

**Defect Prevention
Research Project
for Part 9 Houses**

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prévention des vices de construction des habitations visées par la Partie IX

DEFECT PREVENTION RESEARCH PROJECT

Final Report

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EXECUTIVE SUMMARY

A computer program has been developed to facilitate documentation of construction defects in single-family residential homes. It is written using FoxBASE +/Mac and is designed to run on a Macintosh Powerbook computer with hard drive and minimum 1 MB RAM.

For convenience of data input, both the building description and defect records have been organized through extensive sets of pull-down menus. This format greatly reduces the effort required for data input and also ensures a consistent form and organization of data. This latter aspect is essential to be able to study the information in an organized manner and to be able to summarize data.

Programming and the setup of the data base allows for study of various relationships between building defects, problem areas and causes. At the simplest level, the number of buildings having a particular set of construction details and/or defects can be counted. The location, severity and additional comments related to these defects can also be output. On a more complex level, cross comparisons can be formulated to identify regions, municipalities, buildings or even builders that possess certain combinations of defects or some mix of details and defects.

Data was collected using approximately 100 active claim files available at the ONHWP Regional Offices. These files contained information on over 1000 claim items compiled by Warranty Representatives regarding problem complaints, causes and resolution. In all cases the repair costs were also listed.

Extensive studies of the data and cross-comparisons have been completed and provide relevant information leading to recommendations for improving the design standards and construction supervision of single-family residential construction. The results of the study show that small builders in small municipalities contribute to the most costly defects to the Warranty Program. Foundations, interior finish, and plumbing are the most problematic construction sequence areas for both of these groups. The study also proves that Workmanship defects far exceed all other claims in terms of both cost and frequency, followed by Ontario Building Code violations, Water Penetration claims, Major Structural Defects, Material claims, and lastly Substitution claims.

1. INTRODUCTION

Since ONHWP was established in 1976, we have paid over \$100 million in claims to new home and condominium owners in Ontario, approximately \$75 million of which occurred over the past five years. Between 1988 and 1992 the average claims costs per freehold and condominium unit increased over 100 percent. This provided some of the incentive to undertake a study to identify the main types of defects and to try to correlate these with corresponding building systems or design or construction practices. Regardless of whether remedial costs are borne by the original contractor, the Warranty Program, or by the owner, it is in everyone's interest to take steps to minimize the problems and the resulting costs. In order to be able to obtain the most benefit from steps to be taken to reduce costly problems, it is necessary to identify the problems that are most prevalent and which produce the largest costs, inconvenience or long term loss of value of the property.

Surveys of builders, designers and building officials have in the past proven to be relatively ineffective as a comprehensive source of types, frequencies, and causes of problems in buildings. Therefore, it was decided that the information would have to be gathered by a research team with knowledge of structural and building systems and experienced in evaluation of performance.

The purpose of the Defect Prevention Research Project was to; identify the construction areas of Part 9 houses where technical information is needed, identify future research and development needs, confirm the targeted inspection areas, identify the need for construction quality management to the industry, and to identify the need to streamline HomeWISE coding for improved electronic database collection. This was done by surveying claim file data using a computer database and analyzing the results.

The project direction was established after a Regional trial in the Newmarket Regional Office. Discussions with both the Operations Manager and each of the Warranty Representatives allowed for fine tuning the process of data collection. These discussions allowed for personal input relating to the associated construction problems in the Newmarket Office, as well as directing the selection of common problem claim files. Regional Office input to discuss strategy and project direction was available on four different levels: meetings were held with Operations Managers; Regional Office meetings with Warranty Representatives; questions on individual claim files in the

Regional Offices; and a presentation to the Regional Operations Committee on April 21, 1993.

The consulting firm of Proctor & Redfern Limited was retained to assist in the identification of project parameters and analyze project data. The following is an outline of the project work:

- Analyzing approximately 100 claim files for the purpose of documenting actual construction defects.
- The claim files analyzed contained over 1000 individual claim items where monies were paid by the ONHWP.
- For each claim item, information was gathered regarding the warranty type, the original complaint, the location of and building component involved, and the cause of the defect.
- Total claims analyzed in this project amounted to nearly 1 million dollars.
- A standard data collection menu was programmed into a personal computer, based on the construction sequenced format which was completed earlier in collaboration with the National Warranty Council.
- The viability/user friendliness of the data base system was verified using a sample of claim files.
- Data was gathered by in-house and external experts. Causes of the defects were determined so that appropriate solutions could be recommended.
- Problem areas related to moisture, health, safety and construction practices were identified. Specific locations, type of construction and the defective component were also identified.
- Overall problem trends including the incidence and cost of Building Code defects which will be useful for municipalities were identified.
- Appropriate graphs for use with builders and municipalities that are reflective of small, medium and large size groups were developed.

2. ORGANIZATION OF THE STUDY

2.1 Organization of the Data

2.1.1 Introduction

Initially it was planned that input on building design details and defects would be organized using a spreadsheet program with details and defect information gathered and entered by a team of students hired by the ONHWP.

However, as the work of preparing this spreadsheet progressed it became apparent that, due to its length and the complexity of descriptions of building details and defects, the use of students would not be feasible. As a result the Client and Technical Services department of ONHWP carried out the analysis. This provided the required level of technical expertise, as well as consistency of information gathering.

2.1.2 Form of the Data Base

It was decided to use an up-to-date data base program possessing reasonable versatility and one with which potential users of this research would likely be familiar. The FoxBASE +/Mac was chosen. The intent is that special computer or dBase knowledge would not be required for future data entry or study of the data. For this reason and so that data entered by different people would be consistent, use of pull-down menus for data input was selected. This is in fact an essential feature if in-depth correlations of problems with building details are to be possible.

2.1.3 Organization of the Data Base

There are two data entry screens as indicated below:

- a) The first screen, Figure #1, provides a means for listing the building details and includes:

Regional office name, Warranty Representative name, municipality name and size, builder name, registration number and number of homes built, homeowners name, enrolment number, enrolment date, and address. Each of these items is stored in a separate field which can be included as parts of later searches or correlation of claim files. Two final fields provide a total count and cost amount of all individual claim items paid out under this claim file.

- b) The second screen, Figure #2, contains the specific information relating to each individual claim item:

Beginning with the original complaint by the homeowner, the location and component involved in the defect, (following a construction sequenced format defined in a previous study), and the cause as determined by the Warranty Representative. The warranty type is also identified. Each of these aspects of the claim: complaint, location, component, cause, and warranty type are selected using pull-down menus. (See Tables 1-5). Due to the sheer number of items listed under location and component, a sub-heading based on the construction sequenced format was selected to narrow down the choices. These construction sequence sub-headings are:

1. Ground and Subsoil
2. Foundation
3. Structure
4. Roof
5. Insulation, Air and Vapour Barriers
6. Crawl Spaces and Floor Spaces
7. Interior Finish
8. Exterior Finish
9. Room Dimensions
10. Stairs and Handrails
11. Windows and Doors and Skylights
12. Fire and Sound Protection
13. Mechanical
14. Plumbing
15. Electrical
16. Site Work

Selection of any one of these sub-headings produces listings of possible locations and components relevant to that construction sequence and for each type a menu pops up to provide choices for the input.

If for example, a review of the claim file indicated that the defect was foundation related, selecting this sub-group would provide the corresponding location and components, such as poured concrete (location) and wall (component).

2.1.4 Simplified Warranty Coverage Types

Only those warranty coverages administered by the Program that apply to the construction related claims on single family dwellings were categorized into "Warranty Types" in this data base. The coverage's, as defined in the Ontario New Home Warranties Plan Act, were simplified into six categories: Material, Major Structural Defect (MSD), Ontario Building Code (OBC), Substitution, Water Penetration, and Workmanship. These simplified "Warranty Types" allowed for appropriate grouping to maintain accurate data since actual claim files do not always cite warranty type for each individual claim item. For example, a typical claim file in a Regional Office does not list whether or not an OBC claim falls under the first year OBC coverage, or the second year OBC health and safety coverage. Rather than improperly categorizing, collecting both claims as just "OBC" was required. The same logic was applied when defining the "Water Penetration" coverage. All claims referencing water entry into the home were collected in this category, rather than separately as a Water Penetration - Basement, or a Water Penetration - Building Envelope claim.

The purpose of this survey was to identify built-in construction defects and where they occur. Simplification of the "Warranty Types" allowed for the focus to remain on the construction data, and give a general but accurate picture of the coverage breakdown.

2.1.5 Searching the Data Base

Using only the data describing the buildings (Screen 1) it is possible to list and/or count the number of buildings that have similar characteristics such as size of builder, size of municipality, or region. This can be useful for quantifying information on aspects such as effect of builder size, inspection practices, locations of buildings etc.

For buildings searched for a specified set of construction details, those that also

have specified defects can be identified. For example, buildings in large municipalities can be searched to see which are the most common warranty types, locations, etc. The search will provide the number of cases and total cost of claims of defects for buildings conforming with the description. Report-type listings of the buildings and of the problems can be printed or reviewed on the screen if desired.

These types of searches are most useful for comparison and correlation studies. For comparison studies two searches might be done to obtain information on the relative frequency of some problem, or set of problems, or one of a number of problems.

3. ANALYSIS OF DATA FROM THE DEFECT DATA BASE

3.1 Introduction

A major part of the work of this project was to develop a system for collecting and studying data on building and construction defect details. Another major part was the actual analysis and listing of this data.

A large variety of simple listings, comparative studies and correlations have been run. Brief comments are provided below on some of these studies. The definition of terms are as follows:

Warranty Type	=	Workmanship, Material, OBC infractions, Water Penetration, Substitutions.
Location/Subgroup	=	Affected element of the structure e.g., foundation or interior finish.
Type	=	Subset of location e.g., poured concrete or kitchen.
Component	=	Subset of type e.g., wall or ceramic tiles.
Complaint	=	Description of defect e.g., cracked or damaged.
Cause	=	Reason for defect e.g., poor construction or poor workmanship.

3.2 Overall Defect Distribution by Construction Sequence (C/S)

The following table is a summary of the frequency and cost of defects listed according to Construction Sequence. The total distribution of defects is shown graphically in Figures #3 and #4.

SUMMARY OF PROBLEMS BY CONSTRUCTION SEQUENCE

	<u>Construction Sequence Sub-heading</u>	<u>Frequency</u>	<u>Cost \$</u>
1.	Ground and Subsoil	8	5,000
2.	Foundation	83	260,884
3.	Structure	60	70,363
4.	Roof	43	30,075
5.	Insulation, Air and Vapour Barriers	40	28,377
6.	Crawl Spaces and Floor Spaces	6	3,408
7.	Interior Finish	267	192,675
8.	Exterior Finish	73	48,990
9.	Room Dimensions	2	2,140
10.	Stairs and Handrails	43	21,232
11.	Windows and Doors and Skylights	173	75,499
12.	Fire and Sound Protection	1	200
13.	Mechanical	65	30,932
14.	Plumbing	89	138,031
15.	Electrical	33	6,568
16.	Site Work	<u>32</u>	<u>37,589</u>
	TOTAL	1,017	951,967

This table shows that areas which cost ONHWP the most in defect claims are: Foundation, Interior Fixtures, Plumbing, Windows/Doors/Skylights, Structures, and Interior Finishes.

It is encouraging to note that most of these areas have been identified by the ONHWP as areas requiring special attention. This is evidenced by the targeted inspections (Appendix B) which pay close attention to Foundation, Excavation, Framing, and Interior and Exterior Finishes. The high cost of claims relating to Plumbing defects are due mainly to several large septic system problems which have been addressed in a separate research report sponsored by ONHWP.

The one area where additional efforts in inspection may be necessary is in the area of windows/doors/skylights. This is the location identified with the second highest incidence of claim items and the fourth most costly.

3.3 Distribution of Defects by Location Subgroup (Component Breakdown)

Figures #5 through #16 illustrate the breakdown of the 16 construction sequence locations into their components by cost.

These graphs are the breakdowns of each of the locations shown on Figure #4. Each of these locations are broken down into their most expensive components and expressed as a percentage of the dollar amounts paid out for that particular location. (e.g. For Figure #5 on foundations, 54.2% of the cost of claim dollars for foundations are caused by defects in walls). These graphs allow for analysis of each of the sixteen construction locations, and provide a clear view of where the defects are occurring.

3.4 Specific Detail and Defect Correlations

The frequency and cost of all claims arranged by construction sequence sub-groups, outlined in the previous section, can be seen graphically in Figures #3 and #4. As an example of the versatility of the data base, these figures can be broken down to show frequency and cost by builder size and municipality size.

Figures #17 to #20 identify that small builders and small municipalities have problems with the interior finish, windows/doors/skylights/, and foundation construction sequences in terms of frequency. It is interesting to note that medium municipalities have an unproportionally large number of claims in the interior finish construction sequence compared to the other sized municipalities and other construction sequences. In terms of cost, foundations, interior finish, and plumbing construction sequences are problematic for all builders and all municipalities. These construction sequences are unproportionally high compared to the other sequences, and represent high cost areas to ONHWP.

3.4.1 Distribution of Defects by Warranty Type

Figures #21 and #22 show the frequency and cost distribution of defects by Warranty Type. Workmanship claims are by far the most frequent and result in the most cost to the ONHWP. (It is interesting to note that the "average cost" for the Workmanship claims reviewed in this study is \$675, whereas the MSD claims reviewed cost an average of \$8,250.)

Figures 23 to 26 show the frequency and cost distribution of defects by Warranty Type as a function of builder size and municipality size. It is interesting to note that the smaller municipalities have a proportionally higher incidence of MSD and OBC claims. (This will be discussed further in a later section.)

3.4.2 Distribution of Defects by Complaint

Figures #27 and #28 show the frequency and cost distribution of defects by complaint.

The highest number of complaints and largest cost items such as: missing, improperly installed, damaged, cracked, etc. are related to workmanship claims (by a ratio of 2:1 over all other warranty types). Water leak complaints correspond largely (85%) to Water Penetration claims.

One complaint item which did not occur frequently but which appears as a high cost contributor is adfreezing. This complaint item comes up only four times but ranked in the seventh highest cost position. Also important to note is the fact that three of the four occurrences were OBC claims accounting for over \$28,000 of the \$32,000 paid out.

3.4.3 Distribution of Defects by Location

Figures #29 and #30 show the frequency and cost distribution of the location of the defects.

Poured concrete elements were identified as both the most frequent and most costly location of defects. A further breakdown of the frequency and cost of this particular location (poured concrete) by Warranty Type (Figures #31 and #32) reveals a relatively broad distribution of the defect area among Warranty Types. Material and MSD claims average about \$10,000 while water and workmanship averaged \$2,000 - \$3,000.

Again, two locations which did not occur frequently, but which appear as high cost items are identified: septic tank systems and ground water drainage. Both locations came up 13 times each, but ranked second and fifth in terms of cost to the ONHWP. In the case of septic tank systems, half of the occurrences were

OBC or MSD warranty claims and accounted for \$64,000 of the \$74,000 total.

3.4.4 Distribution of Defects by Component

Figures #33 and #34 show the frequency and cost distribution of defect by Components. Many of the components with the highest number of occurrences and largest costs: such as drywall, windows/doors/skylight, and trim and mouldings are related to Workmanship claims (80%). However, the component: wall, is associated (60%) to Water Penetration (at 40% of the total cost).

Again, some components: slab, leaching bed, weeping tile and septic tank have very few occurrences (1-7) yet contribute greatly to the cost. These high cost items are mainly as a result of MSD and OBC claims.

It should be pointed out at this time, that a search of the 12 single highest cost claims (over \$10,000 per single item) revealed:

Analysis of 12 Single Highest Claims.

Warranty Type: 4 OBC, 3 MSD, 2 Water Penetration, 2 Workmanship, 1 Material.

Location: 5 poured concrete, 3 septic tanks, 1 ground water drainage, 1 vapour barrier, 1 kitchen, 1 casement windows.

Component: 2 slab, 2 leaching bed, 1 wall, 1 floor, 1 weeping tile, 1 septic tank, 1 insulation/air barrier, 1 window/door/skylight, 1 tiles, 1 foundation.

Cause: 4 poor construction, 6 not to code, 2 poor workmanship.

Therefore, it is clear that while poor workmanship and Workmanship claims are the most frequent, and therefore, most costly in total to ONHWP. The most costly defects, in terms of cost per claim, are those related to OBC, and MSD claims, resulting from poor construction practices, and Code violations.

3.4.5 Distribution of Defects by Cause

Figures #35 and #36 show the frequency and cost distribution of defects by Cause. As expected from an analysis of the Warranty Types, defects due to poor workmanship are by far the most frequent and result in the most cost.

Figures #37 and #38 show the frequency and cost distribution of defects by Cause as a function of municipality size. As expected from the analysis in previous sections (see section 3.4.1), the smaller municipalities show a much higher proportion of defects caused by inadequate design/detail, not to code, not to plan, and poor construction. The distribution of poor workmanship related defects is proportional to the number of claims.

3.4.6 Distribution of Defects by Builder Size

For analysis purposes, the files were sorted by builder size. Small, medium and large builders were defined as those having built less than 10, 10 to 100 and over 100 houses respectively. Our data base of 1017 claim items revealed 496 (48.7%) claims by small builders, 410 (40.3%) claims by medium builders and 111 (11%) claims by large builders. The table below indicates the top three instances of complaint, location, component, and cause for both small and large builders. (Minimum 10 occurrences or \$10,000.)

	Highest Frequency	Highest Cost	
Component	drywall wall (foundations) windows/doors/skylight	wall (foundations) weeping tile floor	SMALL BUILDERS <10
Component	drywall window/door/ skylight	wall (foundations)	MEDIUM BUILDER 10 - 100
Component	drywall	slab (garage) tile (ceramic) drywall	LARGE BUILDER >100

3.4.7 Distribution of Defects by Municipality Size

For analysis purposes, the files were sorted by municipality size. Small, medium and large municipalities were defined as those having less than 10,000, 10,000 to 100,000, and over 100,000 people respectively. Our data base of 1017 claim items revealed 430, 274 and 313 claims from small, medium and large municipalities respectively. It is interesting to note that over 50% of claims in terms of frequency occur in small municipalities. In addition, over 50% of claims in terms of cost occurs in medium municipalities.

As mentioned in the previous sections, the small and medium municipalities exhibit a much higher proportion of MSD and OBC claims as well as defects caused by not to code or not to plan.

3.5 Focusing Resources for Preventing Defects

One of the purposes for this report is to establish strategic lists for builders and municipalities to use in targeting problem construction areas. By analyzing the 1017 claim items, lists of the top 5 most common components in terms of both frequency and cost were created.

3.5.1 Builder Lists

Figure #39 shows the top 5 components for all builders sizes in terms of the number of times they occur.

This list was created by analyzing the approximately 1000 claim items surveyed, and then by grouping the components into a hierarchy defined by frequency.

The top 5 construction defects in terms of frequency are:

TOP 5 MOST FREQUENT DEFECTS

1. DRYWALL
2. FOUNDATION WALL
3. WINDOW/DOOR/SKYLIGHT
4. TRIM AND MOULDINGS
5. WINDOW/DOOR/SKYLIGHT FRAMES

The most common construction defect of all claim items surveyed occurs in the "drywall" component. The majority of drywall problems are caused by poor workmanship and the lack of care taken in installation, and are generally located throughout the house. Seams showing, poor finishes, cracks, and damage are all common complaints. **See photo #1**

The second most frequent component was "wall", which is a component of foundations. 85% of all foundation wall problems occurred in poured concrete walls, with only 11% occurring in concrete block. Over 90% of the complaints for foundation walls are associated with cracks and water leaks that occur. **See photo #2**

The third most frequent component is "other window/door/skylight". Improper installation of door and frame assemblies, causing them to be inoperable, is the most common complaint of this component. **See photo #3**

The fourth most frequent component is "trim and moulding". Missing and incomplete trim, along with poor finish are the most common complaints. **See photo #4**

The fifth most common component is "frame", which is a component of Windows/Doors/Skylights construction sequence. Common defects include unsealed or uncaulked, improperly installed, and damaged frames for both exterior windows and doors, including garage doors. **See photo #5**

Figure #40 shows the top 5 most expensive components.

The top 5 components in terms of cost are:

TOP 5 MOST COSTLY DEFECTS

1. FOUNDATION WALL
2. GARAGE SLAB
3. CERAMIC TILES
4. LEACHING BEDS
5. OTHER WINDOW/DOOR/SKYLIGHT

The most costly component was "wall", which is a component of foundations. 85% of all foundation wall problems occurred to poured concrete walls, with only 11% occurring in concrete block. Over 90% of the complaints for foundation walls are associated with cracks and water leaks that occur. **See photo #2**

The second most costly component was "slab", which is also a component of foundation. Approximately 89% of slab claims are related to frost heave and settlement. **See photo #6**

The third most costly component is "ceramic tile". Ceramic tile claims were largely related to poor workmanship causes. Cracked, broken, uneven alignment, and improperly installed are the most common complaints. **See photo #7**

Failure of leaching beds was the fourth most costly component. Failure, improper grading, too small of field beds, and leaching proved to be the most common complaints. **See photo #8**

The fifth most costly component is "other window/door/skylight". Improper installation of door and frame assemblies, causing them to be inoperable, is the most common complaint of this component. **See photo #3**

PHOTOGRAPH #1 DRYWALL DEFECT



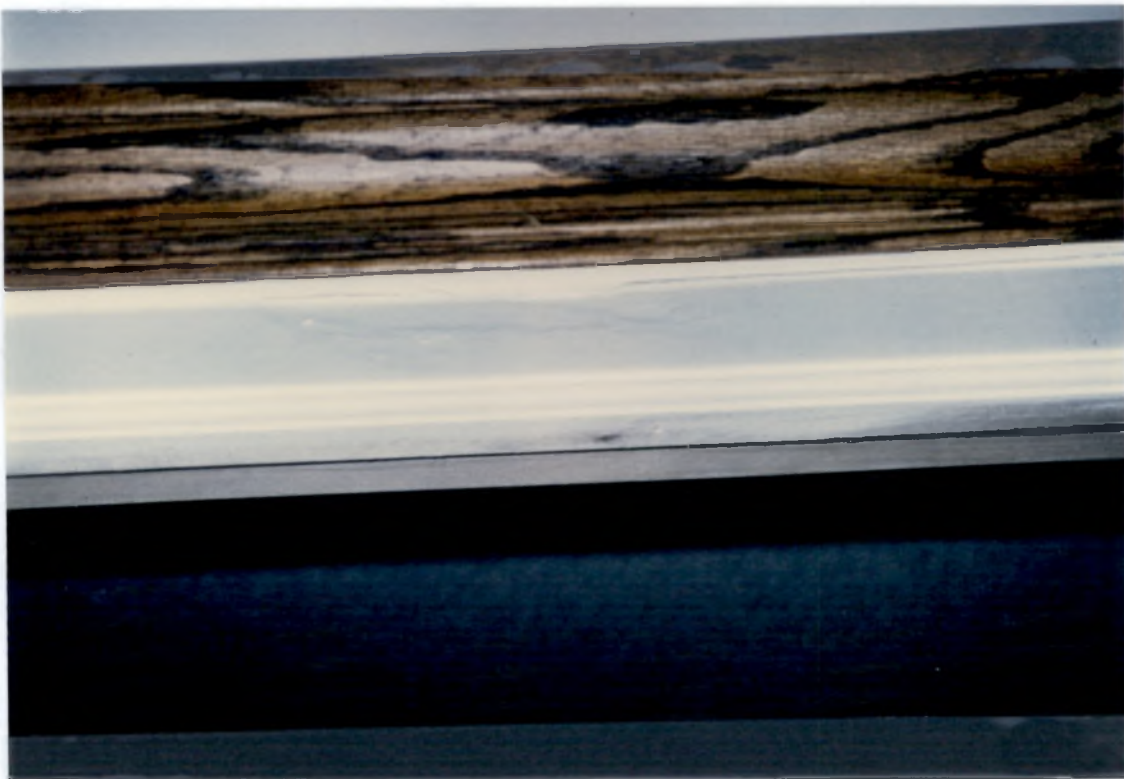
PHOTOGRAPH #2 FOUNDATION WALL DEFECT



PHOTOGRAPH #3 WINDOW/DOOR/SKYLIGHT INSTALLATION DEFECT



PHOTOGRAPH #4 TRIM AND MOULDING DEFECT



PHOTOGRAPH #5 WINDOW/DOOR/SKYLIGHT INSTALLATION DEFECT



PHOTOGRAPH #6 GARAGE FLOOR SLAB DEFECT



PHOTOGRAPH #7 CERAMIC TILE DEFECT



PHOTOGRAPH #8 LEACHING BED DEFECT



3.5.2 Municipality Lists

Figure #41 shows the top 5 Ontario Building Code related components in terms of the number of times they occur.

This list was created by grouping the approximately 1000 claim items surveyed by warranty types, and then by grouping OBC related claims into a hierarchy defined by frequency.

The top 5 OBC Warranty Type construction defects in terms of frequency are:

TOP 5 MOST FREQUENT OBC WARRANTY DEFECTS

1. INSULATION/AIR BARRIER
2. CAULKING/SEALANT
3. GARAGE SLAB
4. SUMP PUMPS
5. ACCESS HATCH

The most common OBC Warranty Type component is "other insulation/air barrier". Missing air/vapour barriers, weather stripping, and insulation are the most frequent complaints. Other common defects include unsealed or uncaulked, and incomplete air barriers. **See photo #9**

The second most common OBC Warranty Type component is "caulking/sealant" which is closely related to "other insulation/air barriers". Unsealed or uncaulked air barriers, and vapour barriers are the most common complaints. **See photo #10**

The third most common OBC Warranty Type component is "slab". Problems with settlement of poured concrete garage slabs represent 100% of this component. **See photo #11**

Missing and improperly installed "sump pumps" represent the fourth most common OBC Warranty Type component. Additional complaints include improper drainage. **See photo #12**

Missing, improperly installed, and too small "access hatch" represent the fifth OBC Warranty Type component. **See photo #13**

Figure #42 shows the top 5 Ontario Building Code related components in terms of cost.

This list was created by analyzing the approximately 1000 claim items surveyed, and then by grouping the components into their warranty types, and then into a hierarchy defined by cost.

The top 5 OBC Warranty Type construction defects in terms of cost are:

TOP 5 MOST COSTLY OBC WARRANTY TYPE DEFECTS

1. GARAGE SLAB
2. SEPTIC TANKS
3. CERAMIC TILES
4. FOUNDATION WALL
5. OTHER FOUNDATION

The most costly OBC Warranty Type component is "slab". Problems with settlement of poured concrete garage slabs represent 100% of this component. **See photo #11**

The second most expensive OBC Warranty Type Component occurred with an improper sized septic tank. **See photo #14**

Improperly installed and not secured "ceramic tiles" was third on the list. Improperly installed subfloors and framing were generally the causes. **See photo #15**

Concrete block, and poured concrete foundation "walls" were fourth in terms of cost. Water leak, leakage, and improperly installed were the complaints. **See photo #16**

The fifth item on the list is a damp/moist/wet poured concrete subfloor. The cause was insufficient granular beneath the slab. **See photo #17**

PHOTOGRAPH #9 INSULATION/AIR BARRIER DEFECT



PHOTOGRAPH #10 CAULKING/SEALANT DEFECT



PHOTOGRAPH #11 GARAGE SLAB DEFECT



PHOTOGRAPH #12 SUMP PUMP



PHOTOGRAPH #13 ACCESS HATCH DEFECT



PHOTOGRAPH #14 SEPTIC TANK



PHOTOGRAPH #15 CERAMIC TILE DEFECT



PHOTOGRAPH #16 FOUNDATION WALL DEFECT



PHOTOGRAPH #17 FOUNDATION FLOOR DEFECT



3.6 ESTIMATED ECONOMIC IMPACT

Of concern to consumers, builders, inspectors and the Ontario New Home Warranty Program, are the large pay outs for built-in defects in Part 9 houses. The costs outlined in this report are representative of ONHWP's repair costs, and only represent a portion of the total cost of construction defects. There are additional costs from repairs done by the consumers, builders, and the trades. Liability costs would have to be added.

In 1992 the portion of the total claim costs borne by ONHWP for house construction defects is estimated at over \$4,000,000.00 excluding administration costs.

Although many houses are built with relatively few problems, problems have been documented in almost all component and location areas. The cost of defects is very expensive. In broad terms the following is an estimate of monies spent:

Defects for Houses - 1992	TOTAL COST <small>(Covering estimated repair costs over the year, excluding administration costs and costs paid by builders, consumers and municipalities)</small>
Foundations	\$ 1.1 million
Interior Finish	\$ 0.8 million
Plumbing	\$0.6 million
Windows/Doors/Skylights	\$0.3 million
Structure	\$0.3 million

The overall combined defects related back to soils is approximately 35% to 40% of all claim items surveyed. This represents an approximately \$1,400,000 to \$1,600,000.00 problem in terms of repair costs per year to ONHWP. The two major contributing factors of soil related defects are major wall cracking (approx. 12%) and settlement of garage slabs (approx. 5%). It is important to consider that the many and varied problems documented in this report are preventable.

