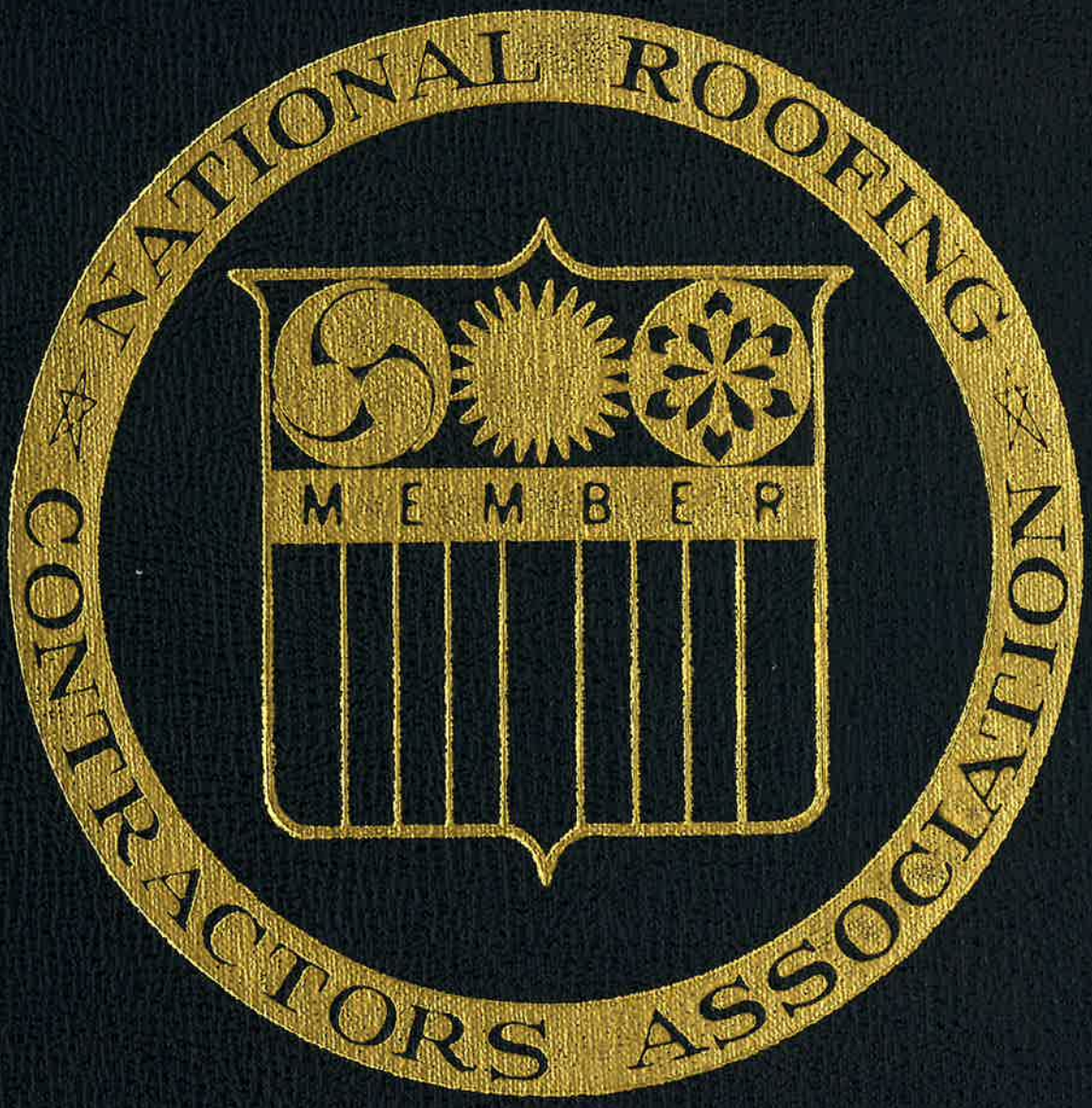
NATIONAL ROOFING CONTRACTORS ASSOCIATION
MEMBER

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A. OBJECTIVES OF ROOFING MANUAL

OBJECTIVES OF ASSIGNMENT: The apprentice will realize the importance of completing his training.

