide indicators of where problems are likely to occur in new houses, existing houses and retrofit cases.

5. Design research projects to test the results of the preliminary analysis.

Output

1. Input for all phases of the program by providing the basic data upon which to compare results.

2. Research designs for necessary field monitoring, field inspection and laboratory modelling.

3. Recommendations for possible solutions to be tested.

Work Plan

1. Conduct a literature search of research in other countries.

2. Identify and quantify sources of moisture, driving forces and blocking forces.

3. Analyze the effects of changes in these parameters.

4. Identify the dominant mechanisms and the conditions under which they are likely to cause problems.

5. Identify areas where information is lacking.

6. Design projects to validate theories.

Scheduling

Start: August 1981.

Complete: November 1981.

Cost

$40,000.

Project B2 - Validate Preliminary Analysis

Project B2(a) - Field Monitoring

Project Objectives

1. To determine actual performance of new houses, existing houses and retrofit cases in terms of the moisture mechanisms identified in project 1.

2. To provide a data base for theoretical analysis.

Outputs

Data on actual performance of houses to be used to determine relationships between various moisture mechanisms.

Work Plan

1. To coordinate this project with the field studies of air tightness, energy efficiency, etc. To record data concerning moisture mechanisms including the location of the neutral plane, fluctuations in moisture content of structural materials, humidity levels, location of air leaks and thermoscans.

Scheduling

Start: July 1982.

Complete: Continuous monitoring for one or two years.

Cost

Monitoring 300 houses @ $500/house = $150,000.

Project B2(b) - Laboratory Modelling

Project Objective

To test theories or results of preliminary analysis under laboratory conditions.

Output

A theoretical model of the mechanisms as tested in the laboratory.

Work Plan

1. Use hot-cold boxes on house mock-up to test relationships and sensitivities of parameters such as wind, rain, humidity, neutral plane, wall components, insulation, thermal resistance, moisture accumulation, etc.

Scheduling

Start: July 1982.

Complete: December 1982.

Cost

$60,000.

Project B2(c) - Field Investigations

Project Objectives

To investigate known cases of moisture induced structural damage to retrieve information useful to determining cause.

Output

Data which will be used to verify theories of moisture accumulation.

Work Plan

1. Identify known problem cases to be investigated using information from surveys in Stream A.

2. Conduct field investigation of houses and collect data on the extent of damage, house characteristics, air tightness, neutral plane, location of leaks, occupants lifestyle, moisture accumulation, etc.

3. Report data.

Scheduling

Start: July 1982.

Complete: December 1982.

Cost

100 houses @ $500/house = $50,000.

Project 3 - Report on Moisture Mechanisms which Induce Structural Damage in Housing

Project Objectives

To evaluate and correlate data from Stream A and B to describe mechanisms by which moisture can induce structural damage in housing.

Output

1. A theoretical model describing mechanisms by which moisture can accumulate within the structural shells and the points at which this condition becomes critical.

2. Recommendations for solutions to the problem.

Work Plan

1. Analyze data accumulated in Stream A and B and evaluate in relation to preliminary analysis and postulations.

Scheduling

Start: July 1983.

Complete: September 1983.

Cost

$30,000.

Stream C

Research Objective 3: To verify the cost effectiveness of technical services.

Project C1 - Design Venting Stack

Project Objectives

To prepare design requirements for an insulated venting stack for installation in endangered Newfoundland houses.

Output

Design requirements for a venting stack which will ensure the neutral pressure plane is well above the structure of the house. This will ensure the house is subjected only to infiltration forces and prevents exfiltration condensation from occurring. This design requirements will provide guidelines for an intensive solution of endangered houses.

Work Plan

1. Determine the air flow rates required to depressurize typical houses under various conditions in Newfoundland.

2. Design a venting stack which will meet these requirements.

Scheduling

Start: August 1981.

Complete: October 1981.

Cost

$40,000.

Project C2 - Install and Monitor Venting Stack

Project Objectives

To determine the effectiveness of the venting flue to prevent further accumulation of moisture in the walls of trouble and to promote the drying out of saturated structural components.

Output

An evaluation of the interim solution.

Work Plan

1. Select a sample of troubled and endangered houses.
2. Design, construct and install venting flue.
3. Monitor performance in terms of moisture levels and energy consumption.
4. Evaluate performance.

Scheduling

Start: October 1981.

Complete: October 1982.

Cost

$30,000.

Phase C2(b) - Field Tests of Corrective Measures

Project Objectives

To obtain field data on the performance of proposed solutions to the moisture problem including:

- venting stack;
- venting stack with heat recovery;
- venting stack with humidistat controlled exhaust;
- dehumidifiers;
- venting of sidings and other solutions indicated by preliminary analysis.

Output

1. Designs and actual operating data upon which the proposed solutions can be evaluated.

Work Plan

1. Develop design requirements for corrective measures.

2. Field installation.

3. Monitor performance such as the accumulation of moisture, movement of neutral plane and changes in energy consumption.

Work should start immediately on the design and installation of venting stacks for Newfoundland as in interim solution to the moisture problem there.

Scheduling

Start: October 1981.

Complete: one to two years.

Cost

$20,000.

Project C3 - Evaluation and Cost-Benefit Analysis of Alternative Solutions

Project Objective

To determine the most cost-effective solution based on the performance of the alternatives in project 1.

Output

1. Recommendations for cost-effective solutions to moisture problems.

Work Plan

1. Evaluate each alternative in terms of capital cost, operating cost, maintenance cost and performance.

2. Analyze costs and benefits.

Scheduling

Start: July 1983.

Complete: October 1983.

Cost

$15,000.

Project C4 - Final Report

Project Objectives

To document the findings of the research program and make recommendations for new housing, existing housing and retrofit cases.

Output

1. A final report for use by CMHC, and the members of the review committee. These members will disseminate the information to their respective audiences through their respective channels.

Work Plan

1. Present the findings of the various research programs.

2. Make recommendations concerning new and existing housing and houses which have been energy retrofit.

Scheduling

Start: October 1983.

Completion: May 1984.

Cost

$30,000.