4. CONCLUSIONS AND RECOMMENDATIONS

The results of the analysis have revealed a number of conclusions:

- Research on specific "high cost" defects such as adfreezing, settlement, septic tanks, ground water drainage, and components such as slabs, leaching beds and weeping tiles should be continued.
- Adequate resourcing, including increased training of inspectors in small and medium sized municipalities, in the areas of foundations, interior finishes, and plumbing in particular, should be encouraged. As a minimum, large municipalities should retain their current level of resourcing to eliminate escalating occurrences of defects due to inadequate staffing. It is estimated that between 30% to 35% of all claim items surveyed were OBC infraction related.
- Increased training of builders in workmanship areas, small builders in particular, such as interior finish, foundations, and windows/doors/skylights should be encouraged because of the high frequency and cost of claims in these areas.
- As a minimum, ONHWP should re-survey claims files in 1995 in order to survey and monitor the effects of Code requirements, training and outreach initiatives, (such as the various construction manuals, Building Smart series, Regional Office presentations, and Speaking in Code seminars) on problem construction areas (e.g. to examine the impacts of drainage provisions used to reduce basement leaks, as introduced in the 1993 OBC.)

To assist in future data collection and analysis of defect data, the following are recommended:

- Data base collection menus should be modified to reflect the warranty coverage types as outlined in the Ontario New Home Warranties Plan Act to include the extended two-year warranty provisions.
- The data base pull down menu's require modification to include possible construction area scenarios which currently can not be selected, prior to a second survey study.
- Regional Office claim files should be modified to identify the actual warranty coverage, for accurate data collection in the future.

TABLE 1. COMPLAINTS

Adfreezing	Leaning	Too Low
Bouncy	Marked (Burnt, Scratched)	Too Narrow
Bowed/Crooked/Bent	Missing	Too Small
Broken	Moisture	Too Wide
Bulging	Mortar Splash	Uncertified Material
Chemical Attack	Mould/Mildew	Unequal
Chipped	Nail Pops	Uneven Alignment
Clearance	No Cover	Uneven Colour
Cold Surfaces	No Water/Low Pressure	Uneven Fill
Compaction	Noisy	Unpaved
Condensation	Non-continuous	Unprotected
Contaminated Soil	Not According To Plan	Unsealed or
Corrosion	Not Adequately Founded	Uncaulked
Cracked	Not By Code	Unightly
Damaged	Not Enough	Uplift
Damp/Moist/Wet	Not Finished	Warped
Debris	Not Grounded	Water Leak
Delamination	Not Secured	Water Ponding
Dented	Not Square/Plumb/Level	Weak
Dirty	Odour	Wind Damage
Drafts	Open Joints	Wrong Colour/Pattern
Efflorescence	Orientation	Yellowing
Erosion	Overflow	
Failed	Peeling Off	
Failure	Plugged/Blocked	
Flooding	Poor Finish	
Frame Crooked	Poor Material	
Frost Heave	Poor Workmanship	
Frosting	Poorly Located	
Ground Water	Rough Finish	
Hazardous Gases, Dusts, or Liquids	Seams Showing	
High Maintenance	Services Not Hooked Up	
Ice Damming	Settlement	
Improper Grading	Shrinkage	
Improper Size	Slip	
Improperly Installed	Soft	
Improperly Located	Soft Spots	
Improperly Supported	Spalling	
Impure	Split	
Inaccessible	Squeaky	
Inadequate Design	Sticking	
Incomplete	Substitution (Specify)	
Incorrect Mounting	Tie-Rod Leak	
Inoperable	Too Cold	
Insufficient	Too Dry	
Lack of Drainage	Too High	
Leaching	Too Hot	
Leakage	Too Large	
	Too Loud	

TABLE 2. LOCATION WITHIN THE CONSTRUCTION SEQUENCE

1	GROUND AND SUBSOIL	6	CRAWL SPACES & ROOF SPACES
	Clay		Non-Accessible
	Sand		Accessible
	Peat		Heated
	Silt		Unheated
	Bedrock		Other (Specify)
	Permafrost		Unknown
	Fill (unknown type)		
	Other (Specify)	7	INTERIOR FINISH
	Unknown Type		Living Room
2	FOUNDATION		Dining Room
	Poured Concrete		Family Room
	Reinforced Concrete		Kitchen
	Block		Master Bedroom
	Preserved Wood		Bedroom
	Reinforced Concrete Against Lagging		Ensuite Bathroom
	Piles/Caisson		Bathroom
	Precast		Stairway
	Other (Specify)		Laundry Area
	Unknown Type		Basement/Cellar
3	STRUCTURE		Attic
	Wood Frame		Closet/Storage Room
	Reinforced Concrete		Passage/Hallway
	Loadbearing Masonry		Main Entrance or Vestibule
	Precast Modular		Mud Room
	Steel Frame		Solarium
	Poured Concrete		Locker Room
	Other (Specify)		Storage Room
	Unknown Type		Garage
4	ROOF		Other (Specify)
	Normal Slope Roof >2:1	8	EXTERIOR FINISH
	Low Slope Roof < 2:1		
	Flat Roof		
	Other (Specify)		
5	INSULATION, AIR & VAPOUR BARRIERS		
	Air Barrier		
	Vapour Barrier		
	Insulation		
	Weather Stripping		
	Other (Specify)		
	Unknown		

9 ROOM DIMENSIONS

Living Room
Dining Room
Family Room
Kitchen
Master Bedroom
Bedroom
Ensuite Bathroom
Bathroom
Stairway
Laundry Area
Basement/Cellar
Attic
Closet/Storage Room
Passage/Hallway
Main Entrance or Vestibule
Mud Room
Solarium
Locker Room
Storage Room
Garage
Other (Specify)
Unknown Room

10 STAIRS AND HANDRAILS

Interior Stairs
Exterior Stairs
Straight Stairs
Spiral Stairs
Curved Stairs
Exit Stairs
Stairwells
Precast Unit
Poured in Place Unit
Decks
Landings
Ramps
Special Elevating Devices
Other (Specify)
Unknown

11 WINDOWS DOORS & SKYLIGHTS

Single Hung Windows
Casement Windows
Sliding Windows
Basement Windows
Solid Doors

11 WINDOWS (Contd.)

Insulated Doors
Skylights
Garage Doors
Other (Specify)

12 FIRE & SOUND PROTECTION

Floor Rating
Wall Rating
Access/Exits
Protection of Openings
Fire Fighting Provisions
Firestopping
Door Self-Closer
Fire Dampers
Smoke Detectors
Equipment (Specify)
Other (Specify)
Unknown

13 MECHANICAL

Gas
Electric
Oil
Wood
Forced Air
Hydronic
Radiant Heating
Air Conditioning
Mechanical Ventilation
Natural Ventilation
Wood Stove/Fireplace
Other (Specify)

14 PLUMBING

Kitchen
Laundry Facilities
Shower Room
Ensuite Bathroom
Main Bathroom
Washroom
Basement
Pool Equipment Room
Well
Water Supply
Ground Water Drainage
Storm Water Drainage
Municipal Sewage Lines
Septic Tank System
Other (Specify)

15 ELECTRICAL

16 SITEWORK

TABLE 3. COMPONENTS WITHIN THE CONSTRUCTION SEQUENCE

1	GROUND AND SUBSOIL	3	STRUCTURE (Contd.)
	Site		Column Capital
	Floor		Column Shear Pan
	Footing		Shear Wall
	Wall		Truss Plate
	Slab		Studs
	Retaining Wall		Lintels
	Drainage		Headers
	Fill		Joist Hanger
2	FOUNDATION		Bridging
	Footing		Steel
	Floor		Wood
	Wall		Concrete
	Slab		Fasteners (bolts & nails)
	Grade Beam		Slab on Grade
	Column Pad		Granular Material
	Mortar Joint		Subfloor
	Tie-Rod		Trusses
	Welded Wire Mesh		Ties
	Reinforcing Steel	4	ROOF
	Rebar Accessory		Shingles
	Expansion Joint		Low Slope Asphalt Shingles
	Cold Pour Joint		Normal Slope Asphalt Shingles
	Construction Joint		Wood Shingles
	Beam Pocket		Roofing Tiles
	Pillaster		Steel
	Closure Strip		Clay
	Anchor Bolts		Built-in Roofing
	Piling Cap		Single Ply Assemblies
	Dampproofing		Inverted Roof Membrane
	Waterproofing		Ballast
	Sleeve		Roof Flashing
	Vent		Eavestrough
3	STRUCTURE		Downspout/rain Water Leaders
	Floors		Valleys
	Walls		Ridges
	Ceiling		Deck Primer
	Roof		Vents
	Beam		Sheathing
	Columns		Eave Protection
	Joists		Rolled Roofing
	Footings		Starter Strip
	Beam Pocket		Shingle Moulding
	Bearing Pad		Trusses
	Column Pad		Collar Ties
			Ribbon Ties
			Caulking

5 INSULATION, AIR & VAPOUR BARRIERS

Ducts and Pipes
Batt
Rigid
Loose-fill
Rock Wool
Foam Plastic
Sprayed Applied
Caulking/Sealant
Gasket Material

6 CRAWL SPACES & ROOF SPACES

Access Hatch
Vents

7 INTERIOR FINISH

Drywall
Plaster
Paint/Varnish
Carpet
Tiles
Trim & Mouldings
Cabinet/Counters
Mirrors
Wood
Vinyl
Marble
Ceramic
Stucco/Stipple
Concrete
Grout
Wall Paper
Caulking
Hardwood Floor

8 EXTERIOR FINISH

Precast Panels
Glass Curtain Wall
Insulated Panel
Roof Overhang
Brick (Type Unknown)
Clay Brick
Calcite Brick
Stone
Wood Siding
Vinyl Siding

8 EXTERIOR FINISH (Contd.)

Metal Siding
Stucco/Wood Battens
Acrylic Stucco
Stucco Lath
Architectural Block
Caulking
Mortar Joints
Fasteners & Ties
Lintels
Weep Holes
Vents
Soffit
Flashing
Fascia
Glass Panels/Trims
Grilles

9 ROOM DIMENSIONS

10 STAIRS AND HANDRAILS

Staircase
Handrail/Railing
Stringer
Tread
Riser
Nosing
Winder
Finish
Ballustrade\Guard
Handrail Hardware
Structural Support
Wood
Concrete
Aluminum
Wrought Iron
Steel
Glass Panel
Fibreglass
Elevator Controls
Elevator Doors
Other (Specify)
Unknown

**11 WINDOWS & DOORS &
SKYLIGHTS**

Metal
Wood
Vinyl (PVC)
Plastic
Insulating Glass Units (Fixed)
Glass
Frame
Sill
Threshold
Caulking
Flashing
Weatherstripping
Bi-fold
Screen
Mirror
Sidelight
Revolving Doors
Fire-rated
Hardware
Accessories (Shutters, Awnings, etc.)
Other (Specify)
Unknown
Siding
Door (Fixed)

12 FIRE & SOUND PROTECTION

13 MECHANICAL

Chimney
Thermostat Control
Ductwork
Chiller
Furnace/Boiler
Fan
Damper
Vents
Grilles/Diffusers
Supply Air/Piping
Return Air/Piping
Combustion Air
Compressor
Condenser
Chimney Flashing
Heat Exchanger
Humidifier
Hed Pump
Electronic Air Cleaner

14 PLUMBING

Pipe & Fittings
Pump/Pressure System
Vent Piping
Sink
Bathtub
Drains All Types
Taps
Water Closet
Shower Stall & Component
Sauna
Whirlpool
Laundry Tub
Trap
Valves
Hose Bibs
Catchbasin
Well Cap
Cleanout
Sump Pit
Sump Pumps
Weeping Tile
Leaching Bed
Septic Tank
Backflow Preventer
Water Meter
Roof Vent Flashing
Hot Water Tank

15 ELECTRICAL

Receptacle/Outlet
Circuit Breaker/Fuse
Switch
Light Fixtures
Panel
Exit Light
Wiring
Door Opener
Ground Fault Indicator
Central Controls
Transformer
Illumination Levels
Security System

Location on Lot
Setback Dimensions
Sodding
Grading
Landscape Materials
Driveway
Traffic Markings
Parking Barriers
Curbs
Site Lighting & Standards
Sidewalks
Garbage Storage Area
Building Services
Pool (Indoor or Outdoor)
Outdoor Parking Areas

TABLE 4. CAUSES

Poor Materials
Poor Construction
Poor Workmanship
Inadequate Design/Detail
Not According to Plan
Not by Code

TABLE 5. WARRANTY TYPES

Material

MSD

OBC

Substitution

Water Penetration

Workmanship

APPENDIX 'A'
TERMS OF REFERENCE

FIGURE 1

CM.H.C / O.N.H.W.P.

Office: BRAMPTON	Builder Information
Wrnty Rep: John Doe	Builder #: 54321
City: Brampton	Regstn Date: 01/01/93
Size: 100,000	Name: ABC CONSTRUCTION
Enrolment #: 123456	Houses Built: 25
Home Owner: Smith	No. of Claims: 1
Total Cost: \$ 10,000.00	Date of Possession: 01/01/93









New Claim **Claim Items** **Exit** **Help**  

FIGURE 2

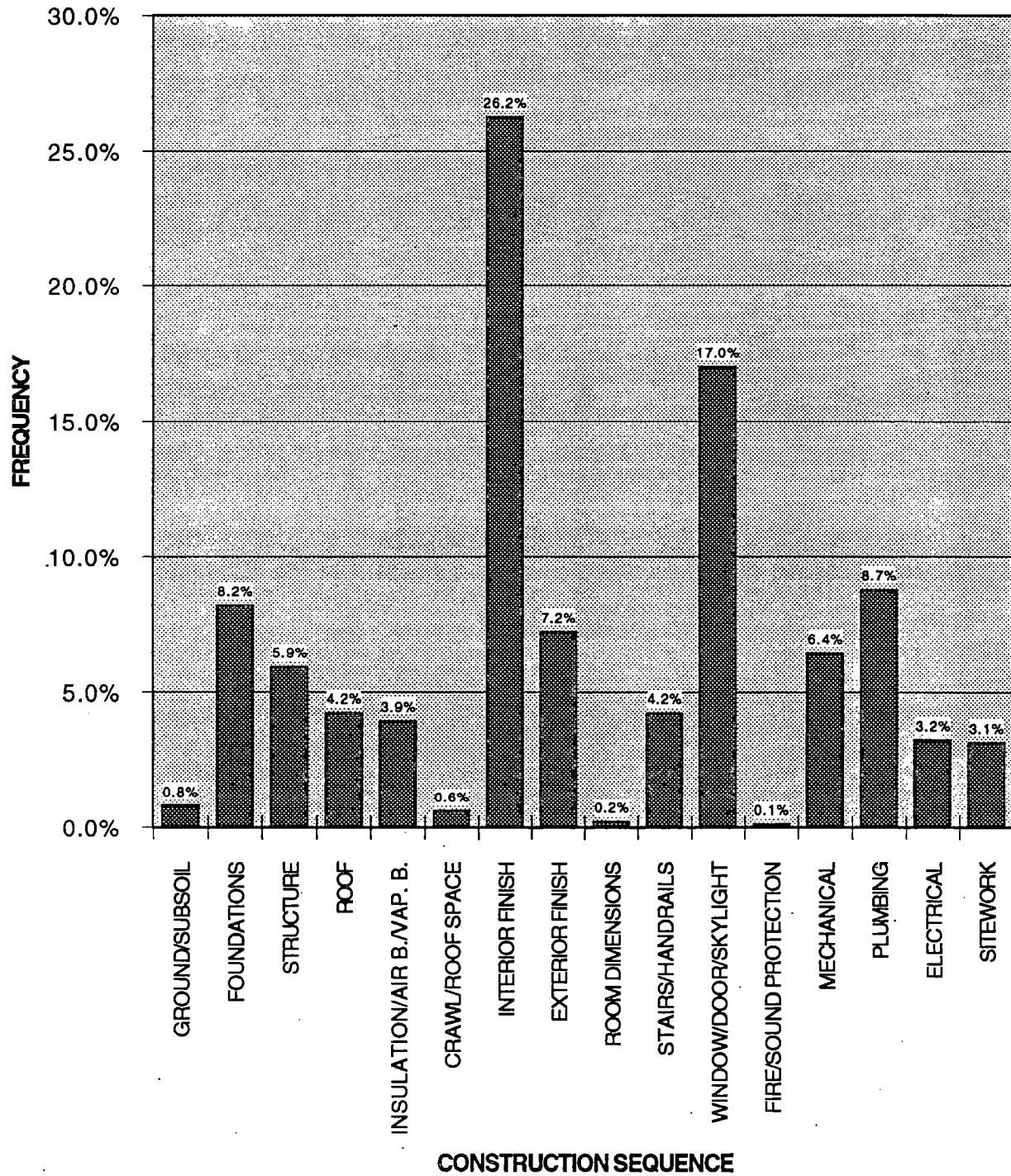
Owner: Smith	Enrolment #: 123456
Wrnty Type: WORKMANSHIP	Cost: \$ 10,000.00
Complaint: CRACKED	Cause: POOR WORKMANSHIP
	
Location Subgroup: Int Finish	Details
Type: KITCHEN	Component: TILES
	

1 **Next Claim** **Done** **Cancel** **Help**  

ONHWP CONSTRUCTION DEFECTS

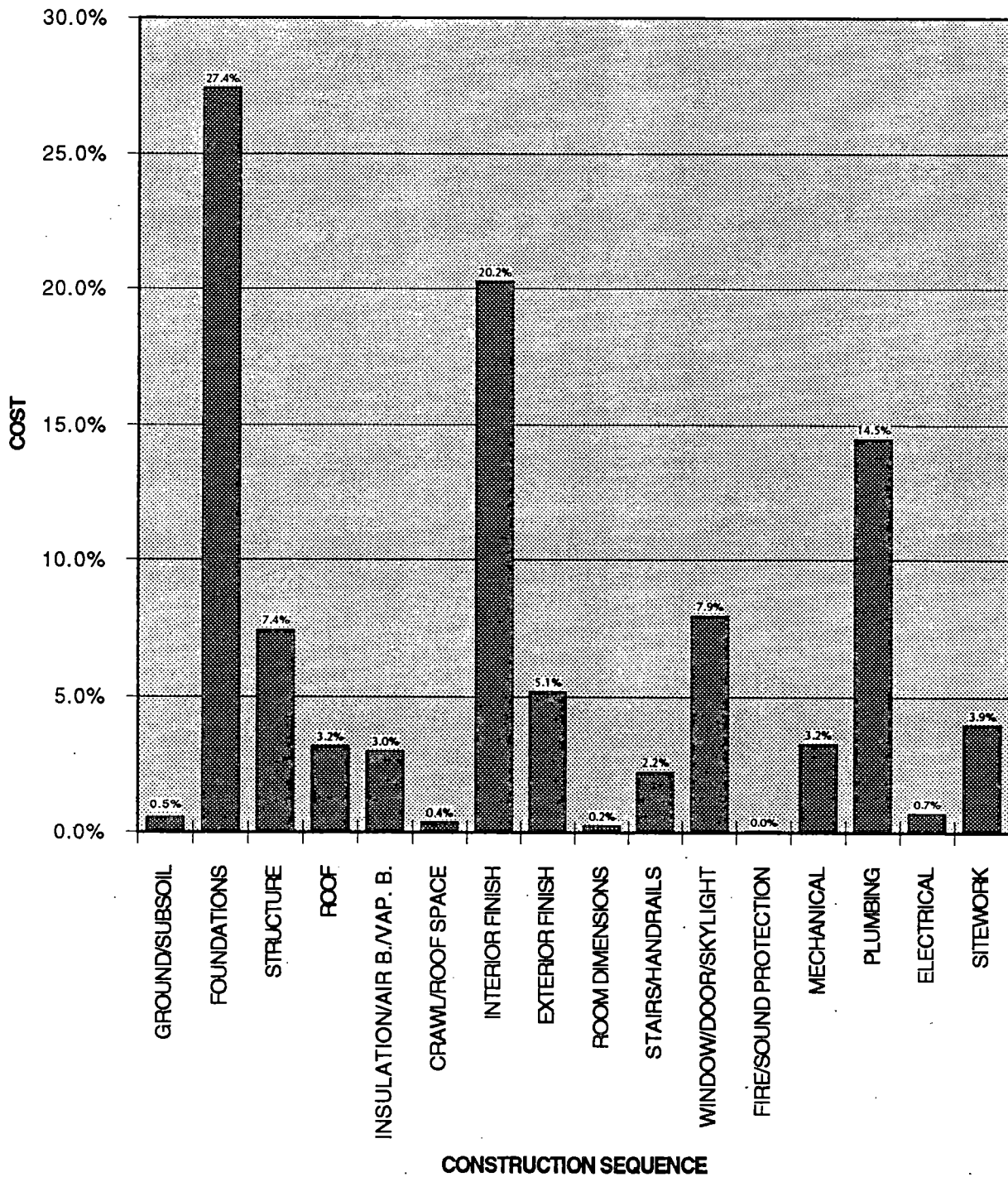
FIGURE #3

FREQUENCY OF CLAIMS BY CONSTRUCTION SEQUENCE



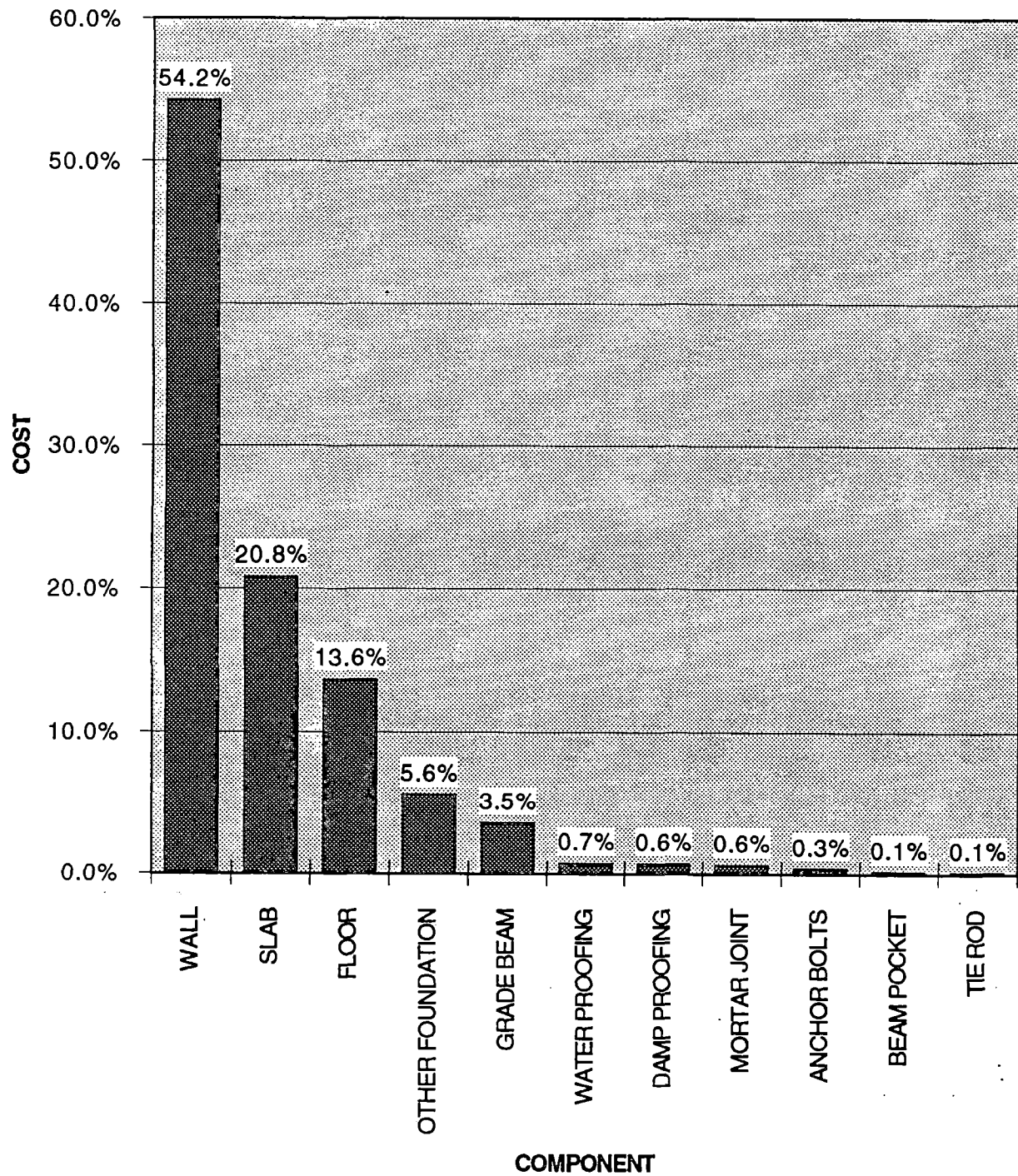
(BASED ON APPROX. 1000 CLAIM ITEMS)

CLAIMS COSTS WITHIN CONSTRUCTION SEQUENCE

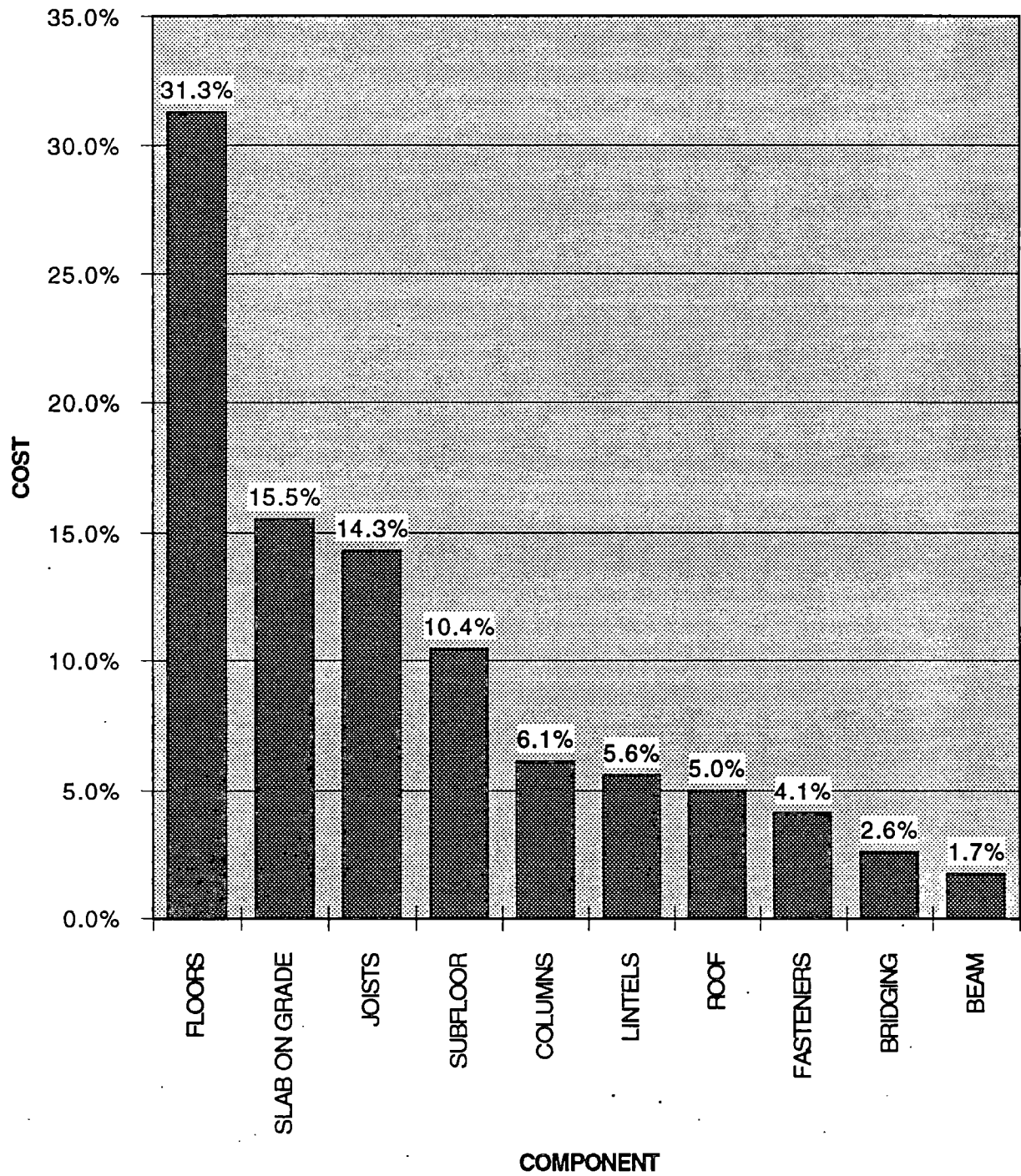


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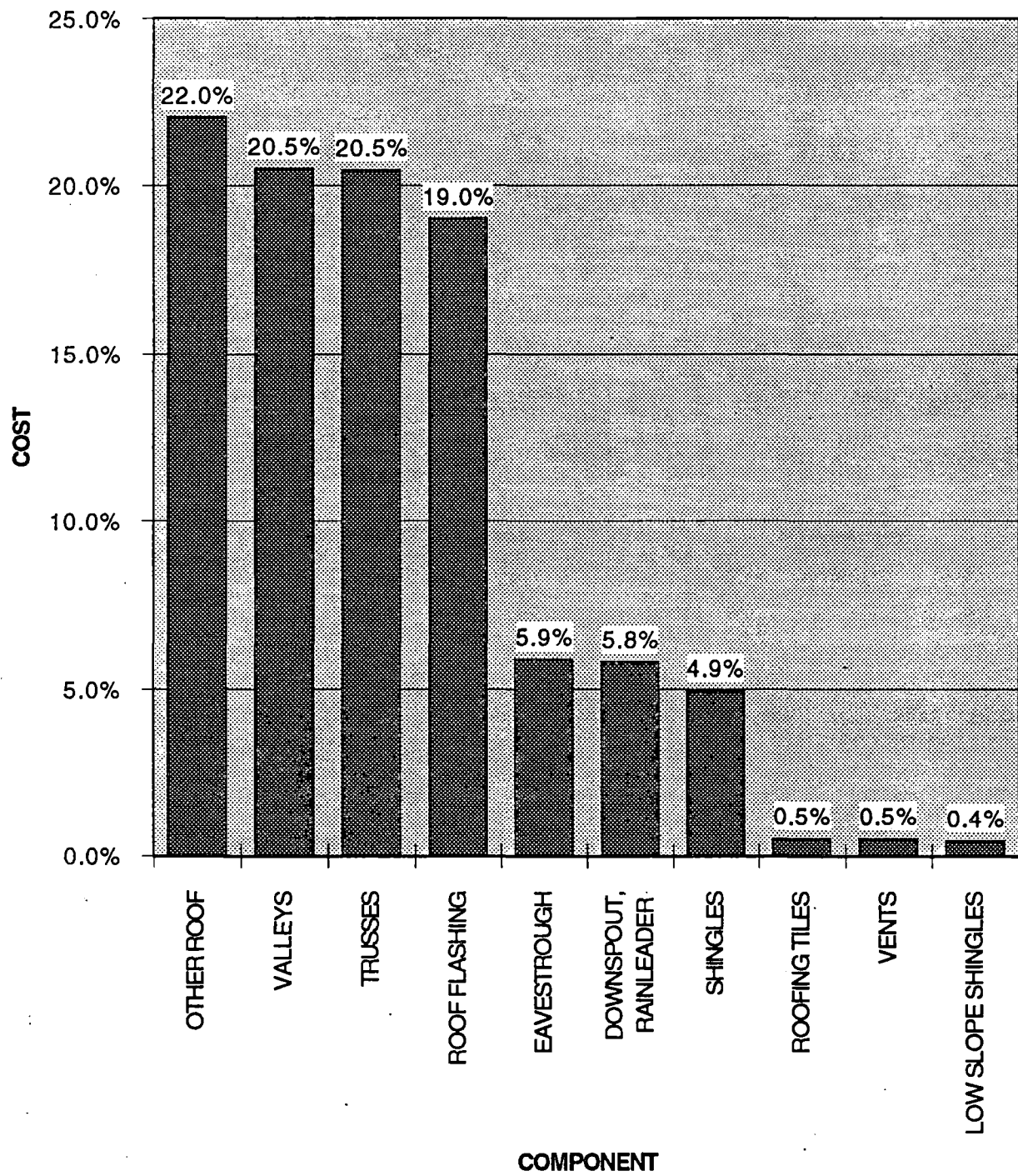
CLAIMS COSTS FOR FOUNDATION DEFECTS