REFERENCES:

RELATED INFORMATION:

General Objectives:

1. To teach the apprentice the obligations he has toward his trade and his employer, and also his responsibility to the public.
2. To develop in the apprentice job pride and appreciation of good workmanship for the betterment of the trade.
3. To teach correct job safety and health rules so that he may know how to guard his life and health.
4. To develop pride in the proper care and use of personal tools and other equipment furnished the roofer for his use on the job.
5. To develop trade judgement needed to promote trade standards.

Specific Objectives:

1. To teach the apprentice the national and local code requirements for certain specific roofing processes.
2. To teach the apprentice the composition and properties of roofing materials.
3. To teach the apprentice blueprint reading.
4. To present a variety of job problems in teaching the apprentice the ability to solve practical problems he will encounter while working at the trade.
5. To teach the trade technology necessary to complete the succeeding courses he will be required to take.

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B. WHAT IS APPRENTICESHIP?

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain what apprenticeship is.

REFERENCES:

WHAT IS APPRENTICESHIP?

Apprenticeship is one of the oldest forms of education known to man. It is an educational system by which an individual who derives his livelihood from a highly skilled occupation imparts the knowledge and skills pertinent to that occupation to another individual who wishes to make his career in the same skilled occupation.

In the early days of recorded history we find apprenticeship a common practice among silversmiths and similar skilled trades. A young man or in some cases his parents would work out an agreement with a skilled trade craftsman. This agreement normally provided that the young man would work for the craftsman as a helper for little or no wages in turn the craftsman would teach the boy the skills of the trade.

Apprenticeship has progressed greatly since those early days. However, the basic concept of the craftsman imparting the knowledge and skills to the apprentice has remained the same. Today, the training program has been highly formalized and refined; the apprentice no longer works for little or no wages, but rather receives a good living wage while he is receiving his education.

Today, apprenticeship is a cooperative business-like method by labor and management through which a young man entering a skilled trade is given instruction and experience, both on and off the job, in all aspects of the scope of the particular trade. Through this system of education the young man progresses, acquires new skills and masters the application of those skills through practical application on the job. In this manner the young man is a productive member of the labor force and becomes an increasingly valuable man as he progresses in the program. Apprenticeship is a sound investment in the future for both the young man and his employer.

ADVANTAGES OF APPRENTICESHIP

1. The apprentice is an employed worker.
2. He is paid good wages while he learns.
3. He becomes self-reliant at a relatively early age.

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4. He should not be a financial burden to his parents.
5. He will learn to produce with modern tools and equipment.
6. He will gain experience in the latest methods.
7. He will have knowledge of current industrial materials.
8. He will work under direction of competent journeyman.
9. He will attend classes for the required number of hours.
10. His work reports and class grades will be reviewed by the Joint Apprenticeship Committee before each wage increase. (He must earn it.)
11. His rate of pay will increase with his knowledge and skill.
12. Apprenticeship is planned training. He will enter his industry through the front door.

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C. WHAT IS A JOURNEYMAN? AND WHAT ARE THE ADVANTAGES OF ATTAINING JOURNEYMAN STATUS?

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain what a journeyman is, and what advantages this status carries.

REFERENCES:

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D. HISTORY OF ROOFING APPRENTICESHIP

OBJECTIVE OF ASSIGNMENT: The roofing apprentice will be able to briefly explain the history of the roofing apprenticeship program.

REFERENCES:

HISTORY OF ROOFING APPRENTICESHIP

Recognizing there is no substitute for apprenticeship, and that there is a definite obligation on the part of the roofing industry to supply means for young men to obtain training and education to fit them for useful working lines, the National Roofing Contractors' Association and the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association, resolved to establish trade training for apprentices in accordance with the basic standards of the Bureau of Apprenticeship and Training. These standards provide guidelines to attain the efficiency and versatility required for true craftsmanship, will help immeasureably to raise the overall level of workmanship for the trade and develop the necessary background for good citizenship.

The first step toward this goal was taken in 1945, when the National Roofing Contractors' Association and the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association, met jointly and formulated a National Pattern for Local Apprenticeship Standards in the Roofing Industry. These pattern standards were valuable as an instrument toward the promotion of apprenticeship as well as being of assistance to joint apprenticeship committees in the formulation of local apprenticeship standards.