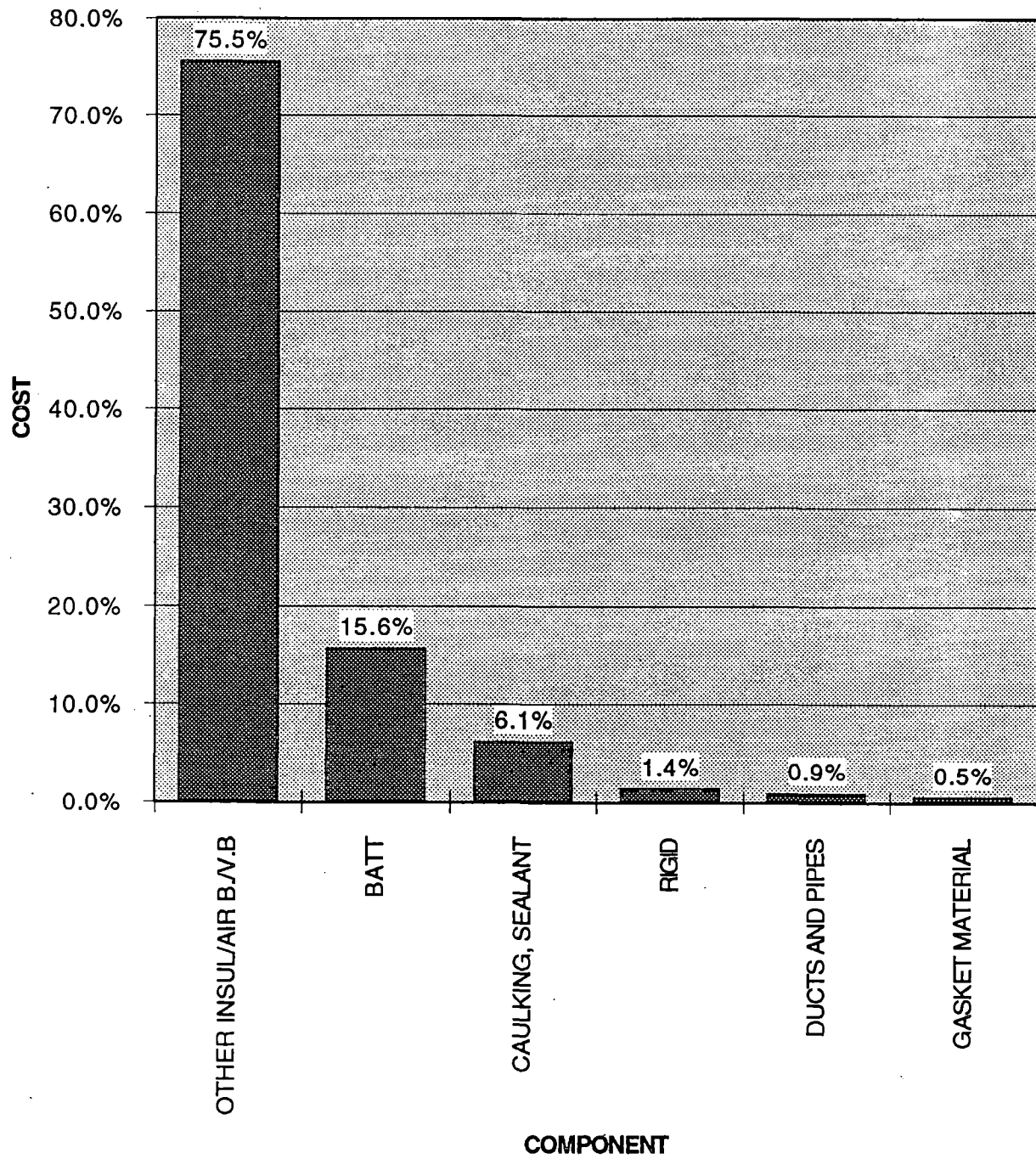
CLAIMS COSTS FOR STRUCTURE DEFECTS



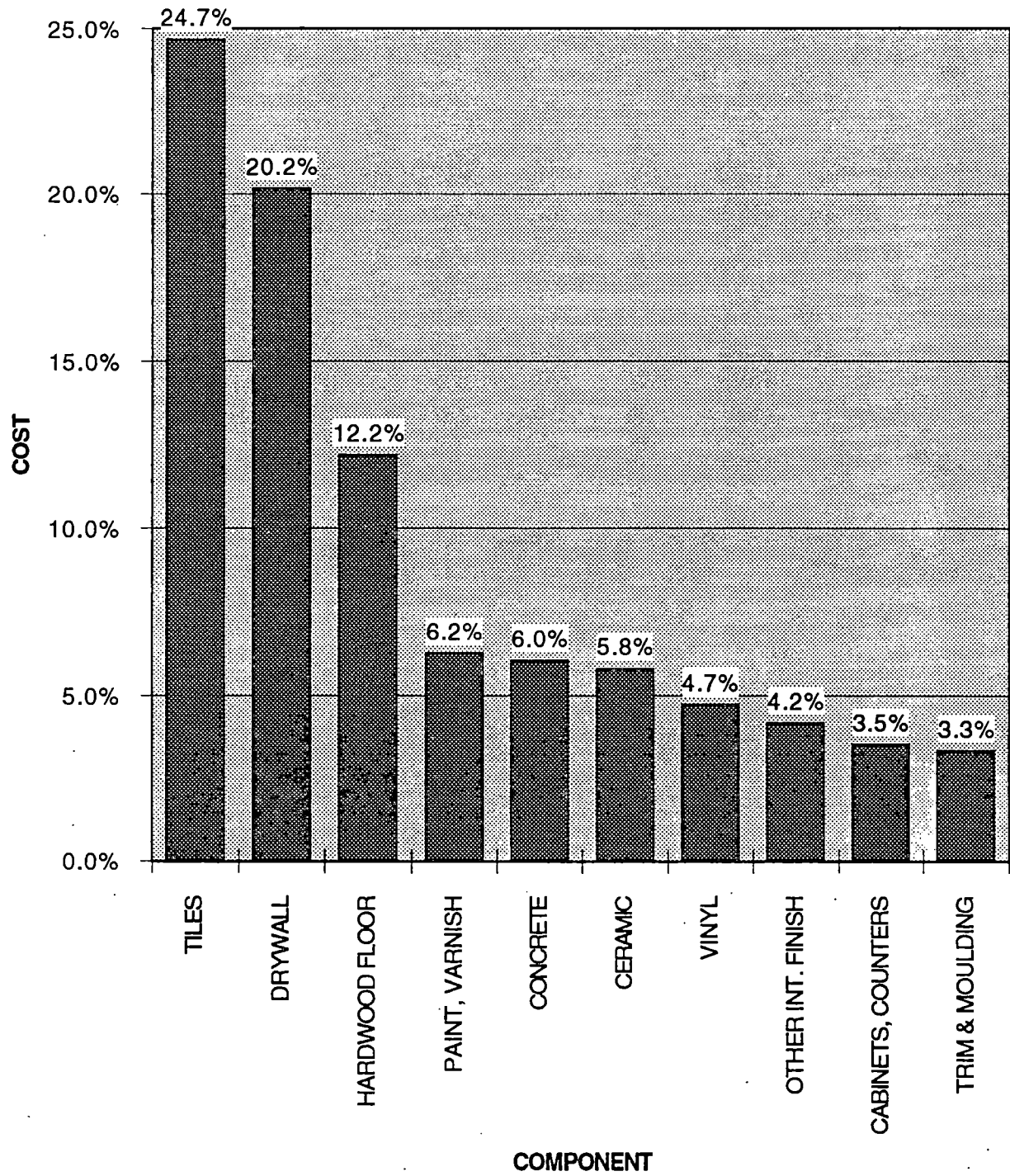
CLAIMS COSTS FOR ROOF DEFECTS



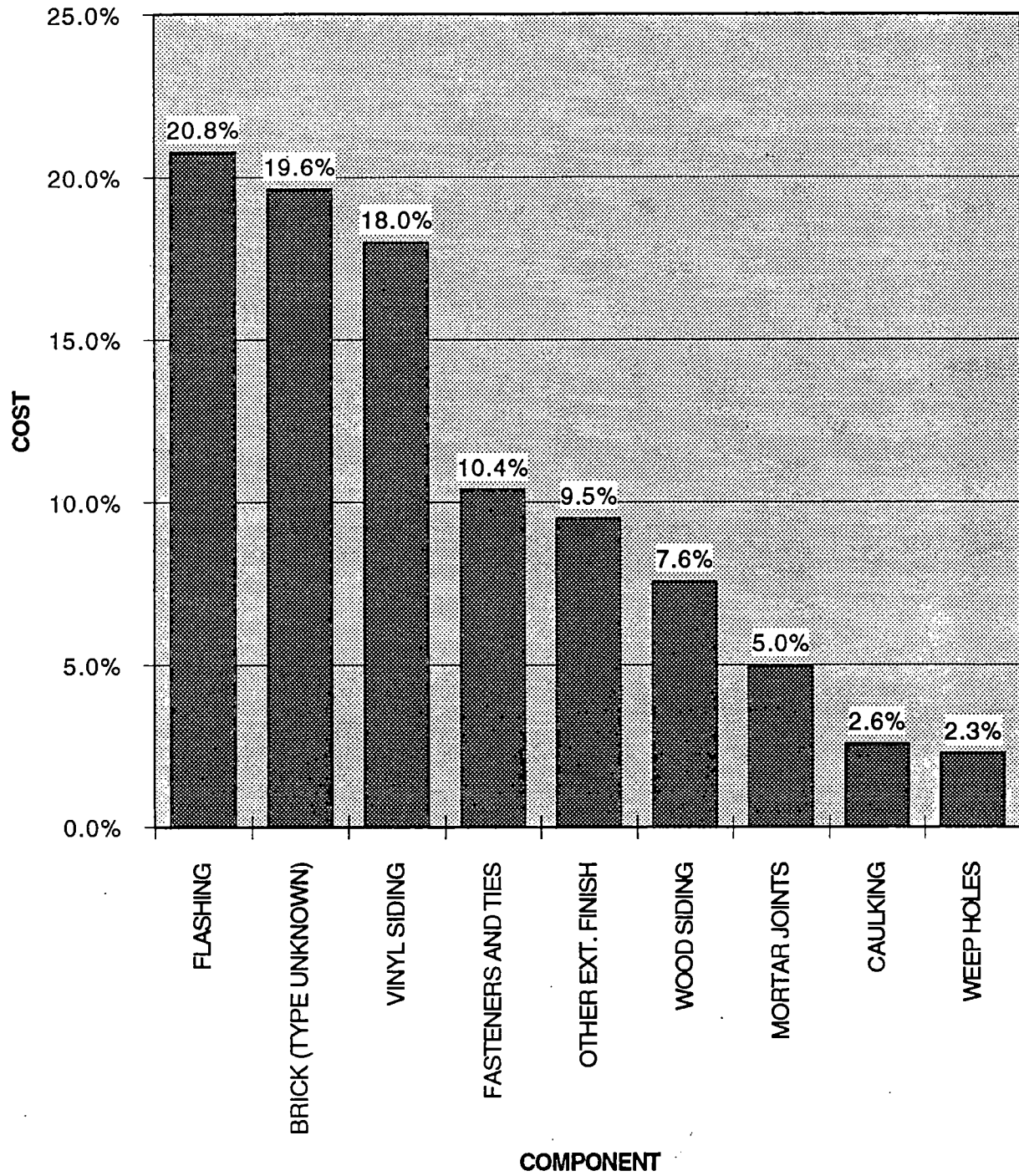
CLAIMS COSTS FOR INSULATION/AIR BARRIER/ VAPOUR BARRIER DEFECTS



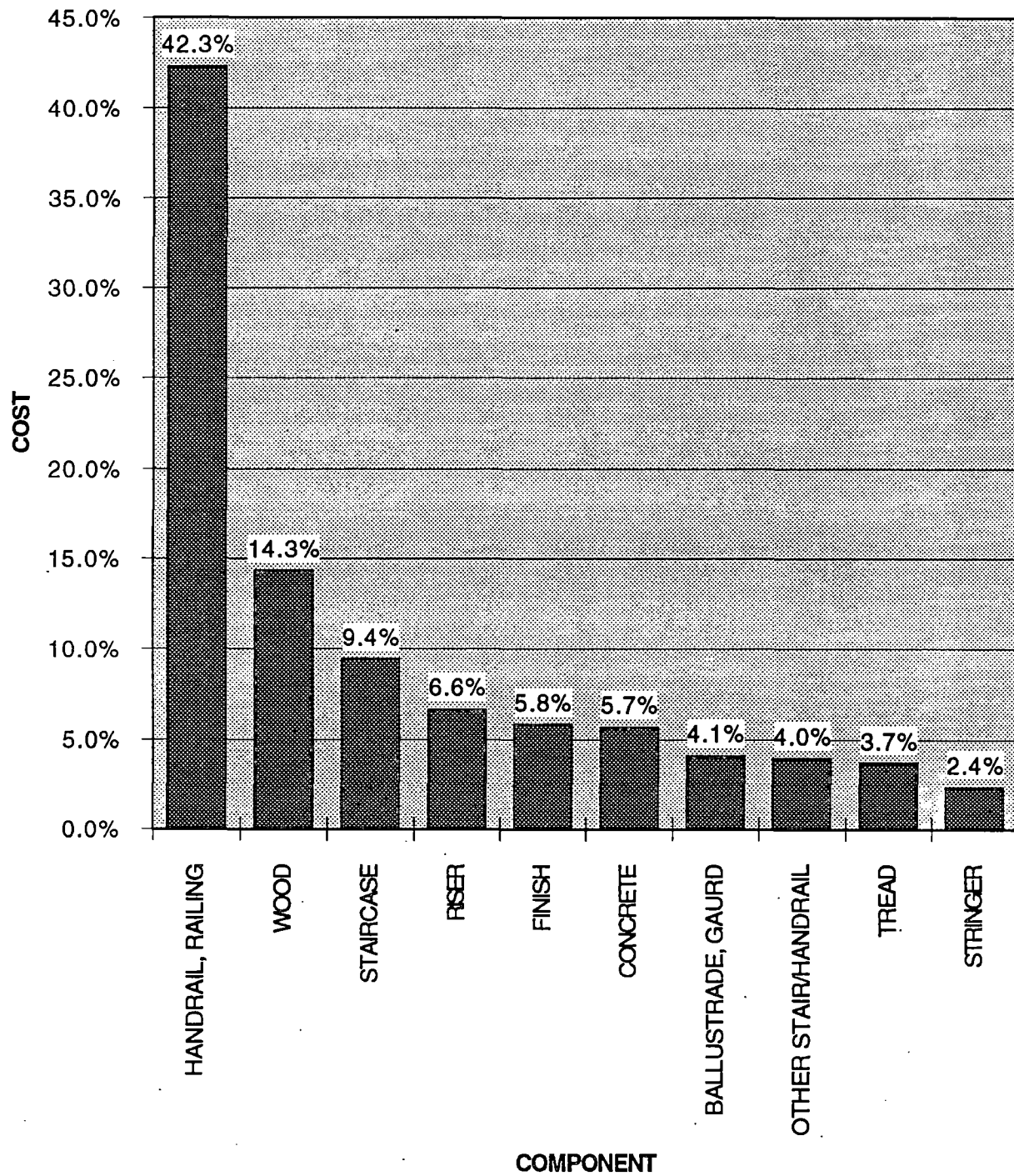
CLAIMS COSTS FOR INTERIOR FINISH DEFECTS



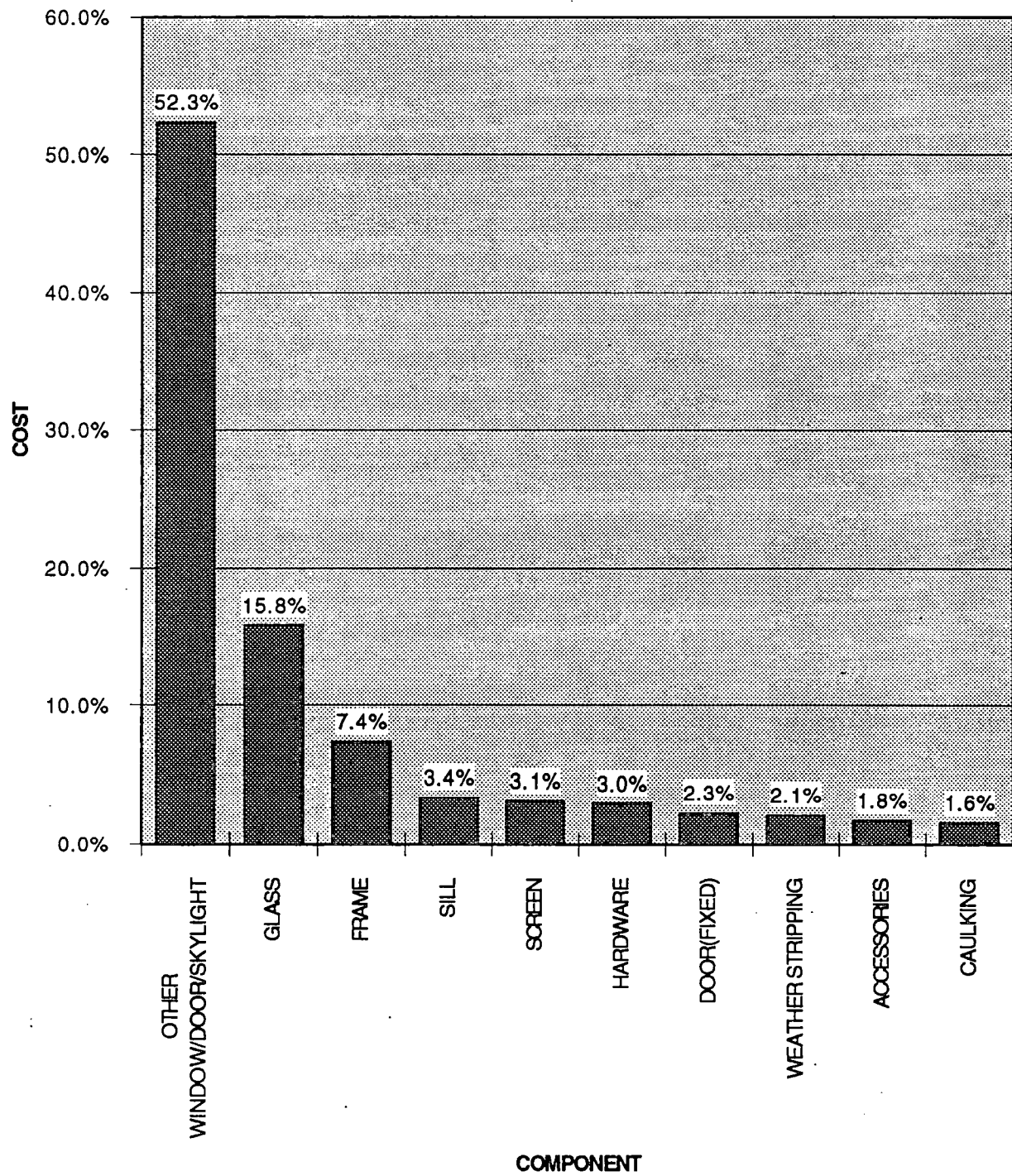
CLAIMS COSTS FOR EXTERIOR FINISH DEFECTS



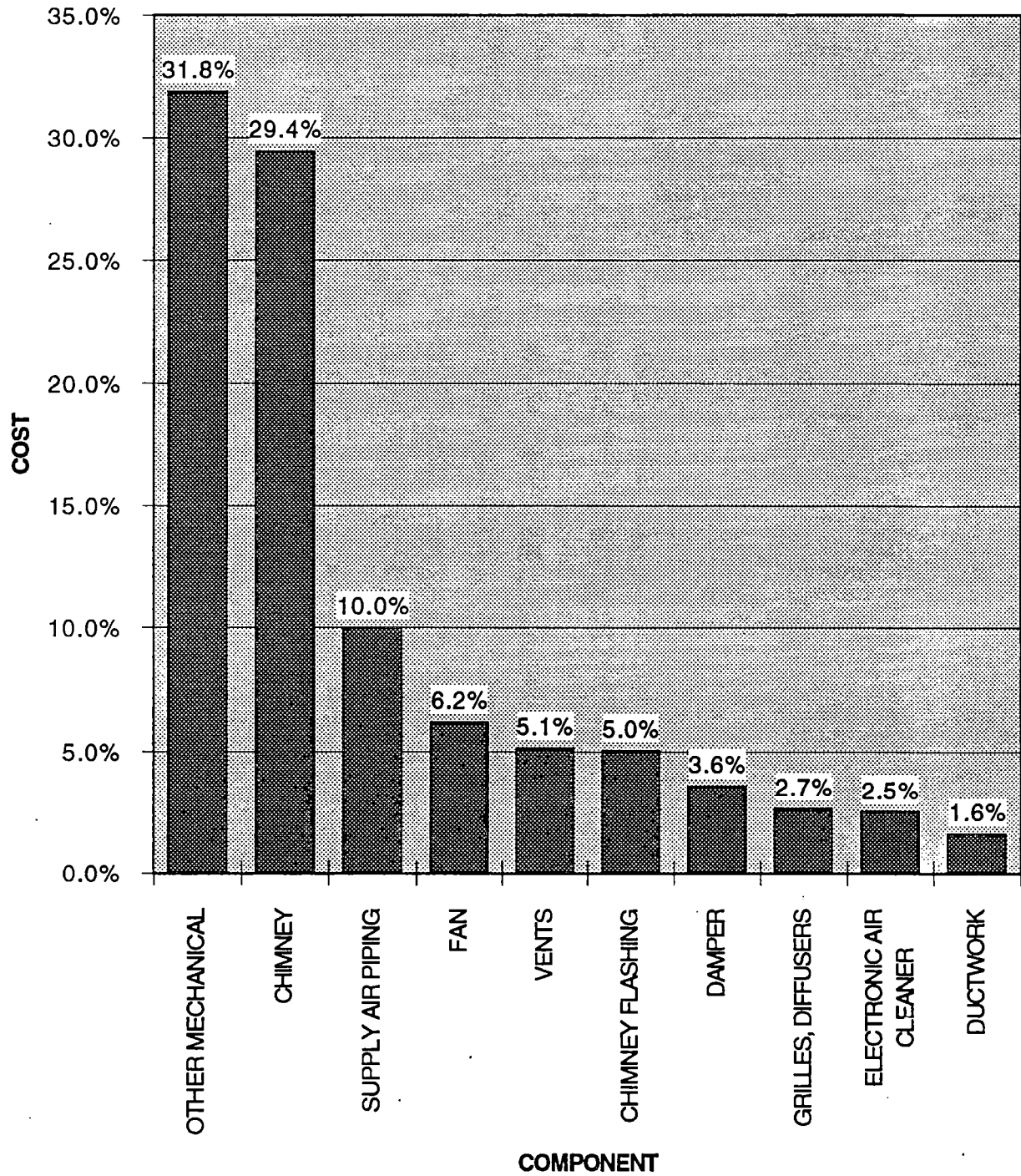
CLAIMS COSTS FOR STAIRS & HANDRAIL DEFECTS



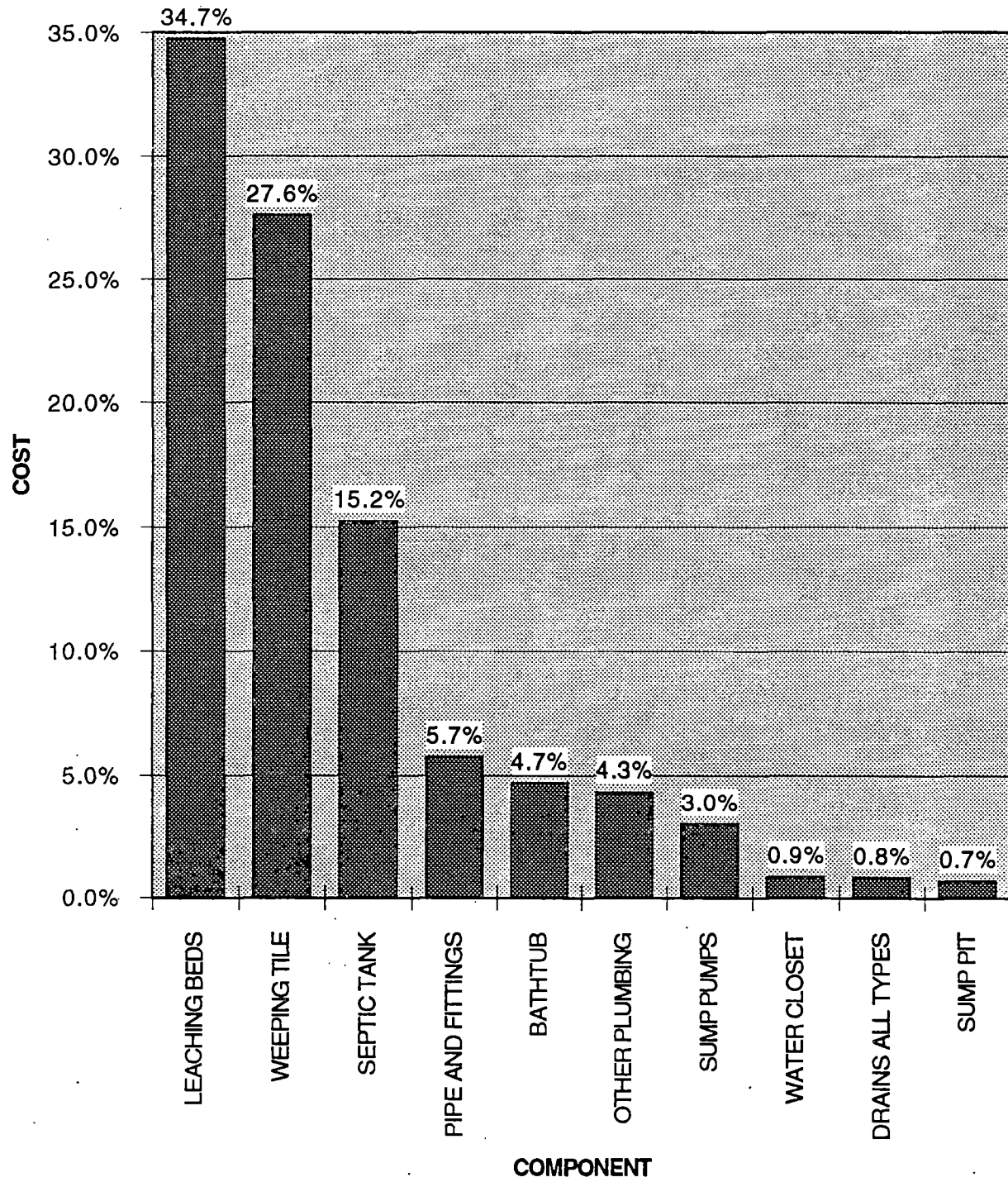
CLAIMS COSTS FOR WINDOWS/ DOORS/ SKYLIGHT DEFECTS



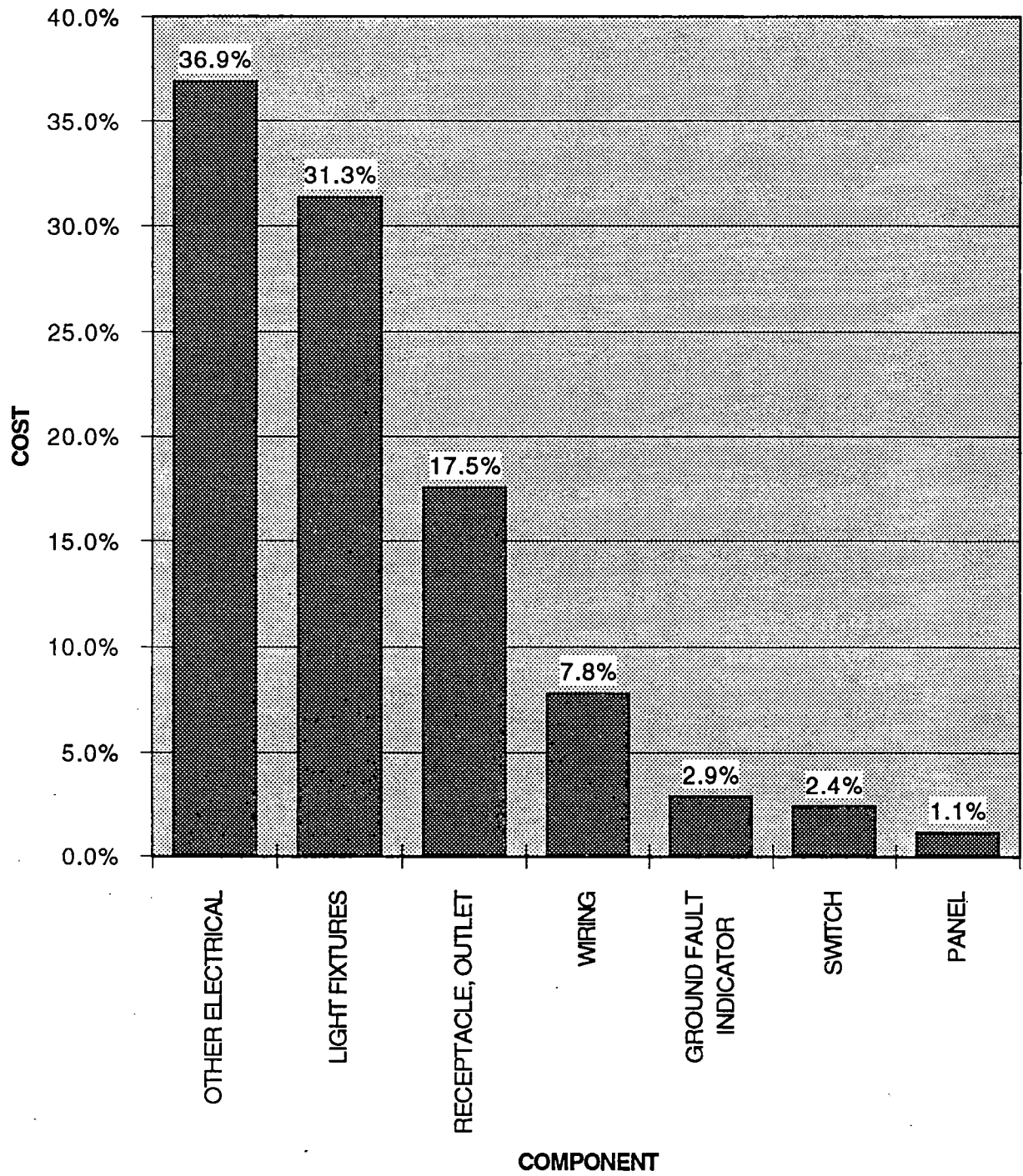
CLAIMS COSTS FOR MECHANICAL DEFECTS



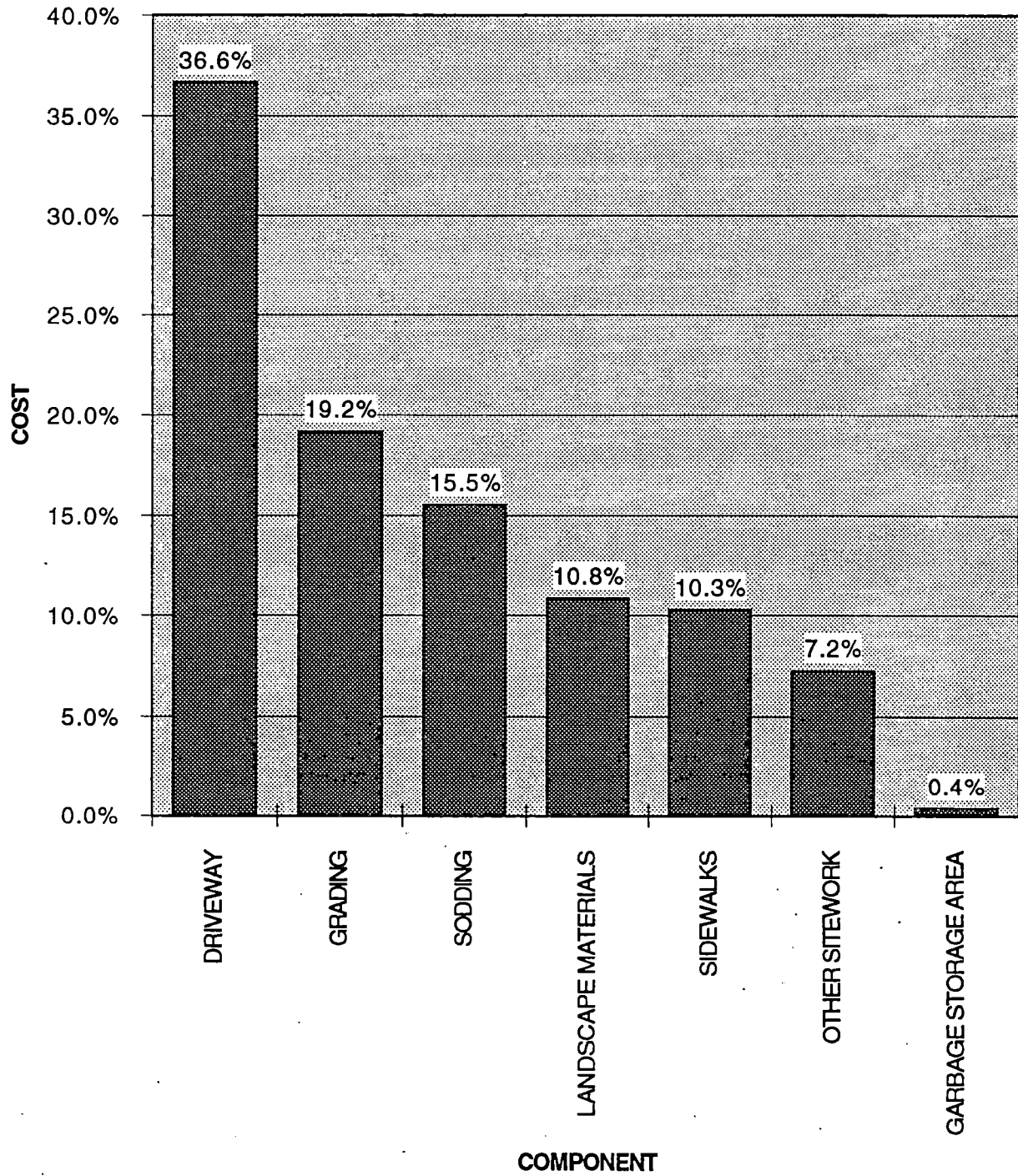
CLAIMS COSTS FOR PLUMBING DEFECTS



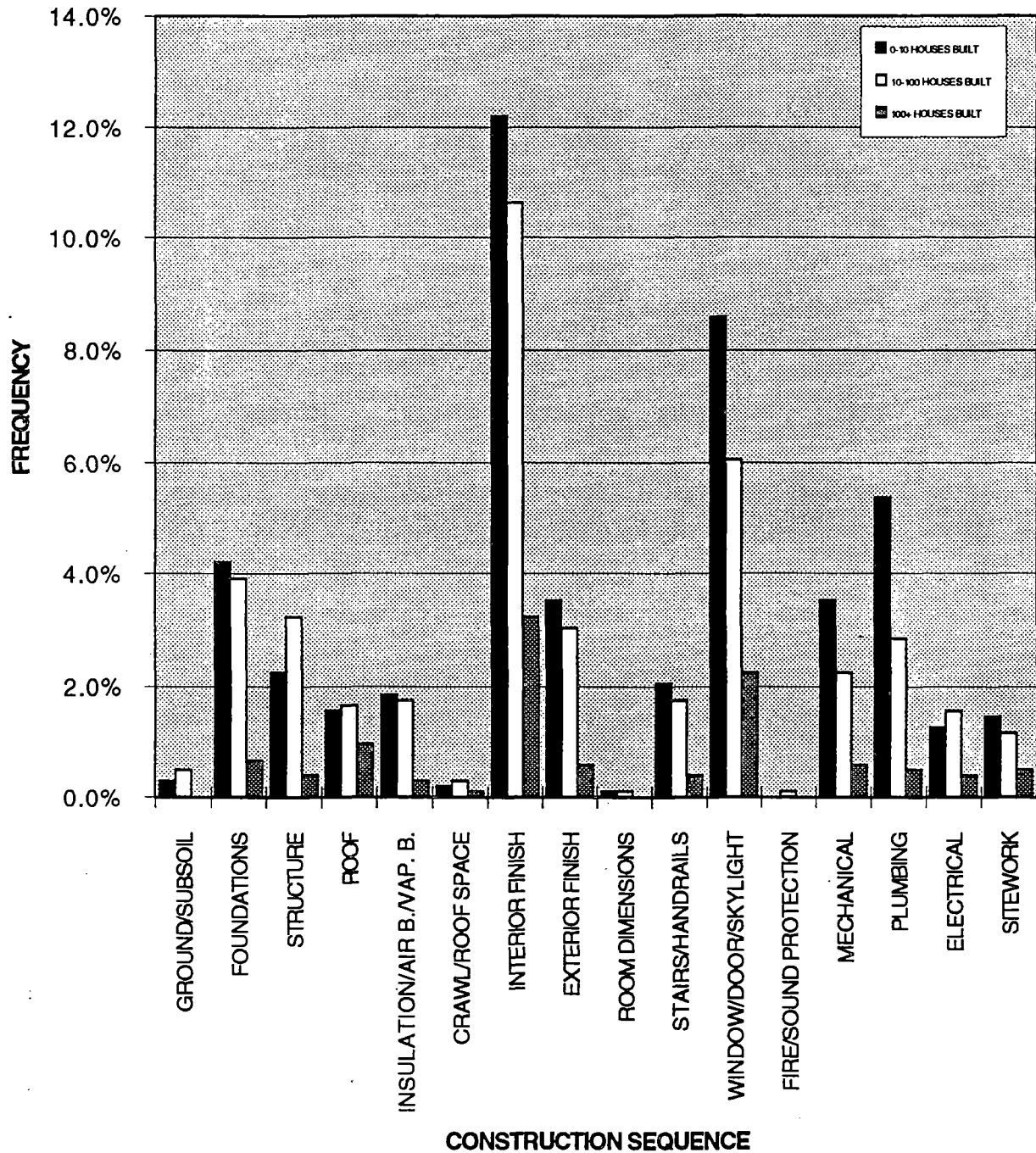
CLAIMS COSTS FOR ELECTRICAL DEFECTS



CLAIMS COSTS FOR SITEWORK DEFECTS

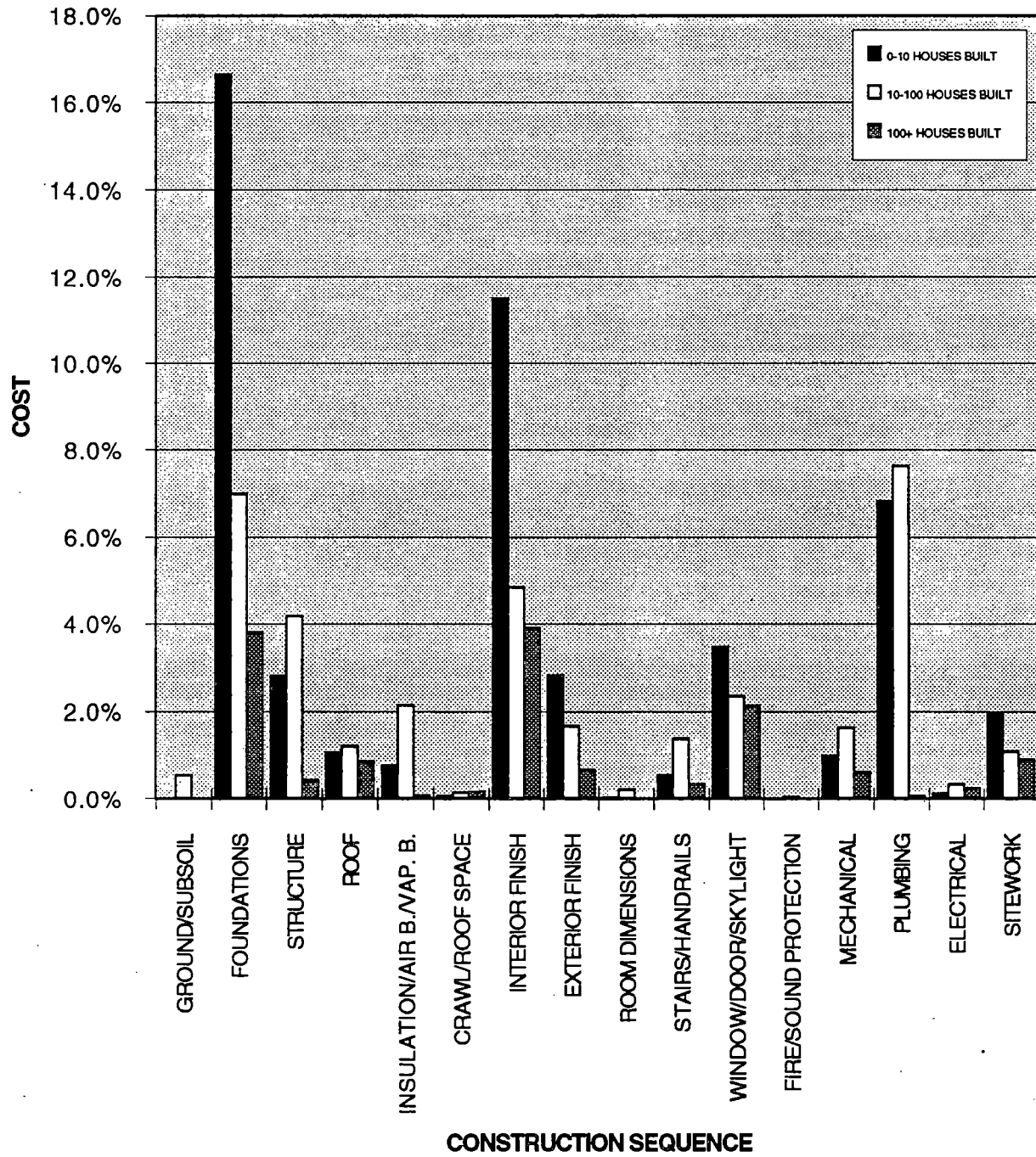


FREQUENCY OF CLAIMS WITHIN CONSTRUCTION SEQUENCE BY BUILDER SIZE



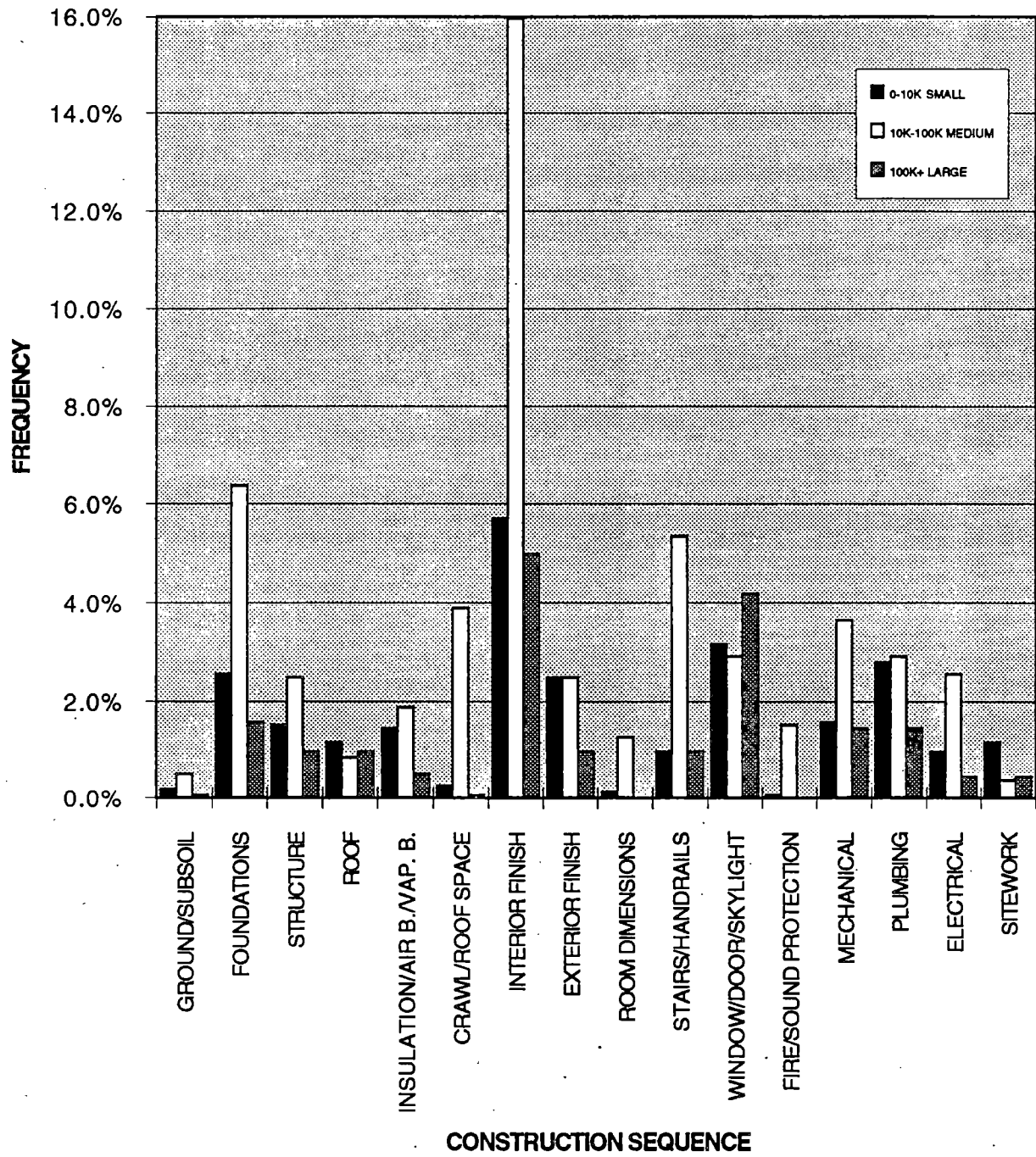
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CLAIMS COSTS WITHIN CONSTRUCTION SEQUENCE BY BUILDER SIZE



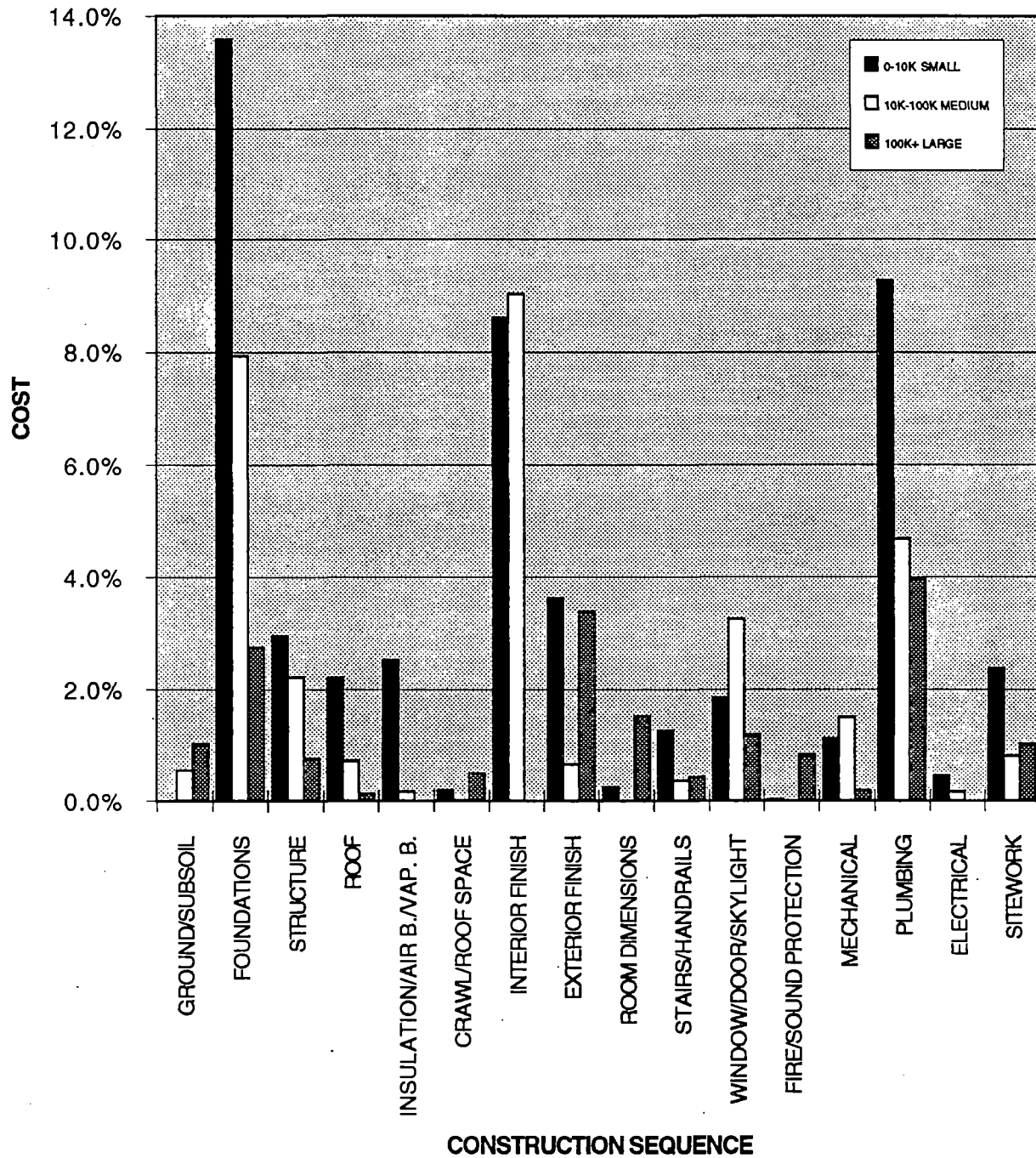
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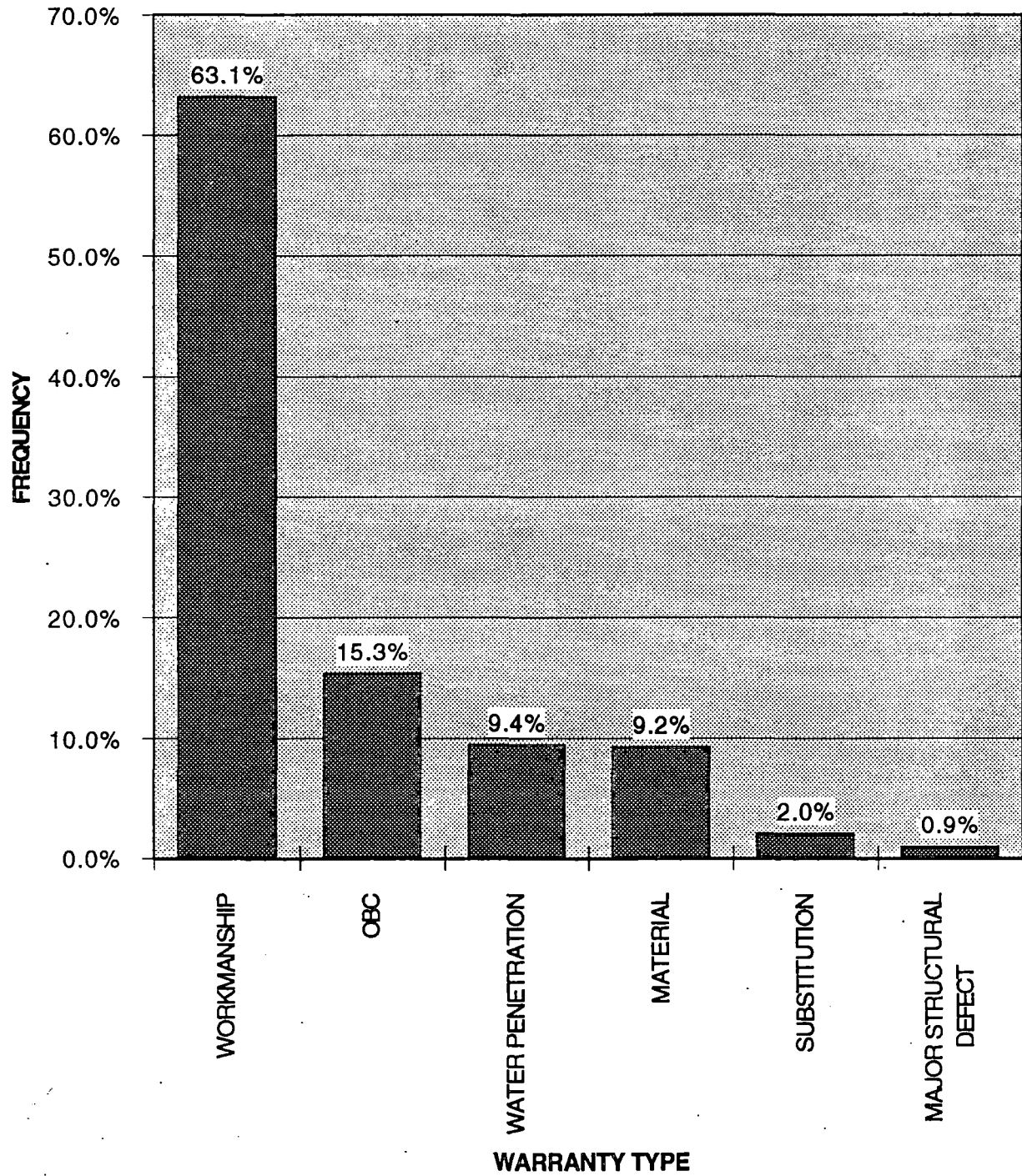
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CLAIMS COSTS WITHIN CONSTRUCTION SEQUENCE BY MUNICIPALITY SIZE

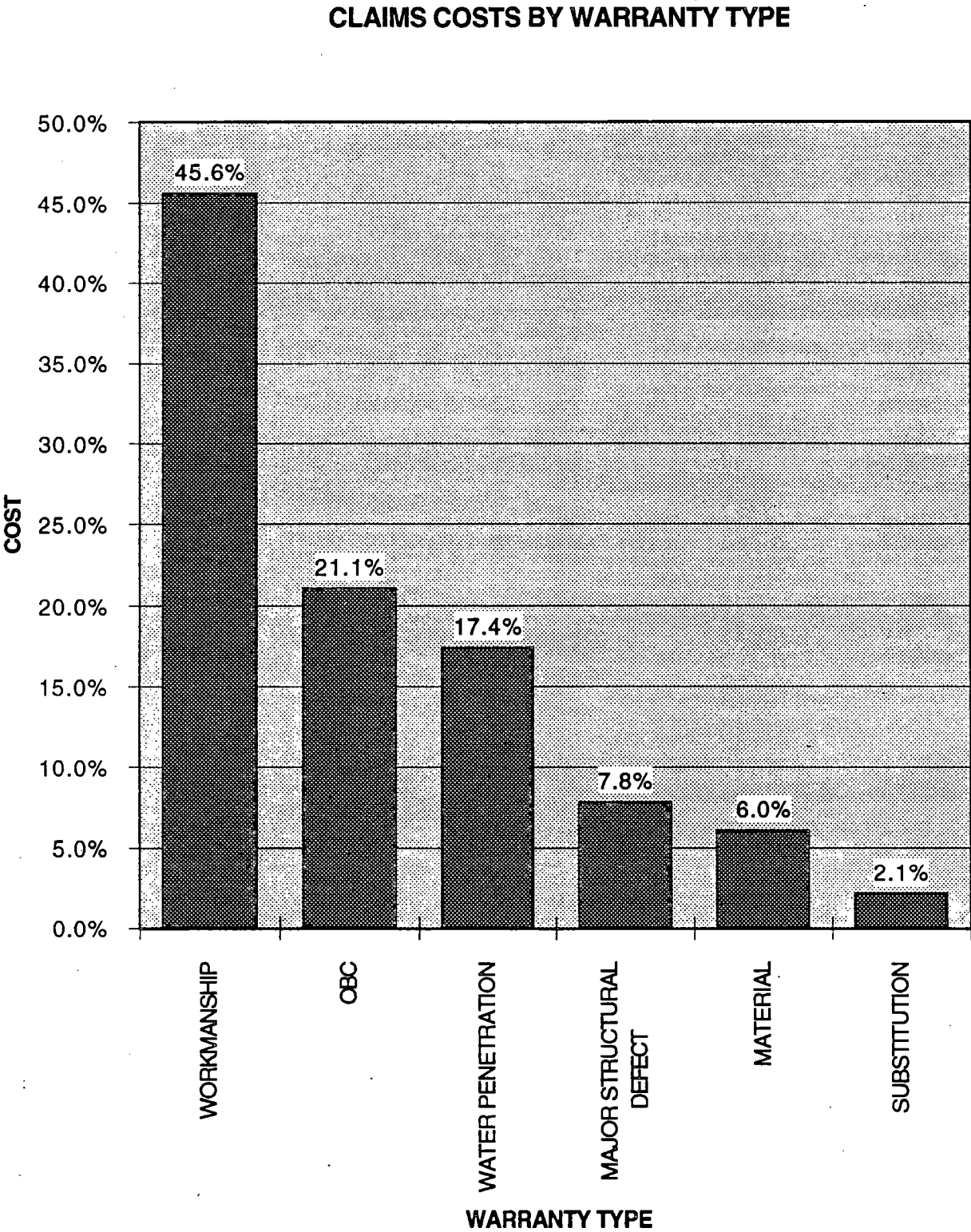


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FREQUENCY OF CLAIMS BY WARRANTY TYPE