Almost twenty years later, it was again evident that the industry and the program had progressed to the point where additional action was necessary. For that reason, the two national organizations of the industry met and formulated the National Joint Apprenticeship and Training Committee for the Roofing Industry.

Continuously on the alert for ways and means to improve training methods and procedures, the National Apprenticeship and Training Committee for the Roofing Industry has revised the original pattern standards. It has established minimum national standards for the industry to meet the requirements for added skills and technical knowledge brought about by everchanging techniques and new competitive materials. These changes have increased the need for more versatile, thoroughly trained craftsmen, capable of performing a more efficient, long-lasting, and perfectly executed job.

Certificate of Registration was received from the Secretary of Labor and Administrator, Bureau of Apprenticeship and Training, March 4, 1955.

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THE APPRENTICESHIP SYSTEM. The apprenticeship as a system for training beginners in the skilled trades has been in use since the dawn of history. Various other systems have been tried without success: there is no substitute.

The apprentice learns by doing, that is, by practicing his trade under the instruction of a journeyman engaged in the same kind of work. Historically, his pay for the work he did for his employer consisted either in whole or in part of the instruction he received. Nowadays, it is customary for an apprentice to receive both instruction and wages.

A written code regulating apprenticeship existed as early as 2100 B.C. Apprentice training formed the chief means of trade education up to the time of the machine age. Originally, it was used in some of the professions as well as in the trades. However, apprenticeship has declined in the professions and in other occupations where general knowledge and scientific principles form a much larger part of the content to be learned than do skills. In the development of skilled tradesmen, training on the job is still considered essential, and apprenticeship is the best means of regulating such training.

APPRENTICESHIP IN THE GUILDS. Very early records of the operations of the apprenticeship system are vague. This system began to flourish with the growth of the guilds at the beginning of the twelfth century. The guild was a trade association whose membership was made up of masters, journeymen, and apprentices in a particular trade. The right to work at a trade depended upon being a member of its guild, and membership often carried with it also the privileges of citizenship.

Apprenticeship based upon a written agreement, called an indenture, was created and controlled under the guilds. The relationship between master and apprentice was much like that between father and son, the master's authority extending to every phase of the apprentice's life. The master was responsible for providing the apprentice with food, clothing, housing, and tools: and for teaching him the trade, as well as instructing him in ethics, morals, and religion usually for four years. In the fifth year, the apprentice received his first pay and provided his own support. In the sixth year, his pay increased so that he could not only support himself but also furnish his own tools. At the end of his training the boy was given an examination; if he passed, he became a "journeyman", or day workers, as the name originally meant. When he was able to pay the necessary fees and to set up his own establishment, he himself became a master. Since this whole process was closely supervised by the guild, apprenticeship in a guild became a thorough and effective means of training.

Under a factory system and with changed production methods, the guilds were doomed to decline. However, apprenticeship outlived the guilds and continued to exist for a time after the development of the factory system of production.

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COLONIAL AMERICAN APPRENTICESHIP. During the early history of the United States, the supply of skilled workers came largely from Europe. There was no organized method of learning a trade. As our country expanded and society grew more complex, tradesmen became interested in organizing their occupations and setting up apprenticeship systems. Colonial apprenticeship resembles that of the guilds in the Middle Ages, although it was not as closely supervised.

EFFECTS OF THE INDUSTRIAL REVOLUTION. As the factory system developed, abuses in the apprenticeship system became prevalent. The protection for the apprentice previously provided by the guilds was gone, and the system developed into a form of industrial slavery for the young. Frequently an apprentice was required to perform all manner of tasks that had no bearing on his trade training, and his period of apprenticeship was often much longer than would actually have been necessary to learn the trade.

By 1860, the Industrial Revolution had blotted out completely the old type of apprenticeship. America entered upon the period of industrial expansion of the seventies and eighties with no established program of effective industrial education. There were many reasons for the decline of apprenticeship: (1) With the development of machinery, fewer skilled workers were needed. (2) Many employers considered it unprofitable to train apprentices because, after the training period was over, the apprentice often found work with another employer who had not bothered to train his own apprentices. (3) Often workmen themselves did not approve of apprentices and tried to prevent a boy from learning all of the trade. (4) Apprentices were frequently poorly paid while learning a trade, whereas unskilled jobs paid much better. (5) Many boys hesitated to enter manual trades because such work meant soiled hands and rough clothes.