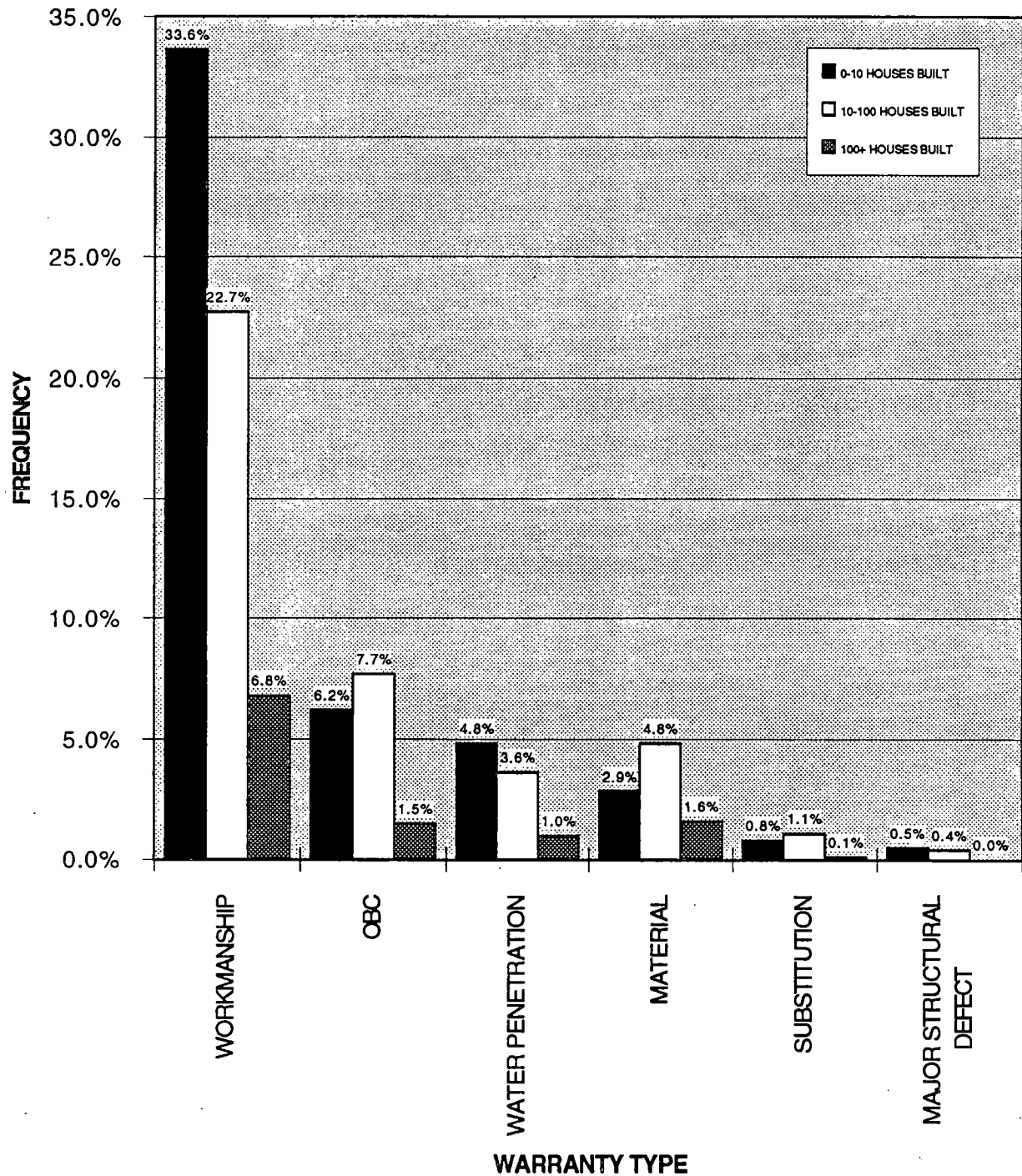


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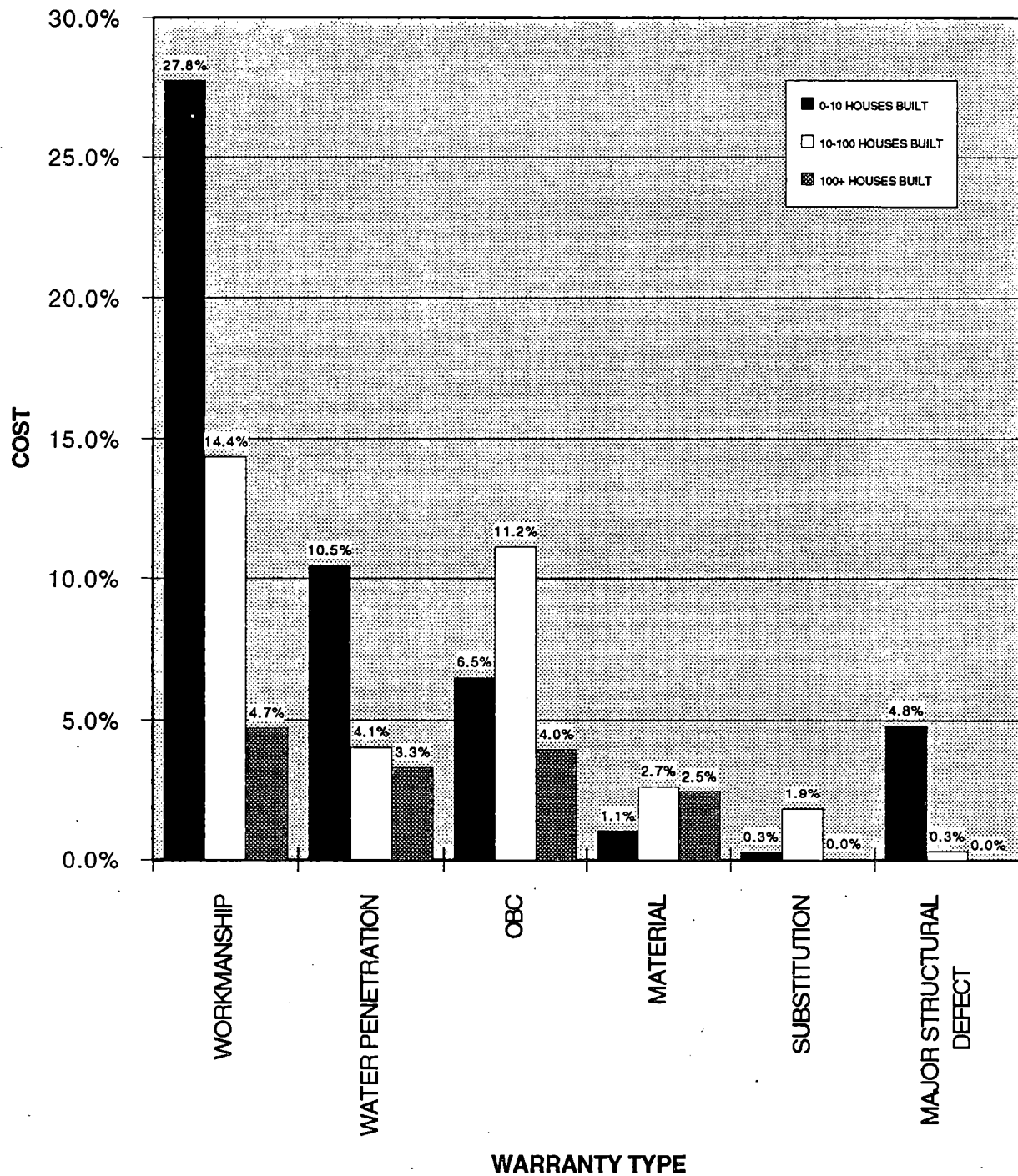
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FREQUENCY OF CLAIMS BY WARRANTY TYPE BY BUILDER SIZE



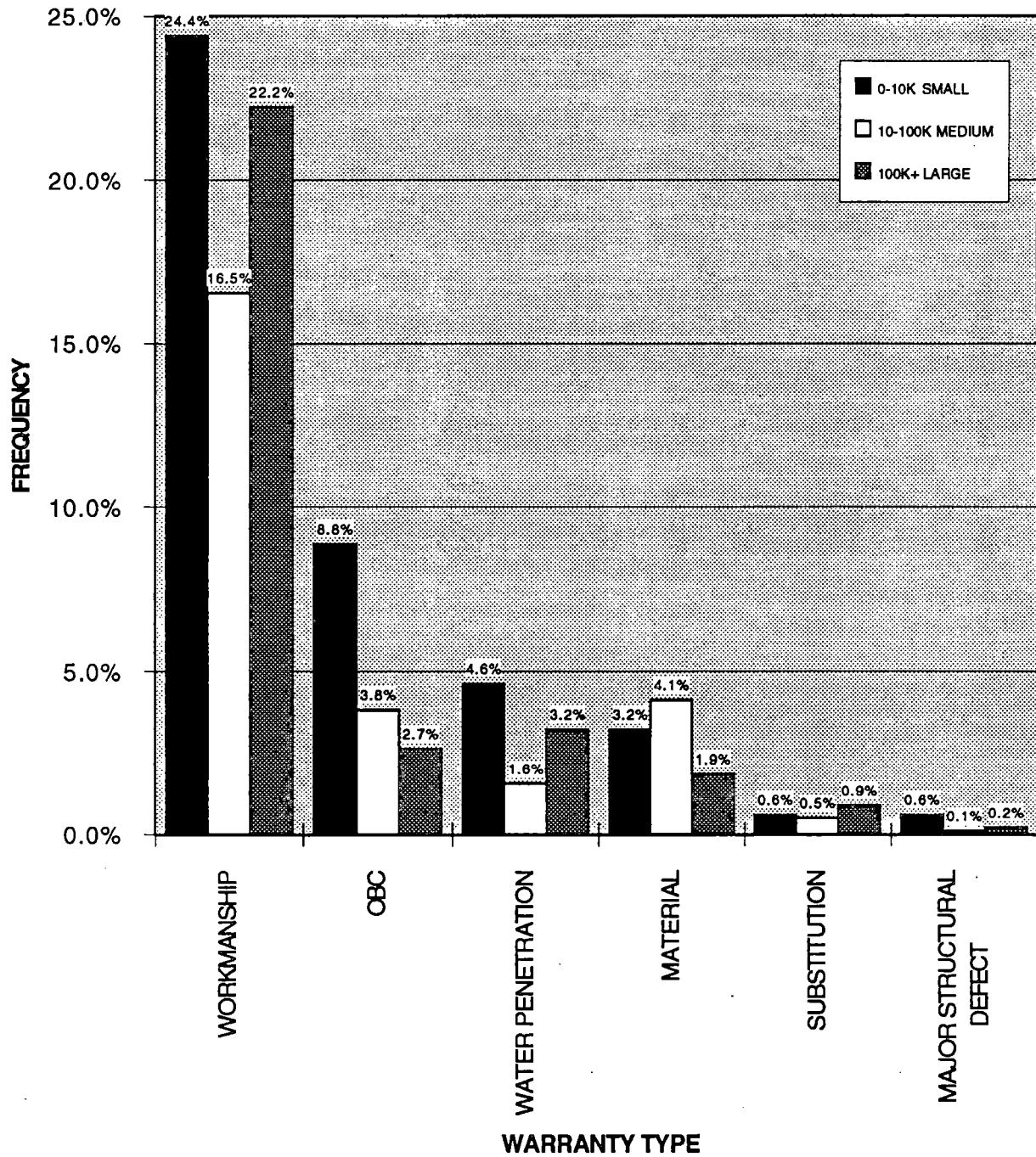
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CLAIMS COSTS BY WARRANTY TYPE BY BUILDER SIZE



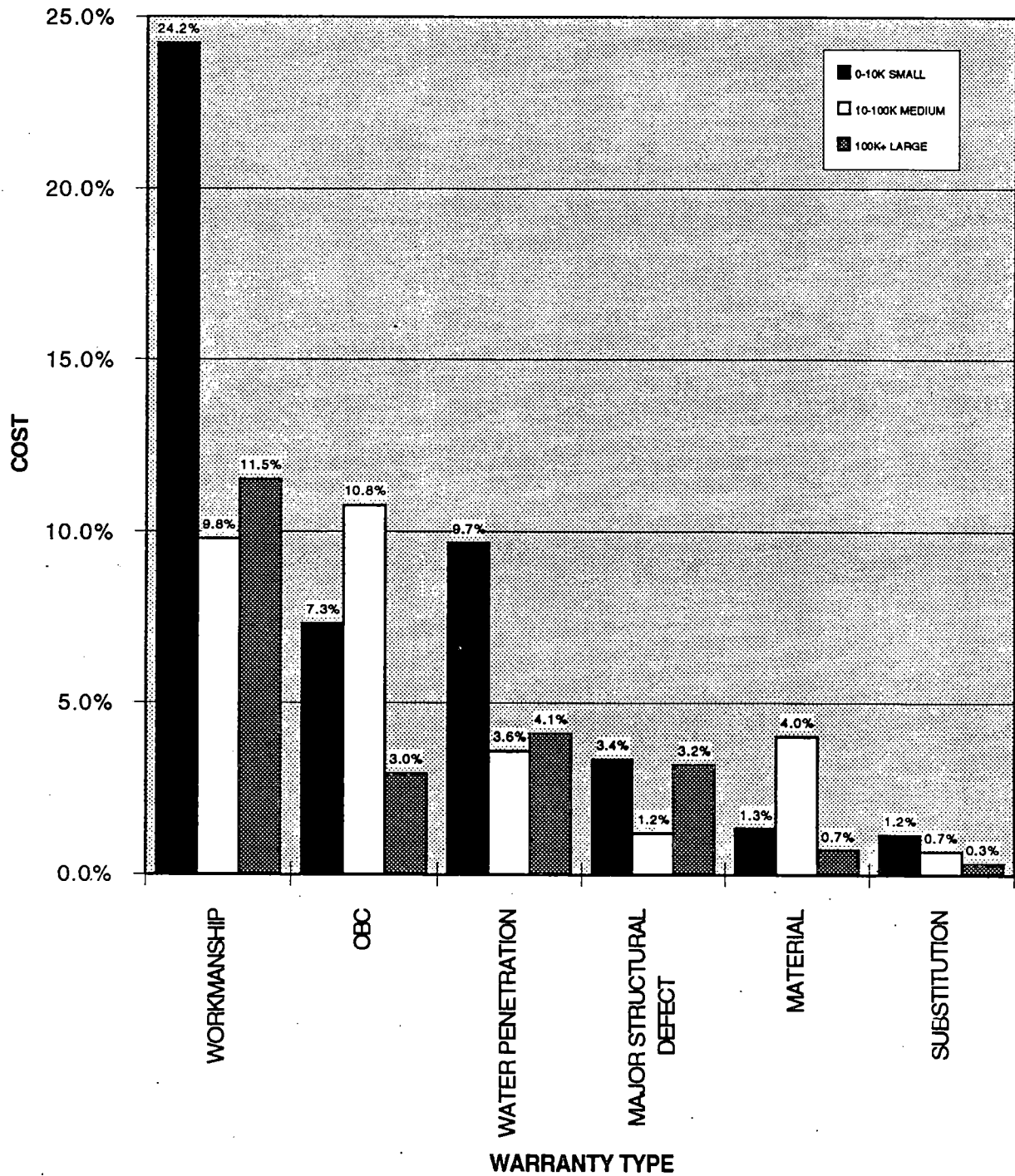
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FREQUENCY OF CLAIMS BY WARRANTY TYPE BY MUNICIPALITY SIZE



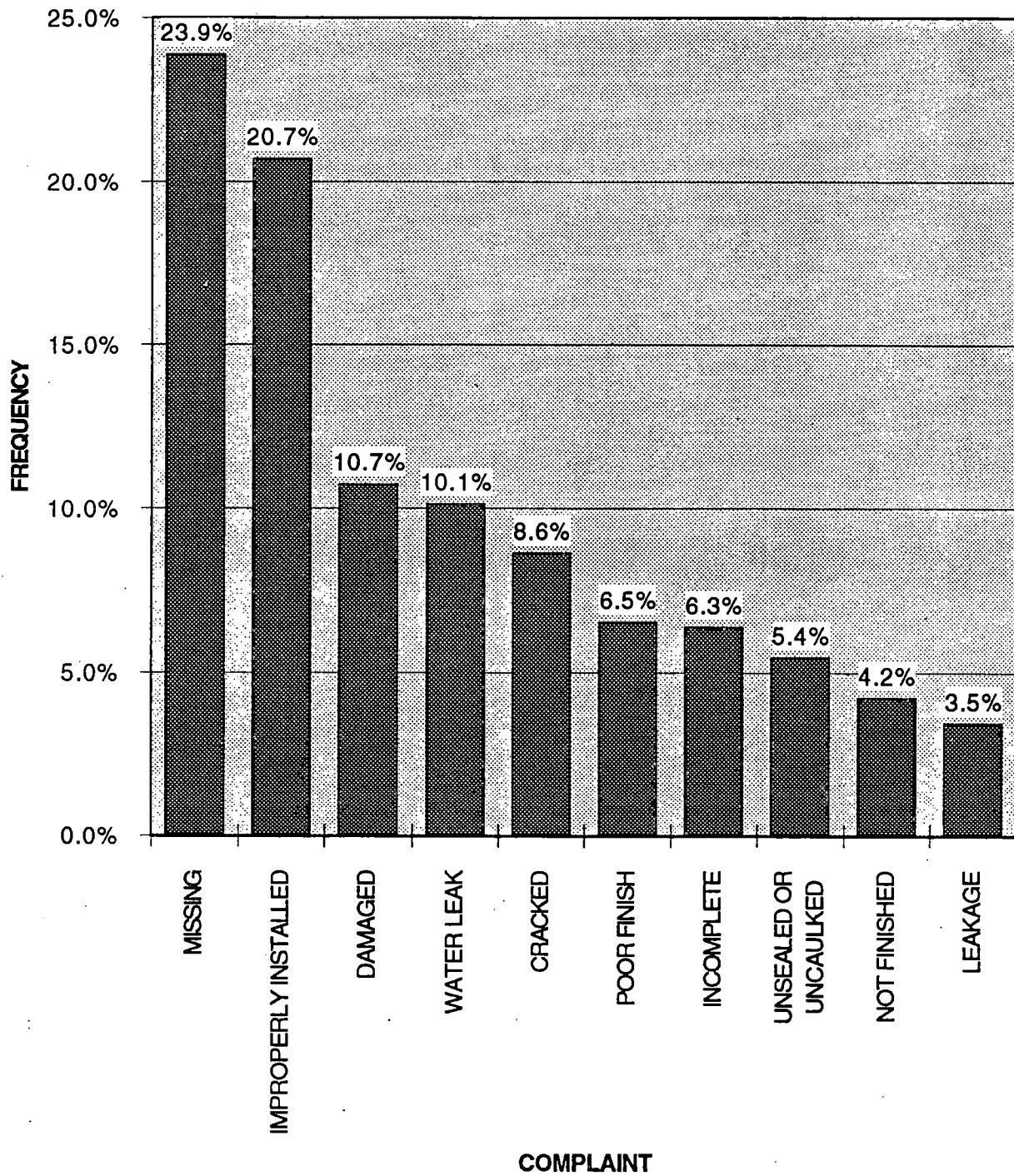
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CLAIMS COSTS BY WARRANTY TYPE BY MUNICIPALITY SIZE



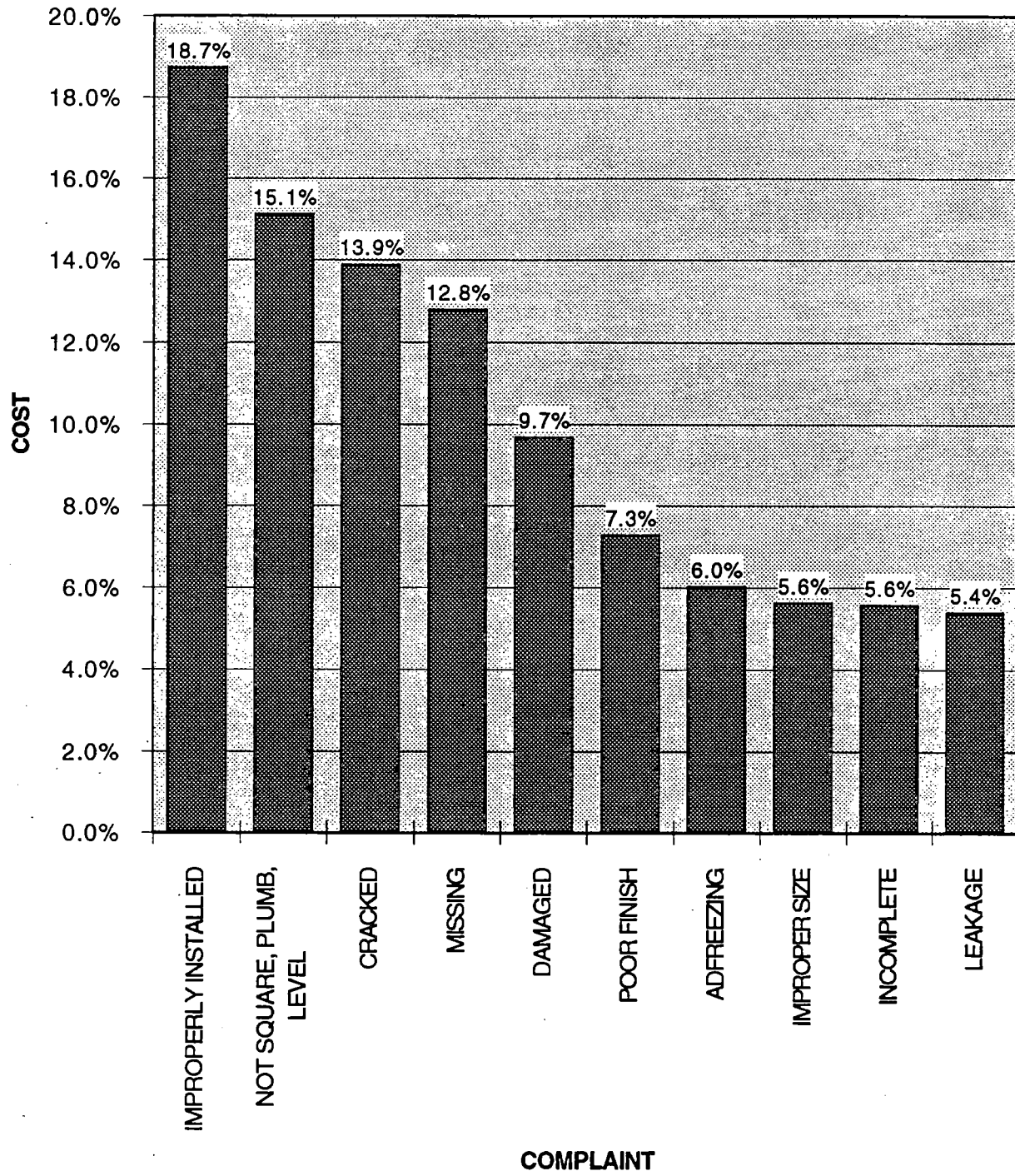
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FREQUENCY OF CLAIMS BY COMPLAINT



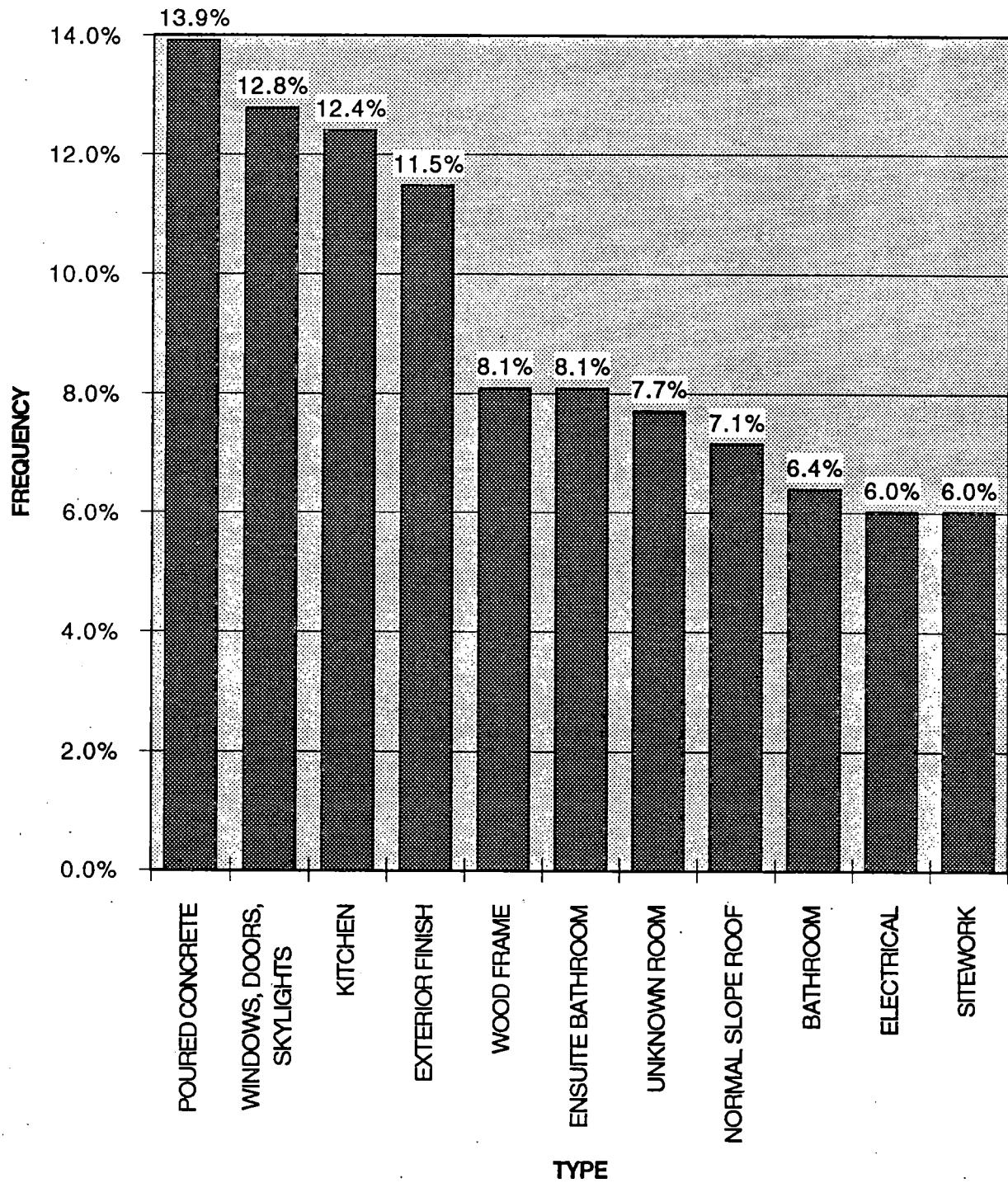
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CLAIMS COSTS BY COMPLAINT



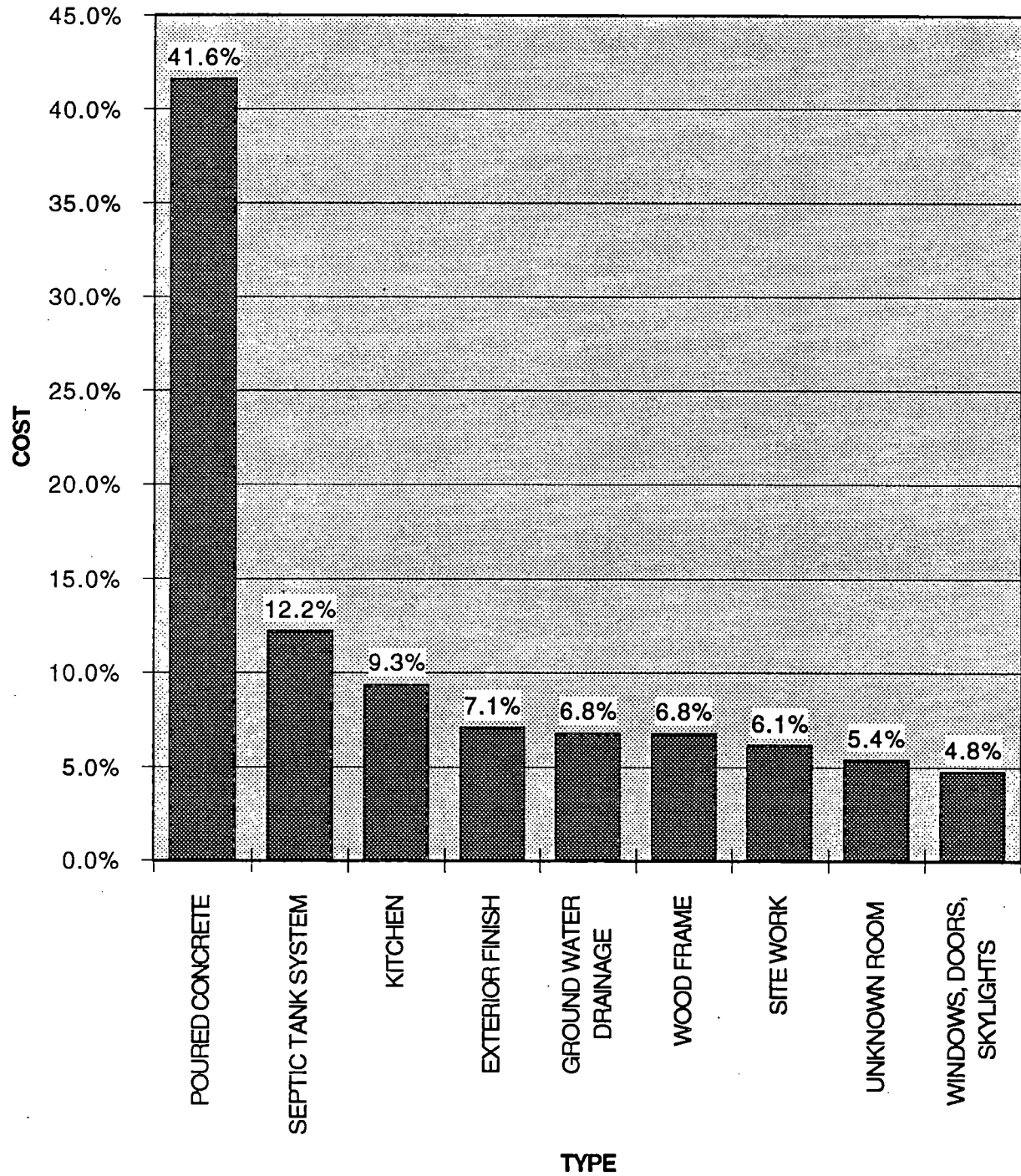
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FREQUENCY OF CLAIMS BY TYPE



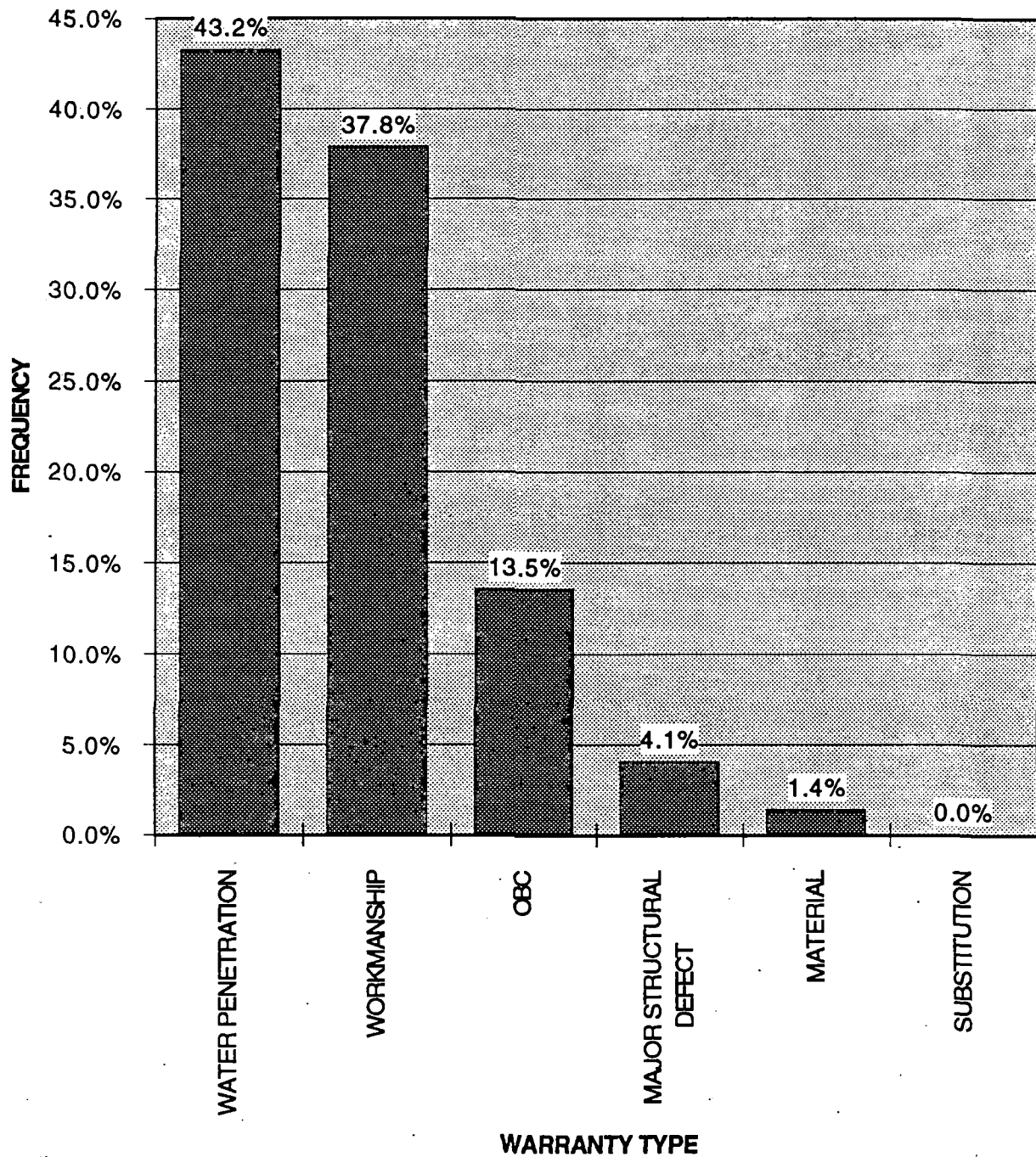
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CLAIMS COSTS BY TYPE



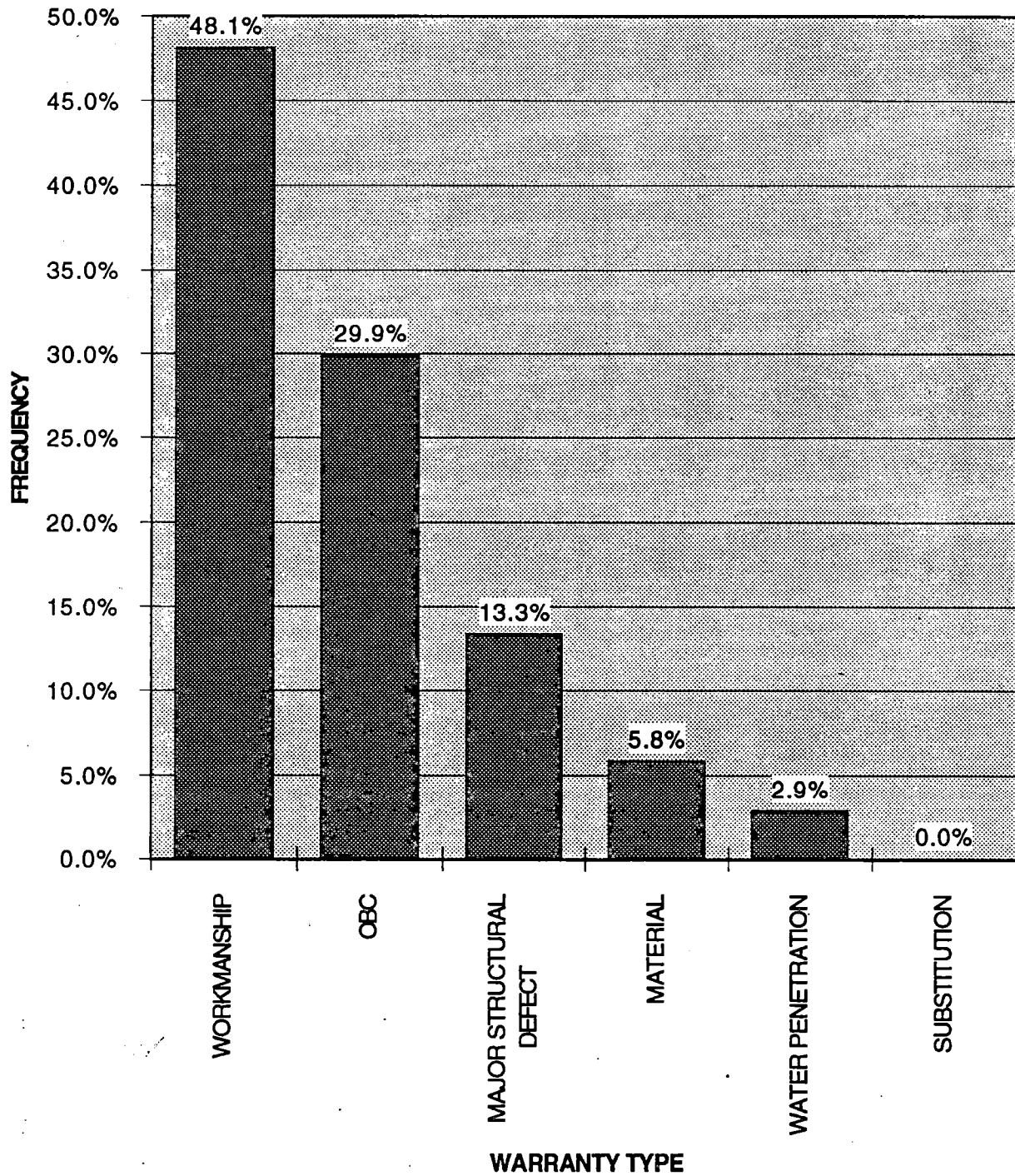
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FREQUENCY OF CLAIMS BY WARRANTY TYPE FOR POURED CONCRETE



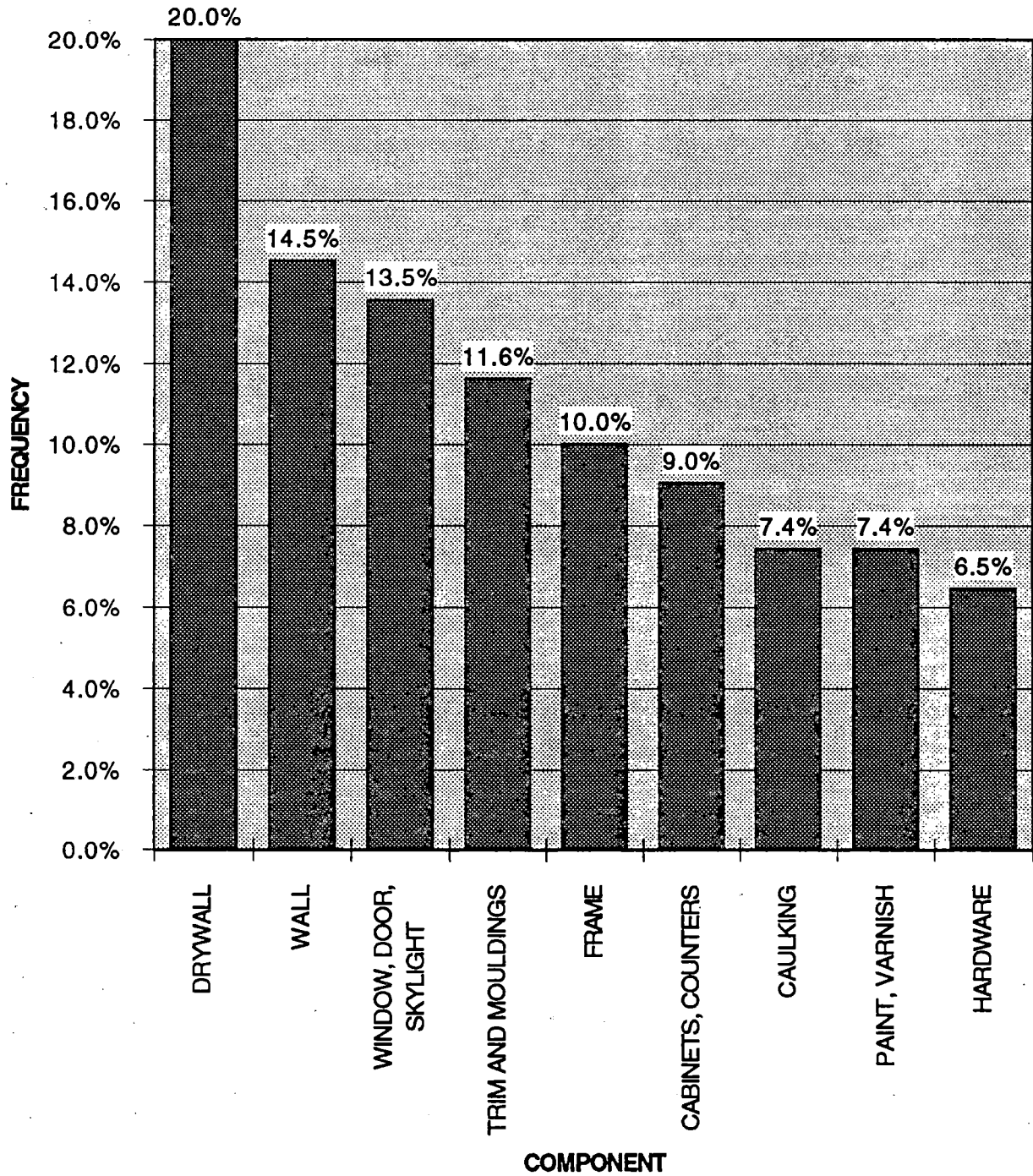
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CLAIMS COSTS BY WARRANTY TYPE FOR POURED CONCRETE



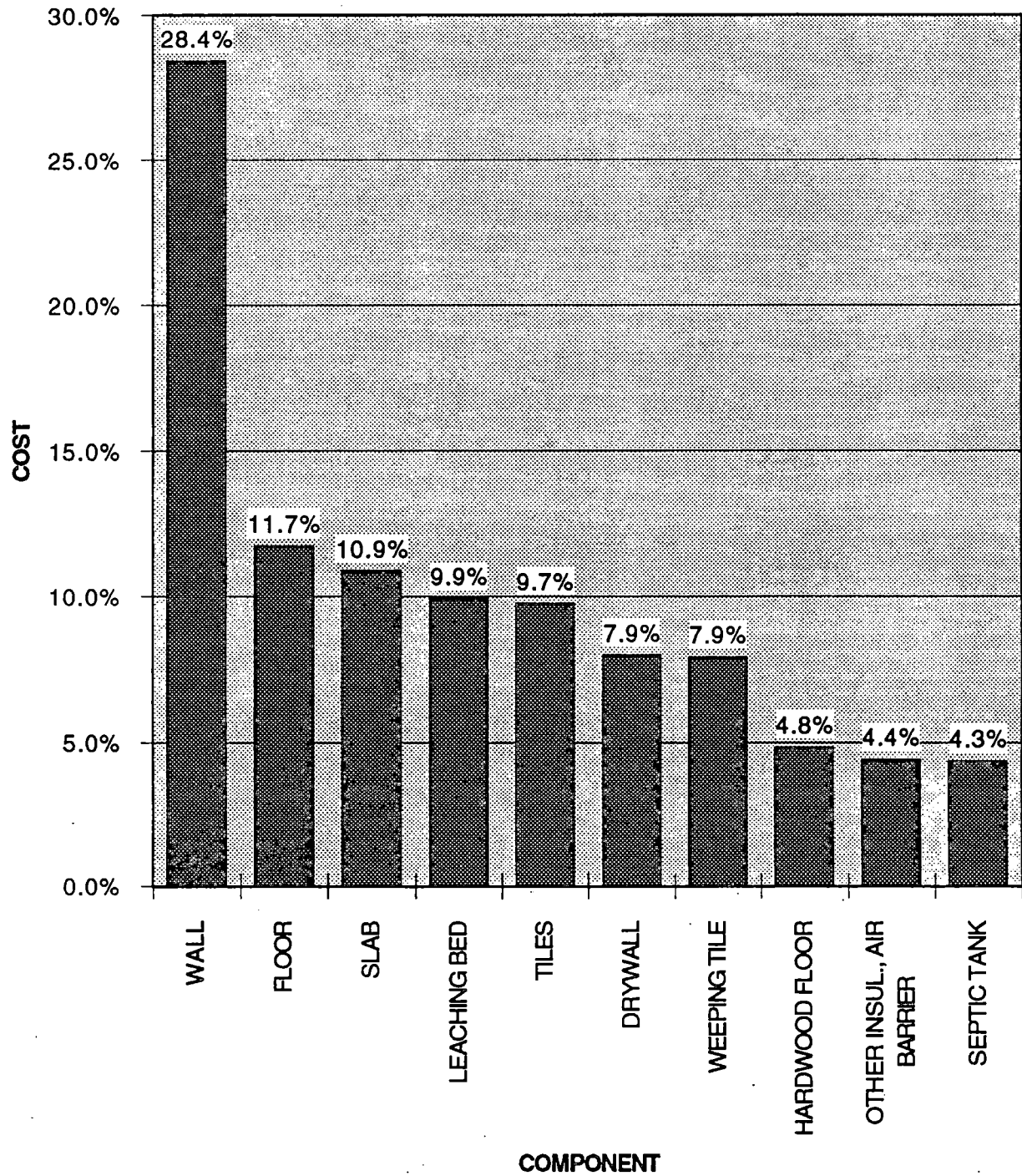
(BASED ON APPROX. 1000 CLAIM ITEMS)

FREQUENCY OF CLAIMS BY COMPONENT
(over 20 claim files)



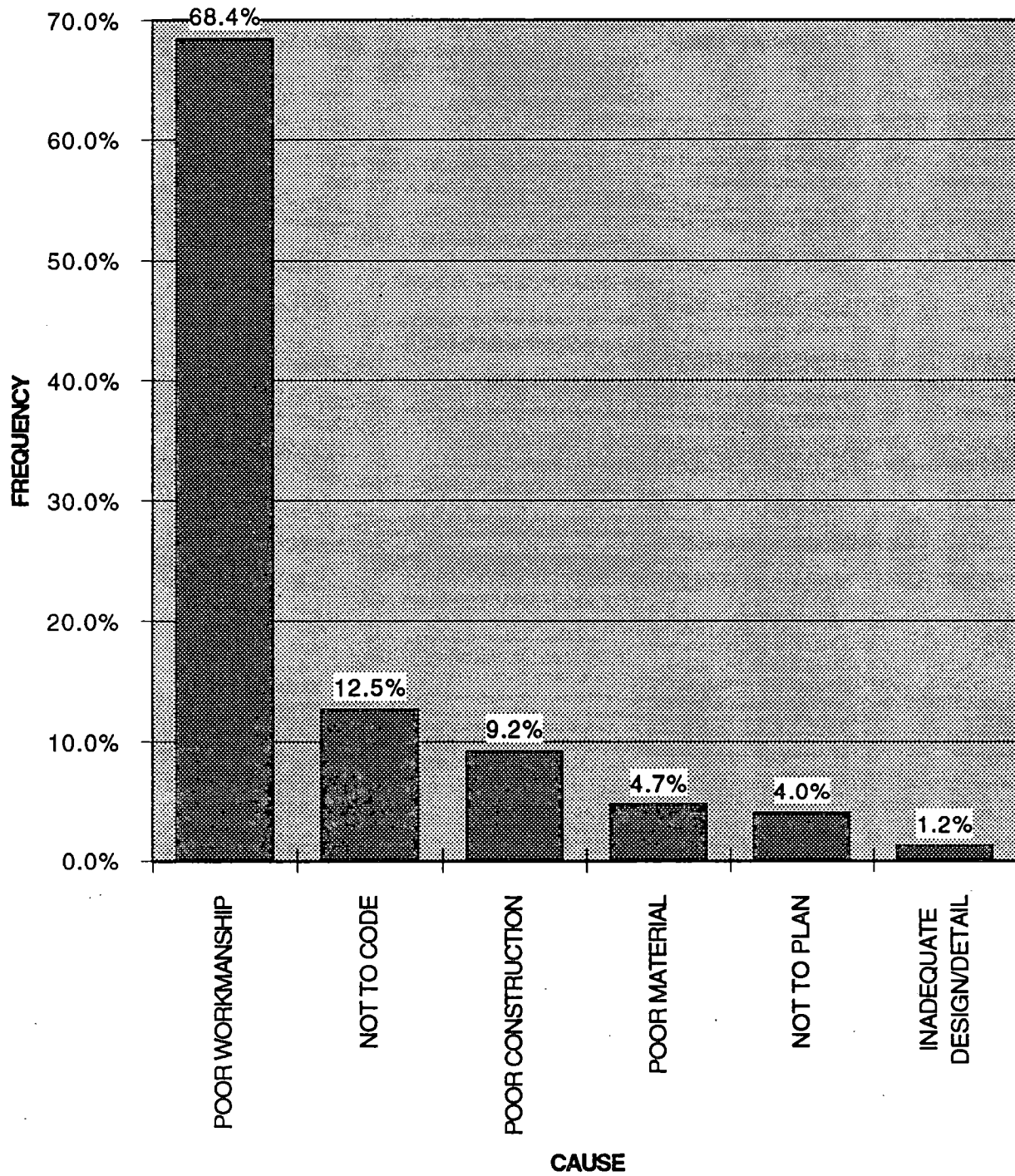
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CLAIMS COSTS BY COMPONENT (OVER \$20,000 IN CLAIMS)



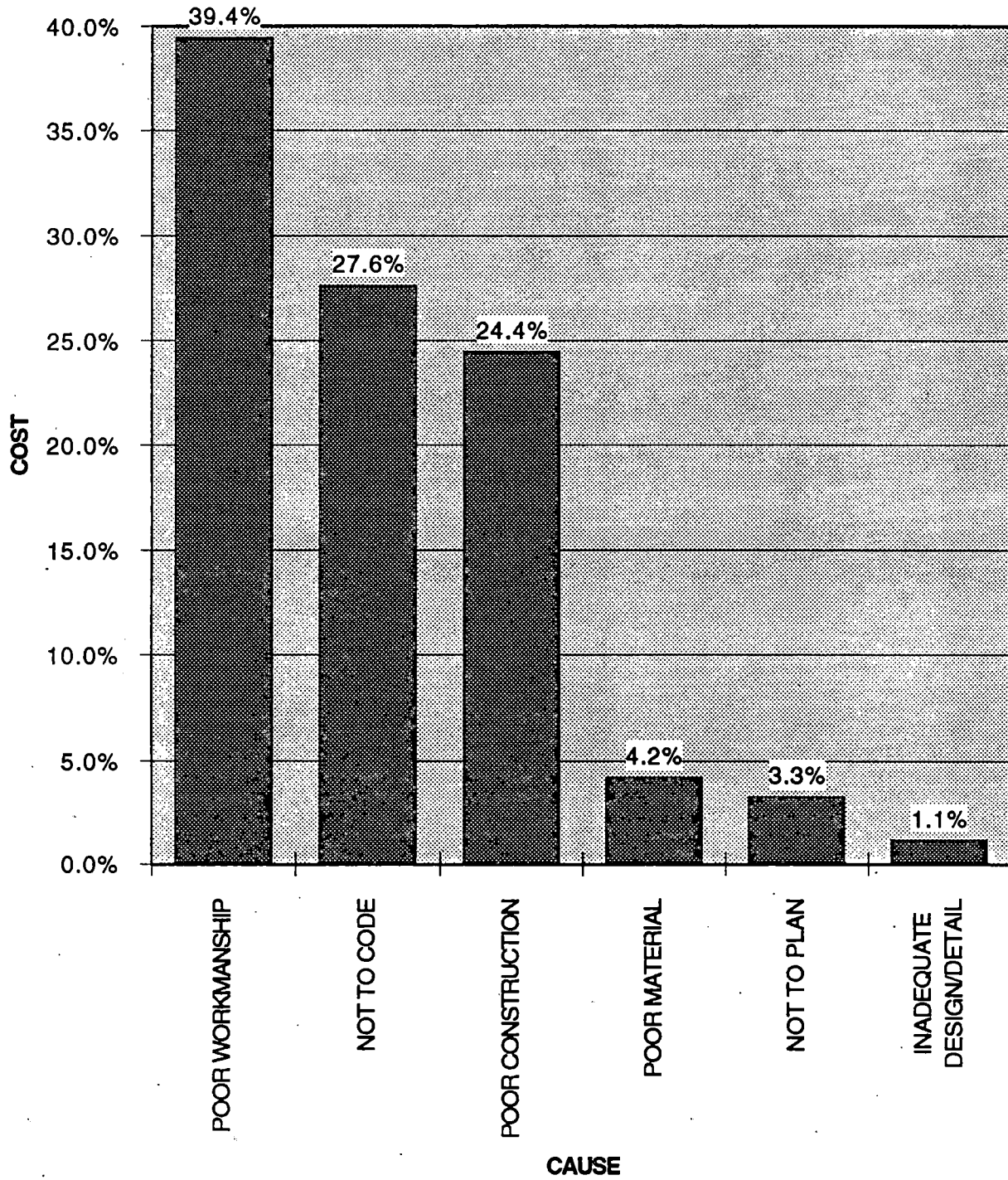
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FREQUENCY OF CLAIMS BY CAUSE



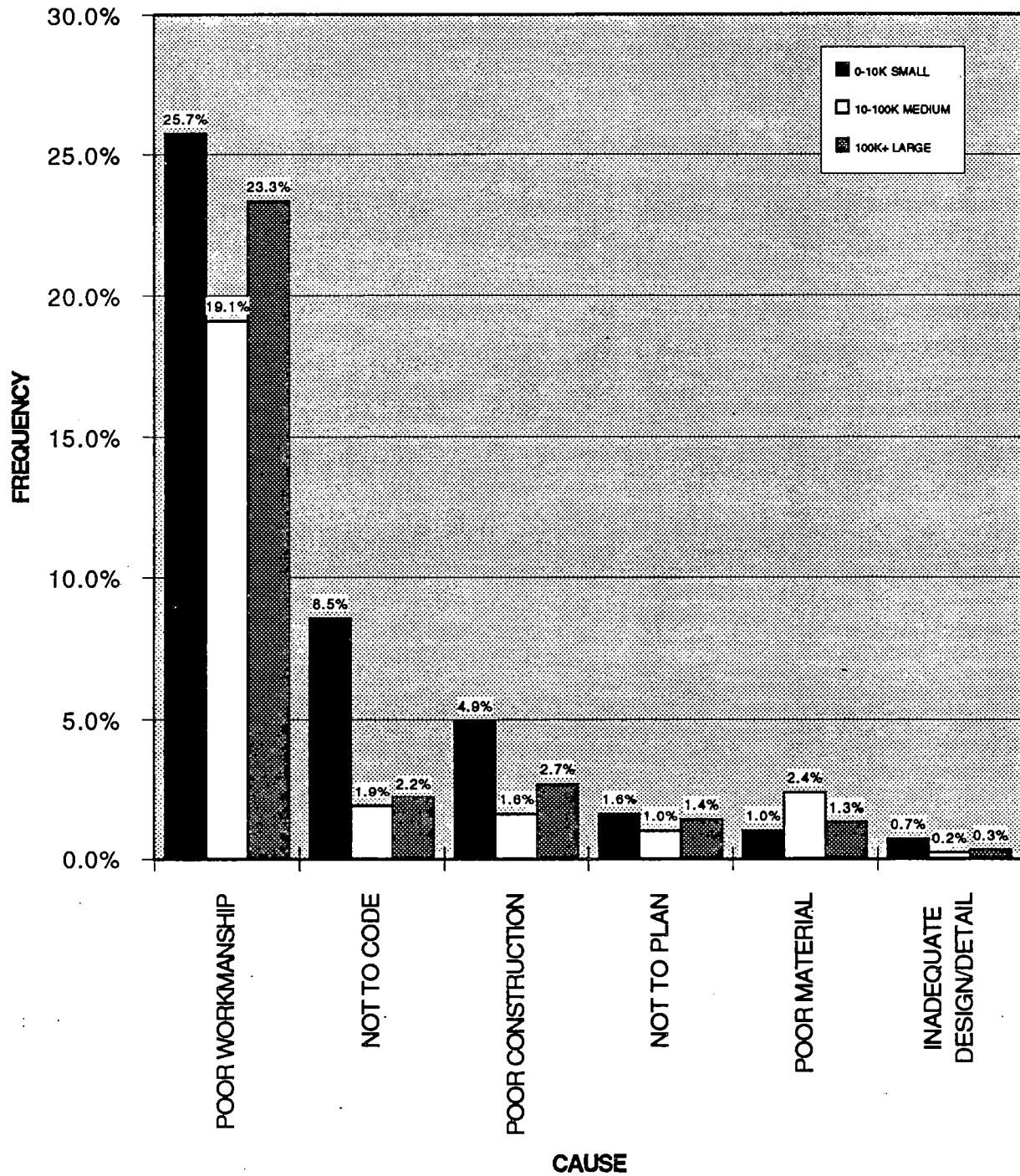
(BASED ON APPROX. 1000 CLAIM ITEMS)