SUBSTITUTES FOR APPRENTICE TRAINING. With the decline of the old type of apprenticeship, many substitutes were tried. For varying reasons, all of them failed. Specific occupational training schools, mostly private institutions, did not fill the need. Sometimes they failed because of the opposition of organized labor groups whose members felt that such training schools would overcrowd the trade; sometimes it was because the number of men taking the training was insufficient to meet demands for keeping the ranks of skilled workers filled. All of these training schools were subject to a serious handicap - it is not possible under school conditions alone to prepare properly for success in most trades. On the job conditions like pay, production speed, commercial standards of workmanship and the possibility of discharge create mental attitudes toward learning that cannot be produced by the school environment.

RECENT REVIVAL OF APPRENTICE TRAINING. By the early part of the twentieth century, an effectively organized system of training was needed in the skilled trades. Since efforts on the part of some of the more active trade groups in the country did not provide a wide enough solution to the problem, it seemed advisable to encourage

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these efforts through action of the federal government. As a result, the Federal Committee on Apprenticeship and the Apprentice-Training Service were established in 1934. The Fitzgerald Act, passed in 1937 made the Apprentice-Training Service, now known as the Bureau of Apprenticeship, a permanent agency of the Department of Labor.

The Federal Committee on Apprenticeship is now made up of five representatives of employers, five representatives of labor and a representative of the U.S. Office of Education. Its functions are:

1. To promote a better national understanding of apprenticeship standards and to to develop and recommend minimum standards of apprenticeship for various trades.
2. To act in a technical, consulting, and advisory capacity to all agencies concerned with labor standards for apprenticeship.
3. To co-operate with state apprenticeship councils and with local trade apprenticeship committees.
4. To act as a control agency for the collection and distribution of information on progress, methods, and procedures useful in promotion labor standards for apprenticeship.

APPRENTICE TRAINING IN ST. LOUIS AND VICINITY. Although the establishment of national agencies contributed greatly to the rebirth of apprenticeship, the details of apprentice training programs have been determined on the local and state levels. Organized apprentice training in California originated with the passage of the Shelley-Maloney Apprentice Labor Standards Act in 1939. According to the provision of this law, the Governor appoints the Apprenticeship representatives of the general public, the Director of Industrial Relations, and the Chief of the Bureau of Industrial Education. The Apprenticeship Council exists mainly to promote and develop apprenticeship throughout the state. Included among the duties of this council is the establishment of standards for minimum wages, maximum hours, and working conditions to be named in apprenticeship agreements.

An apprentice is defined by the Shelley-Maloney Act as a person at least 16 years old who has entered into a written apprenticeship agreement with an employer or his agent. This agreement must provide for not less than 2000 hours of reasonable continuous employment and for participation in an approved program of not less than 144 hours per year of training in related and supplemental subjects.

The Shelley-Maloney Act named the Director of Industrial Relations as Administrator of Apprenticeship and established the Division of Apprenticeship Standards to carry out his duties in his capacity. This office does the detail work necessary for seeing that all apprenticeship agreements conform to the standards set up by the law and by the policies of the council.

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Apprenticeship arrangements are handled by committees representing the local employee and employer organizations. In the roofing trade, representative of the local unions and employers' organizations co-operate to form local joint apprenticeship committees. These committees exercise authority granted them by the apprentice when he signs the agreement and by the organizations they represent, as established in written agreements between employees and employer groups. Usually these agreements are called apprenticeship standards. They commonly involve the selection, rating, registration, promotion, and discipline of apprentices; enforcement of individual apprenticeship agreement; determination of wages for apprentices; and the supervision of job training.

In addition to their responsibilities to the employee and employers organizations, joint apprenticeship committees may be asked by local boards of education to advise school personnel concerning details of class organization, and concerning qualifications and selection of teachers of apprentices. They also work to encourage the active interest and support of the general public for the apprentice training program.

APPRENTICESHIP IN THE ROOFING TRADE. Recognizing the need for appropriate and complete training and education for young men desiring to enter the roofing trade, the National Roofing Contractors' Association and the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association have been instrumental in the development of the apprenticeship program in this trade. In an effort to establish trade training for apprentice in accordance with the recommendations of the Federal Committee on Apprenticeship, these national association in 1945 established a national pattern for local apprenticeship standards in the roofing industry. In 1956 these organizations formed the National Joint Apprenticeship and Training Committee for the Roofing Industry, which functions to "revise the original pattern standards as well as to establish minimum national standards for the industry to meet the everchanging techniques and new competitive knowledge required in the trade and the necessity for more versatile, thoroughly trained craftsmen, capable of a more economical, long-lasting and perfectly executed job." This national group co-operates in its activities with local groups also concerned with apprenticeship.

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E. ETHICS AND PUBLIC RELATIONS FOR THE ROOFING TRADE

OBJECTIVE OF ASSIGNMENT: The apprentice will realize that his actions will reflect on his co-workers, his employer and the roofing trade.

REFERENCES:

RELATED INFORMATION: ETHICS

An individual's ethics determine his actions in relation to other human beings and thus, in a sense, his way of living. In studying ethics we attempt to understand how to live and work harmoniously.

The professions have codes of ethics or sets of principles or rules that provide standards of behavior for the individual and the group. A code of ethics works to the mutual advantage of all those who uphold it and maintain the standards of service to the public. On the other hand it also helps to gain the favor of the public for the individual and the group.

THE ROOFER'S PERSONAL CODE OF ETHICS. The following is a code of ethics which might be kept in mind in all activities on the job. The craftsman with good character and desirable personality is an asset to his employer and consequently his services are sought. This can mean added security for the workman and his family. Also, important is the fact that living by this code of ethics will reward any roofer with the respect of his co-workers and his employers.

I will respect the welfare of my fellow workers, my employer, myself by working and thinking safety in a persistent manner.

I will strive to acquire the respect of the public, my friends and my employer by being honest and trustworthy.

I will strive to create a contagious atmosphere for co-operation among my fellow workers by showing humility and good will in speech and deed.

I will be loyal to my employer at all times, recoginzing the value of loyality to success.

I will never cast doubt upon my employer's integrity but work to secure the respect and admiration of those with whom I associate. In order to maintain my own integrity, I will not accede to the request of unscrupulous employers.

I will be tolerant of other races, of other's ideas in order to build a spirit of friendship and co-operation.

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I will strive to be courteous, recognizing that thereby job tensions are reduced and morale strengthened.

I will strive to avoid profanity, intoxicants, drugs, or abusive actions on the job so that I may never be ashamed of my actions.

I will be punctual at all times in order to be fair to my employer, my fellow workmen and myself.

I will constantly strive to raise my standard of skill and knowledge in my chosen craft so that I may never need to refuse an employer's request for service.

I will strive to take zealous pride in my assigned tasks. This I know will make my life more interesting.

I will be very careful to observe the rules of appropriate personal apperance knowing this will earn me the respect of my fellow workmen and the public. I will remember this is a key to my general character.

I will be glad to disseminate unselfishly the knowledge and skills of my craft in order to help the apprentice and the industry.

I will always strive to maintain proper communications with my employer and my fellow workers.

PUBLIC RELATIONS:

Since almost every craftsman's job depends on his employer's business, it is always wise for him to keep his employer's welfare in mind, particularly as it concerns the public. The employee is largely responsible for the quality of public relations his employer enjoys.

Here are some everyday things you should remember. They help to influence public opinion concerning both you and your employer.

1. Protect the public by maintaining barricades, warning lights and signs. An accident to an outsider because of unprotected work areas may result in serious injury to an innocent bystander. It could also create a poor reputation for your employer, as well as unnecessary difficulties in completing the job. Your employer can also become financially and even criminally involved if obvious negligence should lead to personal injury or property damage.

2. Protect the neighbor's property by shielding when pouring liquids or spraying, keeping nails off lawns, etc. When it is necessary to make electrical connections through his property, protect gardens and shrubbery. Careless employees have often caused lawsuits. Cover the ground under the kettle.