CLAIMS COSTS BY CAUSE



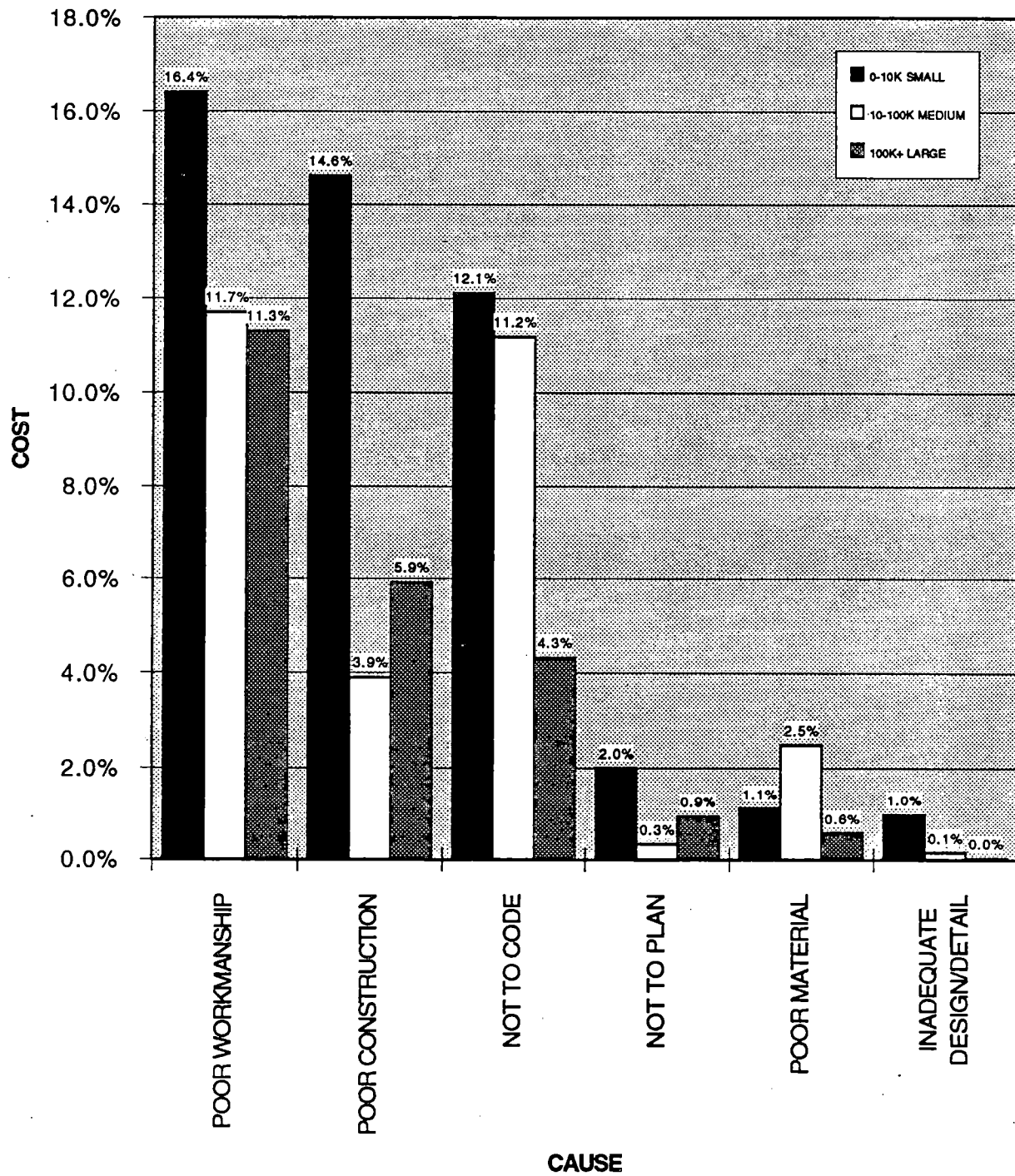
(BASED ON APPROX. 1000 CLAIM ITEMS)

FREQUENCY OF CLAIMS BY CAUSE BY MUNICIPALITY SIZE



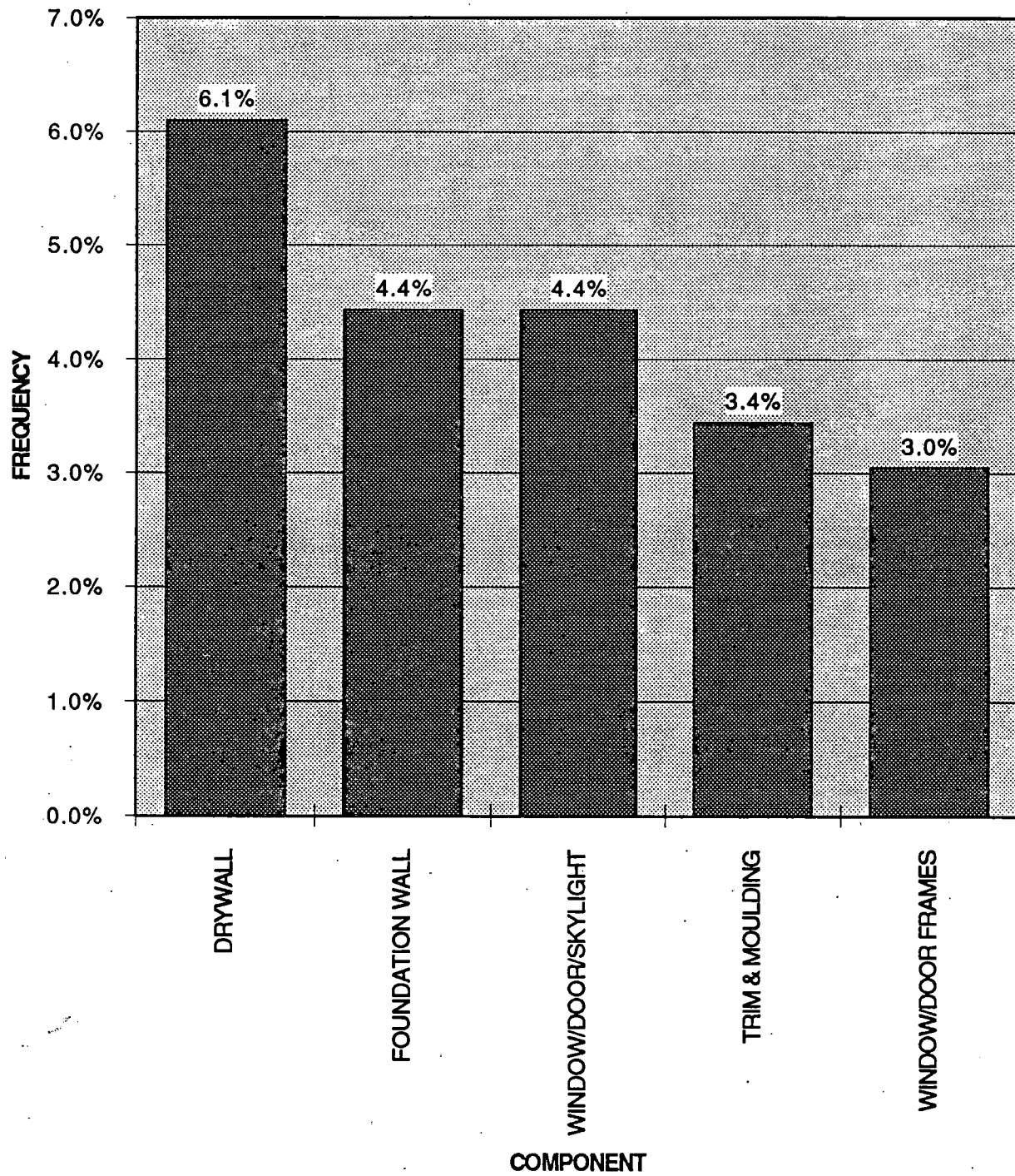
(BASED ON APPROX. 1000 CLAIM ITEMS)

CLAIMS COSTS BY CAUSE BY MUNICIPALITY SIZE



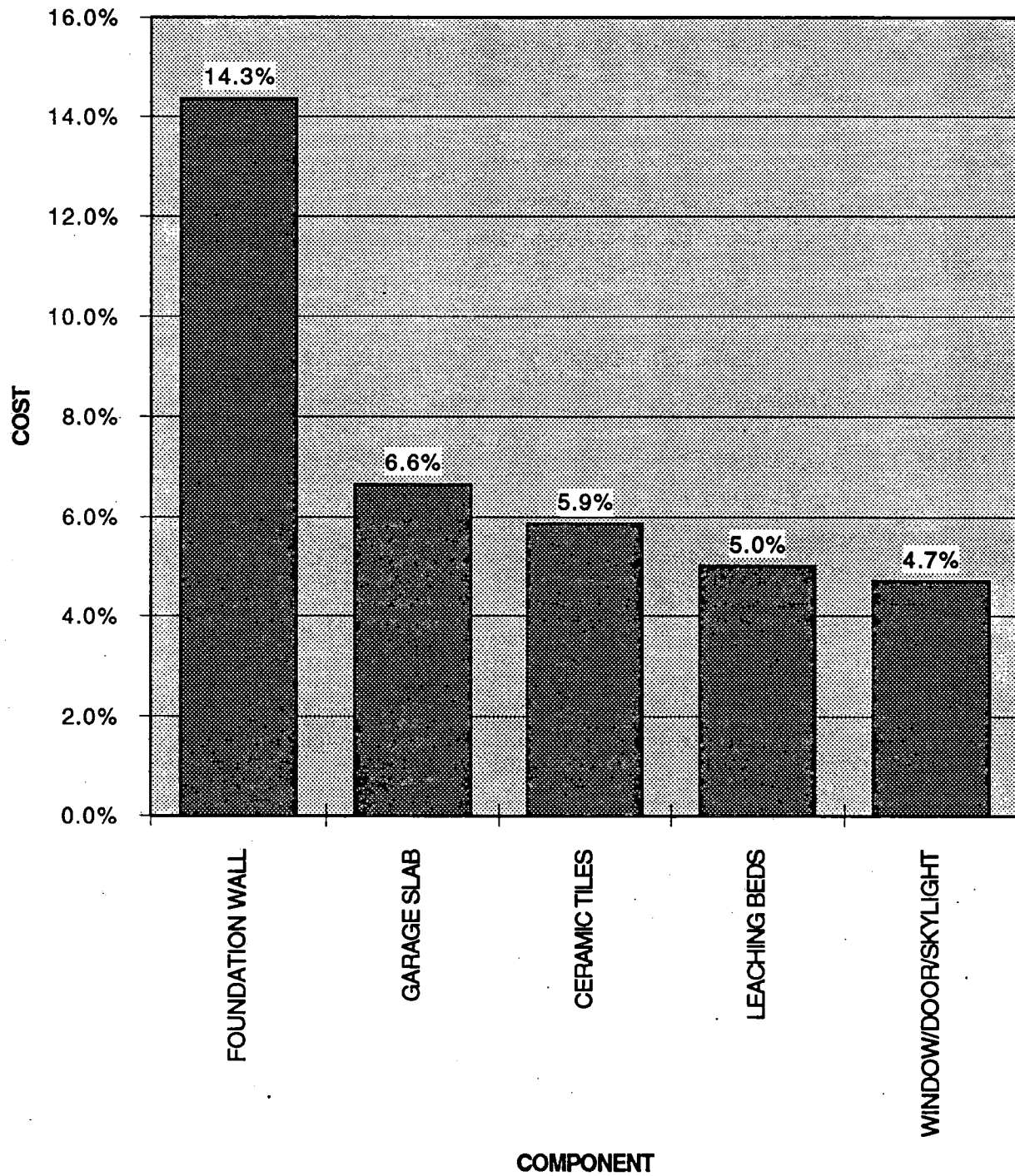
(BASED ON APPROX. 1000 CLAIM ITEMS)

TOP 5 COMPONENTS BY FREQUENCY



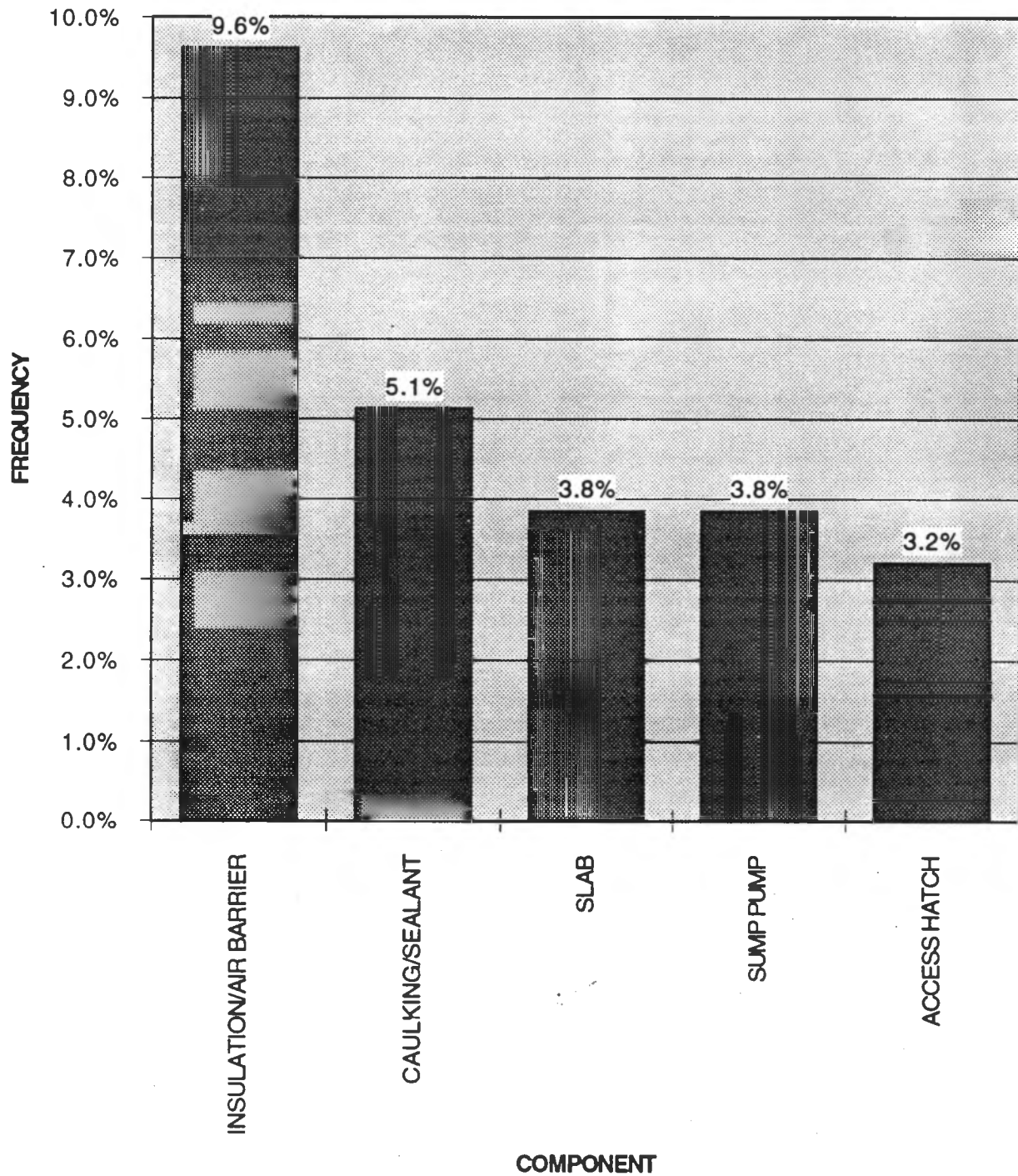
(BASED ON APPROX. 1000 CLAIM ITEMS)

TOP 5 COMPONENTS BY COST



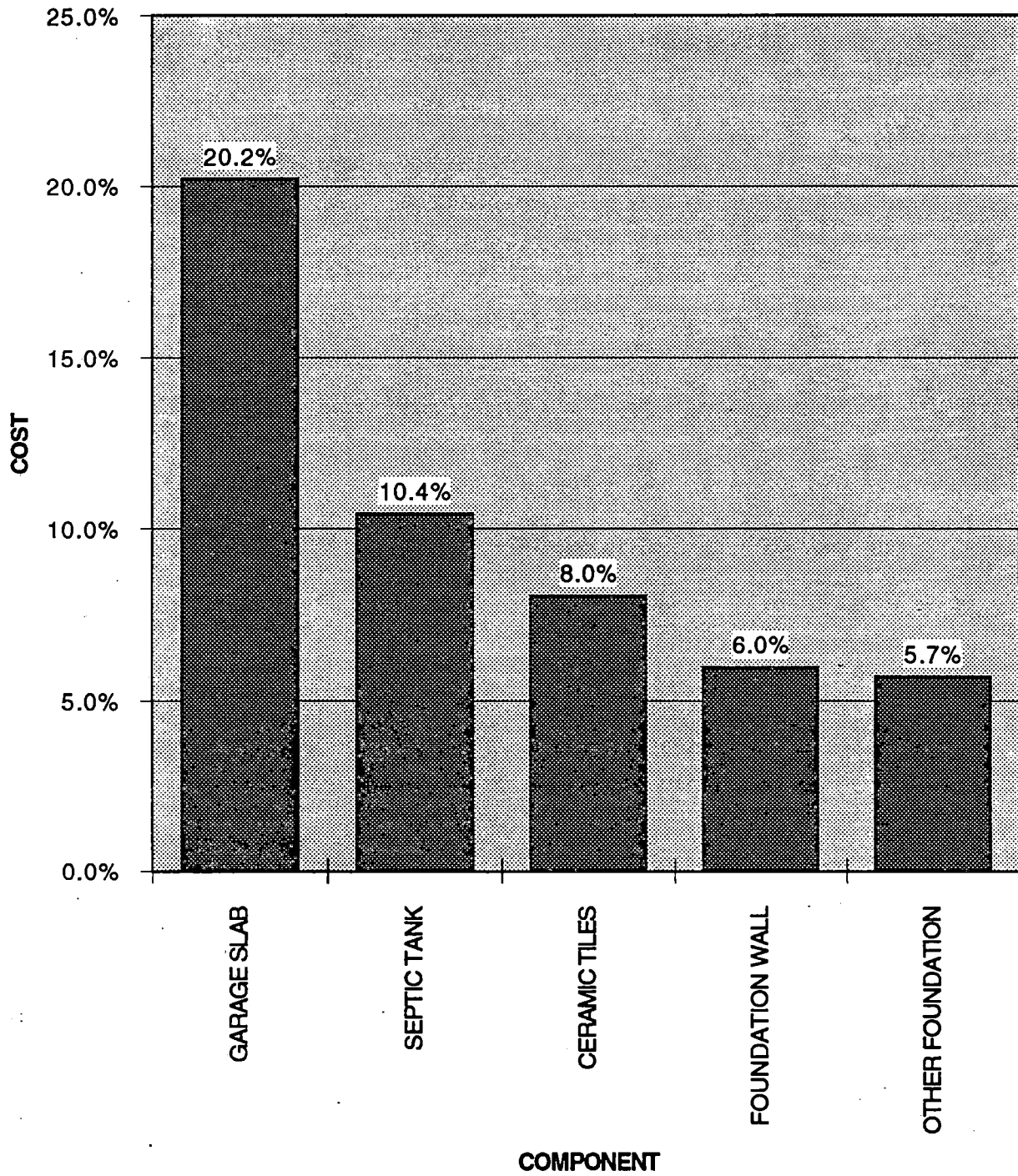
(BASED ON APPROX. 1000 CLAIM ITEMS)

TOP 5 OBC WARRANTY TYPE COMPONENTS BY FREQUENCY



(BASED ON 156 OBC WARRANTY TYPE CLAIM ITEMS)

TOP 5 OBC WARRANTY TYPE COMPONENTS BY COST



(BASED ON 156 OBC WARRANTY TYPE CLAIM ITEMS)

APPENDIX 'B'

ONHWP INSPECTION REPORTS



Excavation Inspection

(Please print clearly, you are making 4 copies.)

Inspection Date: _____ Civic Address: _____
 Builder Reference: _____ Municipality: _____
 Enrolment: _____ Lot: _____ Plan: _____
 Builder Name: _____ Builder's Phone: () _____
 Builder Site Rep.: _____ Building Permit: _____
 Inspector: _____ Regional Office: _____

Identify soil type: Rock ☐ Coarse grain soils ☐ Silt ☐ Clay/undefined ☐
 Is mechanically compacted fill material used? Yes ☐ No ☐
 Is a soils engineering report available? Yes ☐ No ☐
 Identify number of storeys: 1 ☐ 2 ☐ 3 ☐

	Ontario Building Code 1993	Code & Construction Guide 1993	Acceptable		Re- inspection necessary	Corrected (yy/mm/dd)
			Yes	No		
1. Site condition and material storage	(workmanship)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
2. Excavation free from organic material	(9.12.1.1.)	(2.1.1.(1-3))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
3. Excavation free from standing water	(9.12.1.2.)	(2.1.1.(4))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
4. Frost protection provided	(9.12.1.3.)	(2.1.1.(5))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
5. Excavation to undisturbed soil	(9.12.2.1.)	(2.1.2.(1))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
6. Trenches beneath footing formwork	(9.12.4.1.)	(2.2.5.(1))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
7. Construction of step footings	(9.15.3.8)	(2.2.4.(1))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
8. Suitable footing formwork	(workmanship)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /

ADDITIONAL ITEMS: (Items observed, but not listed above, and are deficient and/or require comment.)

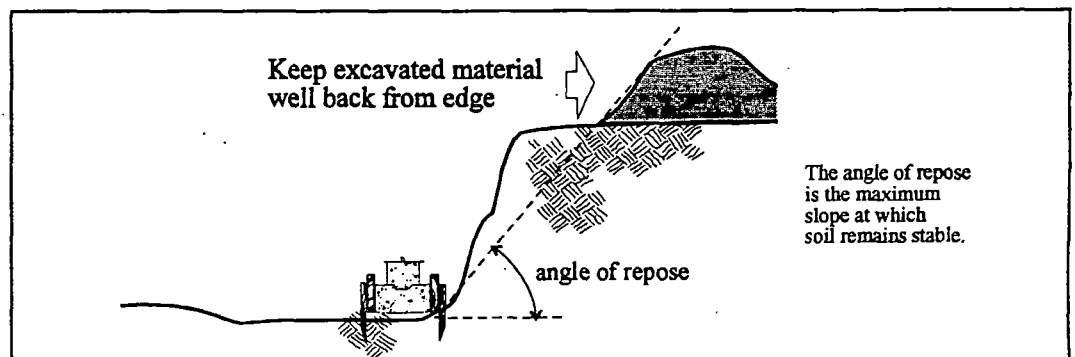
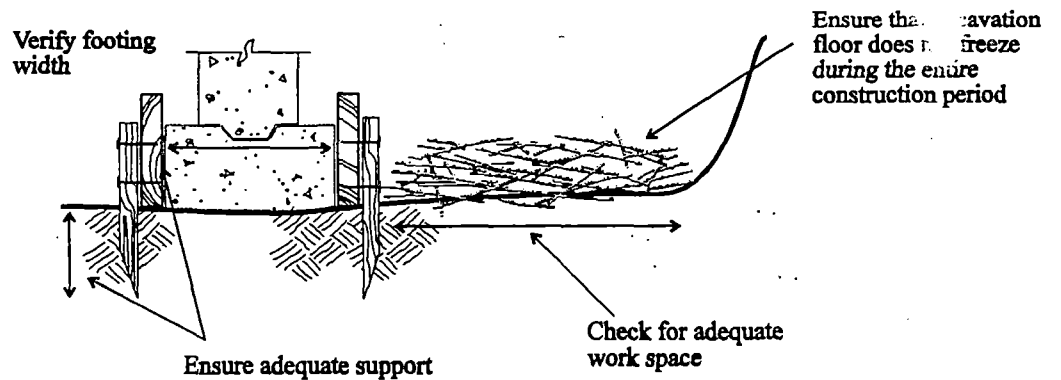
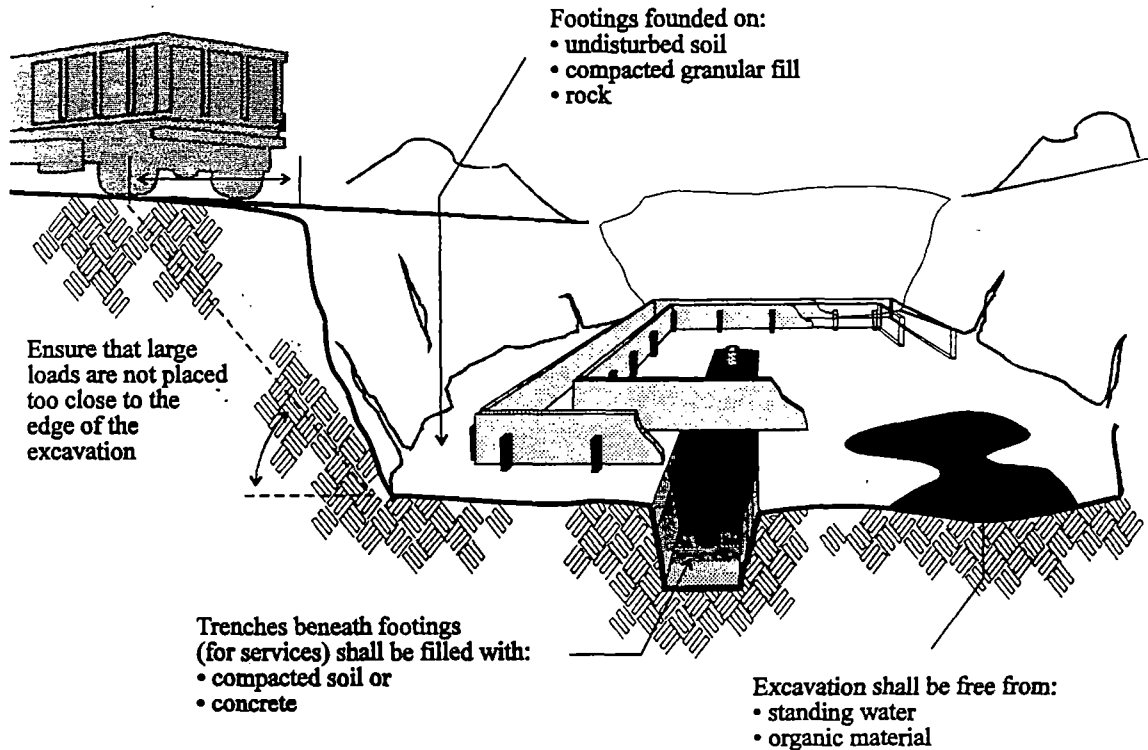
1. _____ ☐
 2. _____ ☐
 3. _____ ☐

Note: This inspection is for Warranty Program purposes only, and does not indicate full compliance with any Codes or Bylaws.

Excavations

WATCH OUT FOR:

- adequate frost protection during cold weather
- footing formwork of suitable material and adequately supported
- how the concrete is to be placed





Foundation Inspection

(Please print clearly, you are making 4 copies.)

Inspection Date: _____ Civic Address: _____
Builder Reference: _____ Municipality: _____
Enrolment: _____ Lot: _____ Plant: _____
Builder Name: _____ Builder's Phone: (____) _____
Builder Site Rep.: _____ Building Permit: _____
Inspector: _____ Regional Office: _____

Identify foundation type: Poured ☐ Block ☐ Preserved Wood ☐
Identify number of storeys: 1 ☐ 2 ☐ 3 ☐
If pier or structural slab foundation: Is an engineer's report available? Yes ☐ No ☐
If unit is subject to Builder Bulletin 33: Has the Certificate of Professional Design and Commitment for Field Review of Private Sewage Disposal Systems (forms A-1, A-2) been received? Yes ☐ No ☐

	Ontario Building Code 1993	Code of Construction Guide 1993	Acceptable		Re- inspection necessary	Corrected (yy/mm/dd)
			Yes	No		
1. Site condition and material storage (workmanship)			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
2. Minimum thickness of foundation (9.15.4.1)	(2.3.1(6))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
3. Interior footings/pads in place (9.15.3)	(2.2(1))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
4. Anchor bolts at top of foundation (9.23.6.1(2))	(3.2.1)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
5. Placement of weeping tile (9.14.3)	(2.10)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
6. Sufficient stone cover over tile (9.14.3.3(4))	(2.10.(14))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
7. Excessive honeycombing/cold joints sealed (poured foundation) (workmanship)			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
8. Below grade parging/coved over footing (block foundation) (9.13.5.1.(1))	(2.8.(5))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
9. Below grade water/dampproofing (9.13.3.(5))	(2.9.(1))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
10. Granular fill under basement slab (9.16.2.1)	(2.6.(4))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
11. Required drainage layer 9.14.2.1	(2.10.(4))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
12. Full height basement insulation (if applied on exterior) 9.25.2.7	(11.2.1.(5))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
13. Adequate footing depth/insulation at walkouts (9.12.2.)	(2.1.2)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
	(9.25.4.5)	(11.2.3.(6))				/ /
14. Adequate lateral support of wall (9.12.3.5.)	(2.12.(5))		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
15. Steps to control adfreezing (workmanship)			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
16. Suitable backfill material (9.12.3.)	(2.12.)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /

ADDITIONAL ITEMS: (Items observed, but not listed above, and are deficient and/or require comment.)

- _____ ☐
- _____ ☐

Note: This inspection is for Warranty Program purposes only, and does not indicate full compliance with any Codes or Bylaws.

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NH1113

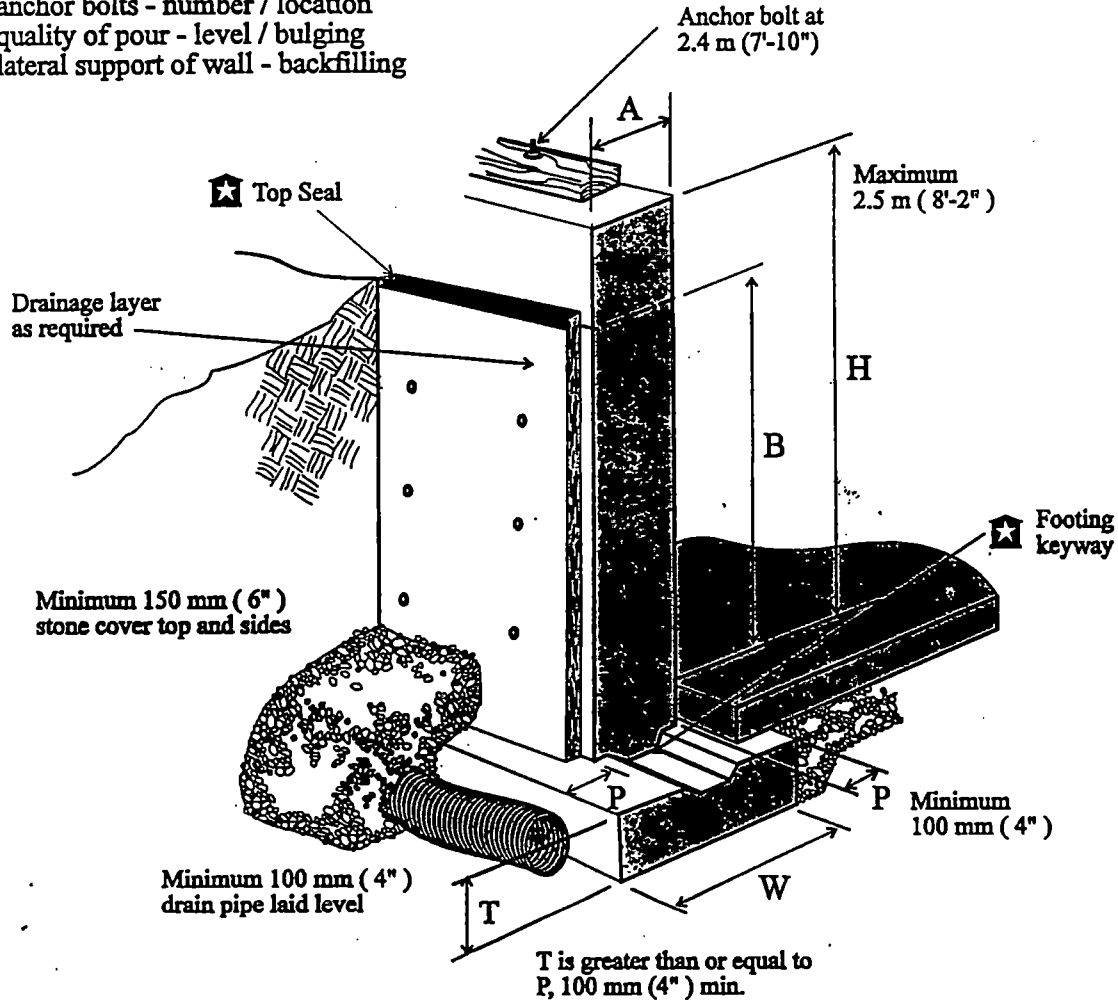
Revised 1994

1st copy: Site Rep.

Foundations

WATCH OUT FOR:

- excessive cracking
- excessive honeycombing
- cold pour joints
- adequate patching of tie rods
- organic and unsuitable fill material in the excavation
- anchor bolts - number / location
- quality of pour - level / bulging
- lateral support of wall - backfilling



Footing Width under Exterior Walls* (W)

Above grade exterior walls	Building Height		
	One storey	Two storey	Three storey
Wood frame & siding	250 mm (10")	350 mm (14")	450 mm (18")
Wood frame & masonry veneer	315 mm (12.5")	480 mm (19")	645 mm (25.5")
Masonry construction	380 mm (15")	610 mm (24")	840 mm (33")

*The footing width must be doubled for high water tables located within one footing width below the footing

**Foundation Wall Thickness (A)
(laterally supported walls)**

Solid Concrete 15MPa		Unit Masonry	
Height* (B)	Thickness	Height* (B)	Thickness
1.5 m (4'-11")	150 mm (6")	0.8 m (2'-6")	140 mm (6")
2.1 m (6'-11")	200 mm (8")	1.2 m (3'-11")	190 mm (8")
2.3 m (7'-6")	250 mm (10")	2.2 m (7')	290 mm (12")

* Height relates to the maximum height of finished grade above the basement floor



Framing Inspection

(Please print clearly, you are making 4 copies.)

Inspection Date: _____ Civic Address: _____
 Builder Reference: _____ Municipality: _____
 Enrolment: _____ Lot: _____ Plan: _____
 Builder Name: _____ Builder's Phone: () _____
 Builder Site Rep.: _____ Building Permit: _____
 Inspector: _____ Regional Office: _____

Identify number of storeys:

1 ☐ 2 ☐ 3 ☐

	Ontario Building Code 1993	Code & Construction Guide 1993	Acceptable		Re- inspection necessary	Corrected (yy/mm/dd)
			Yes	No		
1. Site condition and material storage	(workmanship)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
2. Sill plate anchorage	(9.23.6.1.)	(3.2.(1))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
3. Nailing of framing	(9.23.3)	(3.4.1.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
4. End bearing for beams and joists	(9.23.8.1./9.1.)	(3.5.1.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
5. Joist support on beams	(9.23.9.2.)	(3.5.2.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
6. Joist span	(9.23.4.1.)	(3.3.2.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
7. Floor framing around openings	(9.23.9.5./6.)	(3.6.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
8. Subfloor nailing	(9.23.3.5.)	(1.4.6.(15))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
9. Stud spacing and size	(9.23.10.1.)	(7.1.1.(17))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
10. Notching/drilling of framing	(9.23.5.)	(7.1.8.)/(3.10.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
11. Support of interior walls	(9.23.9.8.)	(3.7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
12. Lintel spans and sizes	(9.23.12.3.)	(7.1.3.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
13. Truss bracing (compressions web members)	(9.23.13.11.(5))	(8.1.6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
14. Roof sheathing (gaps, thickness & edge support)	(9.23.15.3/5/6.(2))	(8.2.(4)/(6)/(9))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /

ADDITIONAL ITEMS: (Items observed, but not listed above, and are deficient and/or require comment.)

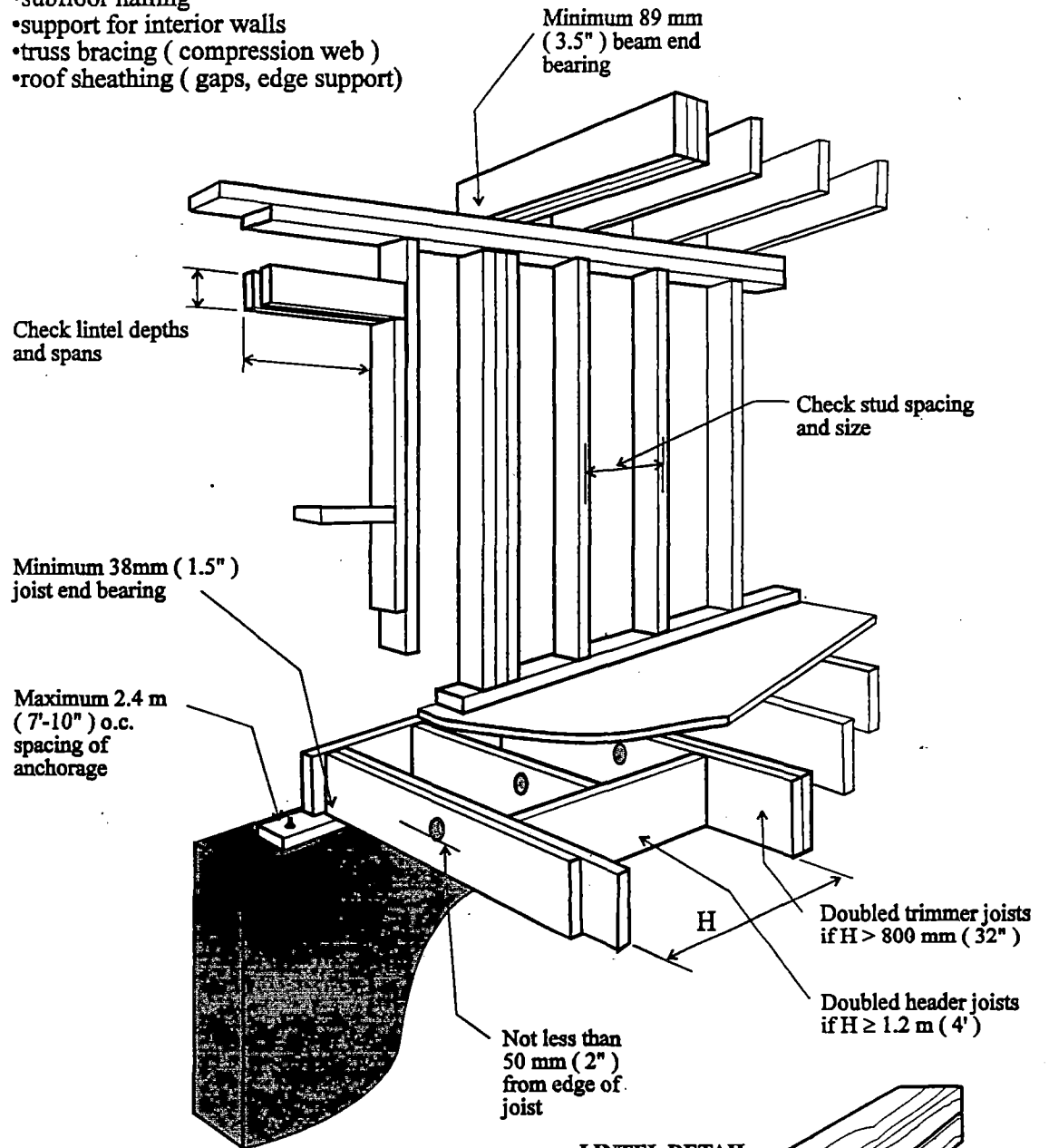
1. _____ ☐
2. _____ ☐
3. _____ ☐

Note: This inspection is for Warranty Program purposes only, and does not indicate full compliance with any Codes or Bylaws.

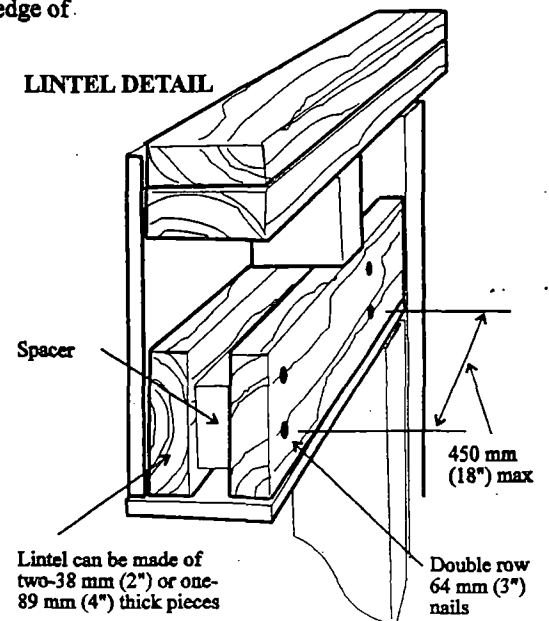
Framing

WATCH OUT FOR:

- nailing of framing
- joist support on beams
- subfloor nailing
- support for interior walls
- truss bracing (compression web)
- roof sheathing (gaps, edge support)



LINTEL DETAIL



Maximum Dimensions for Drilling and Notching of Floor Members

Member Size	Drilling		Notching	
	hole diameter		distance from support edge	depth of notch
38 x 89 mm (2" x 4")	not permitted		44 mm (1-3/4")	30 mm (1-1/8")
38 x 140 mm (2" x 6")	35 mm (1-3/8")		70 mm (2-3/4")	46 mm (1-3/4")
38 x 184 mm (2" x 8")	46 mm (1-3/4")		92 mm (3-5/8")	61 mm (2-3/8")
38 x 235 mm (2" x 10")	58 mm (2-1/4")		117 mm (4-5/8")	78 mm (3")
38 x 286 mm (2" x 12")	71 mm (2-3/4")		143 mm (5-5/8")	95 mm (3-3/4")



Prior to Drywall Inspection

(Please print clearly, you are making 4 copies.)

Inspection Date: _____ Civic Address: _____
 Builder Reference: _____ Municipality: _____
 Enrolment: _____ Lot: _____ Plan: _____
 Builder Name: _____ Builder's Phone: (____) _____
 Builder Site Rep.: _____ Building Permit: _____
 Inspector: _____ Regional Office: _____

Identify cladding type: Brick veneer ☐ Siding ☐ Other ☐ _____
 Identify ventilation system type: Point exhaust ☐ HRV ☐ Other ☐ _____
 (specify) _____
 (specify) _____

	Ontario Building Code 1993	Code & Construction Guide 1993	Acceptable		Re- inspection (yy/mm/dd) necessary	Corrected (yy/mm/dd)
			Yes	No		
1. Site condition and material storage	(workmanship)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
2. Interior foundation moisture barrier	(9.25.4.10.)	(11.2.3.(18-19))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
3. Installation of joist restraint	(9.23.9.3./4.)	(3.5.4.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
4. Proper beam end bearing	(9.23.8.1.)	(3.5.1.(11))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
5. Levelling and full bearing of sill plates	(9.23.7.2.)	(3.2.1.(4))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
6. Notching/drilling of framing	(9.23.5.)	(3.10.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
7. Location/support of interior load bearing walls	(9.23.9.8.)	(3.7.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
8. Stair head room	(9.8.3.4.)	(5.4.2.(4))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
9. Preparation of subfloor beneath areas of ceramic tile	(9.30.6.3.)	(14.2.5.(5))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
10. Continuity of air/vapour barrier	(9.25.5./6.)	(11.3.3./11.4.3.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
11. Installation of insulation	(9.25.2.)	(11.2.1.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
12. Roof/attic space ventilation	(9.19.1.1.)	(8.3.(1-4))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
13. Required ventilation system	(9.32.3.2.)	(12.3.3.(3))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
14. Bowing/warping of framing members	(workmanship)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
15. Masonry veneer flashing	(9.20.13.)	(15.1.9.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
16. Ties for masonry veneer	(9.20.9.5.)	(15.1.7.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
17. Exterior wall sheathing paper	(9.23.17.3.)	(7.1.6.(3-11))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
18. Step flashing at roof/wall intersections	(9.26.4.3./4.)	(8.5.4.(8-14))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /
19. Eave protection	(9.26.5.1.)	(8.5.5.(1-2))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	/ /

ADDITIONAL ITEMS: (Items observed, but not listed above, and are deficient and/or require comment.)

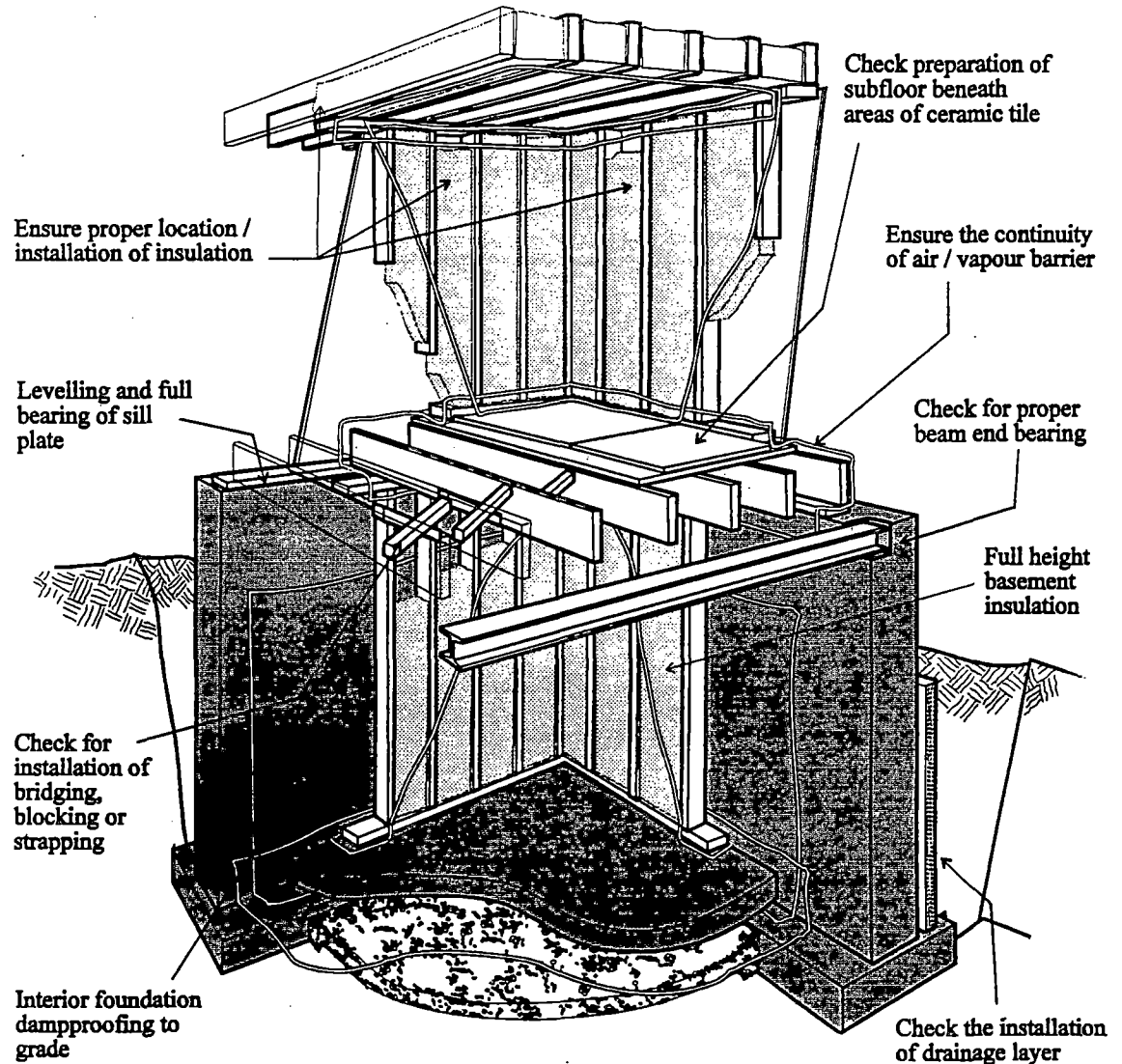
1. _____ ☐
2. _____ ☐
3. _____ ☐

Note: This inspection is for Warranty Program purposes only, and does not indicate full compliance with any Codes or Bylaws.

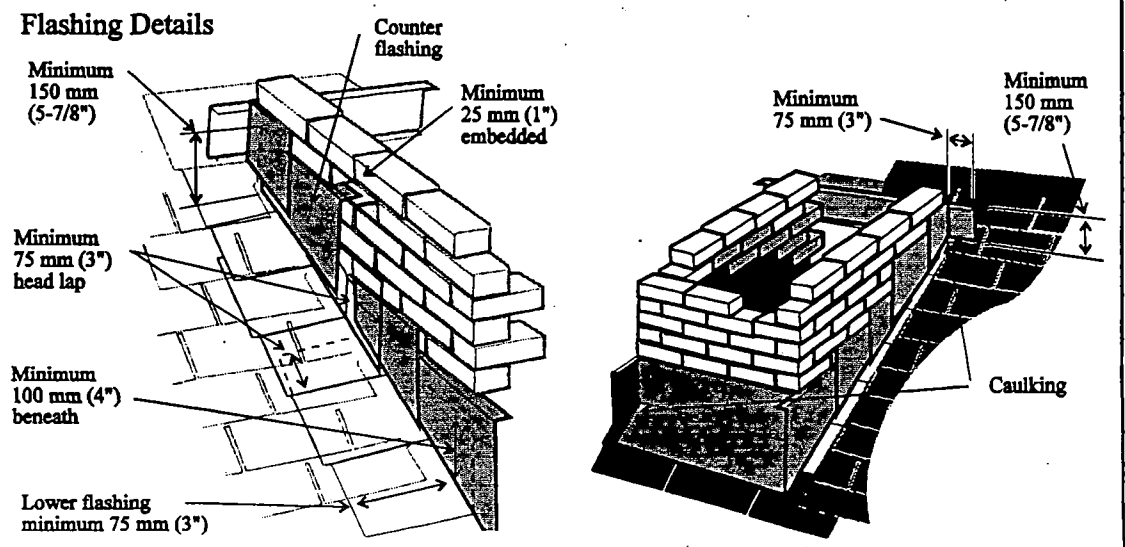
Prior to Drywall

WATCH OUT FOR:

- levelling and full bearing of sill plate
- notching / drilling of framing
- location / support of interior load bearing walls
- bowing and warping of framing members



Flashing Details





Completion Inspection

(Please print clearly, you are making 4 copies.)

Inspection Date: _____ Civic Address: _____

Builder Reference: _____ Municipality: _____

Enrolment: _____ Lot: _____ Plan: _____

Builder Name: _____ Builder's Phone: () _____

Builder Site Rep.: _____ Building Permit: _____

Inspector: _____ Regional Office: _____

If unit is subject to Builder Bulletin 33: Has the Certificate of Professional Field Review and Compliance of Private Sewage Disposal Systems (forms B-1, B-2) been received?

Yes ☐ No ☐

	Ontario Building Code (1990)	Code of Construction (1993)	Acceptable	Yes	No	Comments
1. Stair head room	(9.8.3.4)	(5.4.2.4)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
2. Installation of sump pump (where required)	(9.14.5.2)	(2.10.20)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
3. Weather stripping of attic hatch	(9.25.5.5)	(11.3.3.6)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
4. Attic space insulation	(9.25.2.1/7)	(11.2.1.2)(5)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
5. Installation and insulation of exhaust ducting	(9.32.3.10)	(12.3.6.1-3)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
6. Garage floor slope	(9.35.2.2)	(16.1.1.4)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
7. Exterior finished grading	(9.14.6)	(2.10.21-24)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
8. Masonry veneer weep holes	(9.20.13.9)	(7.2.11.2)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
9. Exterior caulking	(9.27.4)	(15.3.3)	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
10. Sag/distortion of roof sheathing	(workmanship)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
11. Condition of exterior painting	(workmanship)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
12. Condition of exterior cladding	(workmanship)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
13. Condition of interior painting	(workmanship)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
14. Condition of interior drywall	(workmanship)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
15. Condition of interior millwork	(workmanship)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
16. Condition of interior floor coverings	(workmanship)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /
17. Condition of windows and doors	(workmanship)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>		/ /

ADDITIONAL ITEMS: (Items observed, but not listed above, and are deficient and/or require comment.)

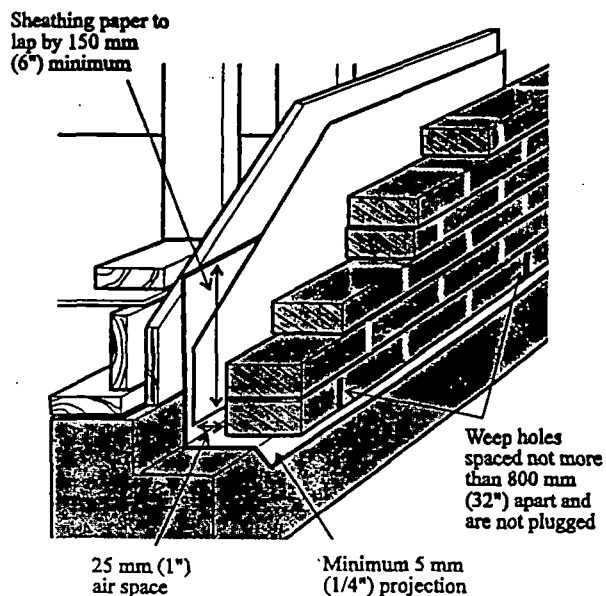
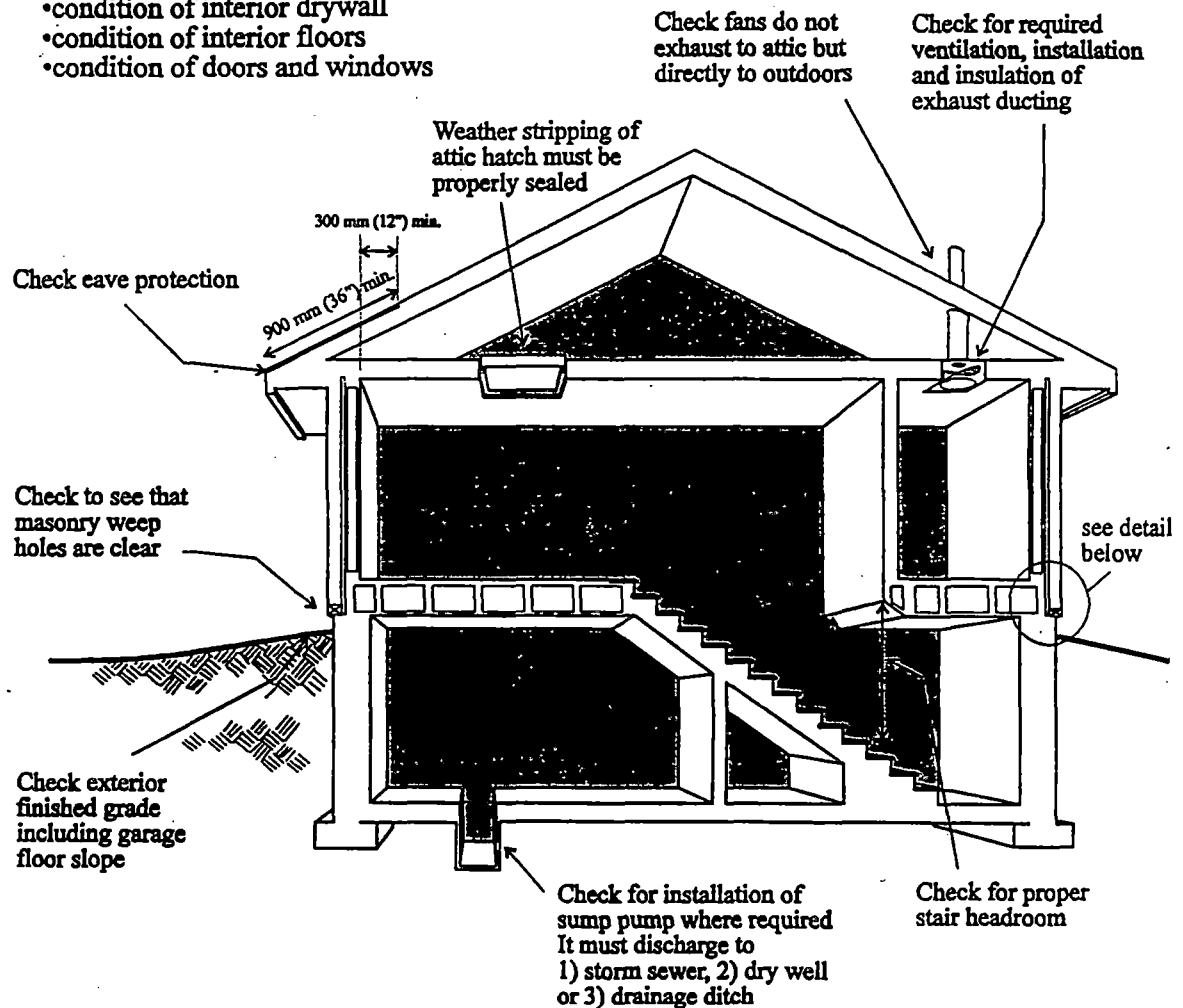
1. _____ ☐
2. _____ ☐
3. _____ ☐

Note: This inspection is for Warranty Program purposes only, and does not indicate full compliance with any Codes or Bylaws.

Completion

WATCH OUT FOR:

- attic space insulation
- condition of exterior painting
- condition of exterior cladding
- condition of interior painting
- condition of interior drywall
- condition of interior floors
- condition of doors and windows



Veneer Tie Spacing

Maximum Vertical Spacing, mm (in.)	Maximum Horizontal Spacing, mm (in.)
400 (16)	800 (32)
500 (20)	600 (24)
600 (24)	400 (16)