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3. Make a habit of using proper behavior and language. It is then possible to work without fear of embarrassment in any situation, such as among women and children.

4. Check and protect materials delivered to the job.

5. Remember with practice a job can be done fast and well if you know how in the first place.

6. Your reputation as well as that of your employer is at stake when you are working on re-cover. Also, exercise particular care in cleaning up and in avoiding hazards or other unsafe or unsightly conditions when the premises are occupied while work is going on.

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F. FEDERAL LAWS

OBJECTIVE OF ASSIGNMENT: The apprentice will realize the importance of the various Federal laws, and how they provide him with security.

REFERENCES:

FEDERAL LAWS THAT PROVIDE SECURITY FOR THE WORKER

The federal government since 1935 has provided old-age survivors insurance to workmen and their beneficiaries who qualify under the social security law.

Several other federal laws also affect the skilled worker. These do not provide him with actual cash benefits, but rather with improved working conditions and standards.

Under the special security law three kinds of payments are made: monthly retirement payments to insured workers and under certain conditions, their wives and dependent children; monthly survivors' payments to widows or other dependents, of deceased insured workers; and disability payments to insured persons from 50 to 65 years of age who totally disabled for work.

Disability Benefits: The social security law makes special provision to protect the old age and insurance rights of people who have sufficient work covered by social security but who become totally disabled and unable to work for a long period of time.

Applying for Social Security Benefits: As soon as you start on a covered (insured) job, you should obtain a social security card, which records your permanent account number. You will be asked to show this card to every employer for whom you work subsequently and you will use the number on it to file claims for old age and survivors' benefits. You should keep in periodic touch with the Social Security Administration Office nearest you for information about your current insurance status. Apply there immediately for benefits when you retire.

Keeping Informed: You may obtain additional information on the benefits discussed in this topic from pamphlets available free from the local offices of the Social Security Administration.

Other Federal Laws Affecting the Worker: The Fair Labor Standards Act provides minimum wages and maximum hours for all workers engaged in interstate commerce or in the production of goods for interstate commerce. Although this does not affect many of the skilled trades directly, it does tend to raise the general level of pay and lower the level of hours worked for everyone, since the skilled worker will always be in sufficient demand to command better pay and working conditions than the minimum, whatever that may be.

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The Walsh - Healy Act sets standards of pay and working conditions for all persons employed on federal government contracts or sub contracts. This also tends to raise the level of conditions and pay for all other skilled workers.

The Labor-Management Relations Act (Taft-Hartley) is an amendment of an older law passed in 1935. The amended law guarantees the right of workers to organize and to bargain collectively with their employers; it permits the union shop (wherein employees may be compelled to join a union after they are hired); and it requires a sixty-day cooling off period before a strike or lockout can be called. There are a number of other provisions many of which are considered controversial, but all of which directly affect the worker in his union and his employer.

Channels for Advancement. Many men who enter the roofing trade think only of journeymanship as their ultimate goal and do not realize the possibilities for higher positions. In the apprenticeship training program, of course, the primary aim is journeymanship. However, many other horizons lie within the reach of every journeyman, with just a little extra effort. The journeyman may become a foreman of a roofing crew, salesman or estimator for a roofing company, a superintendent of a roofing company, or a contractor. He may also become a salesman of roofing materials or equipment for a manufacturer.

Requirements for Advancement. Entrance into any field of work beyond journeymanship requires additional qualifications and training. Courses are available in the public schools and in correspondence schools in which the journeyman can gain technical knowledge additional to that he acquired during his apprenticeship. Whereas the journeyman roofer possesses skills in the use of hand tools and equipment, as well as related knowledge, the good foreman also has the ability to lead men. The superintendent needs all these qualities plus a keen mind, a pleasing personality, a level head, and a good deal more technical information.

To become a salesman requires knowledge of selling methods, understanding of people, acceptable speech, knowledge of basic mathematics and sone bookkeeping, and skill in reading blueprints. Roofing companies often sell many items indirectly related to roofing, such as siding, waterproofing, and insulation. These products, too, must be studied by the salesman. Usually information about such products is available most readily from the manufacturers. In most cases, a salesman of roofing products who is a qualified roofer is more successful than is a person without this qualification.

Usually a roofing contractor must obtain a license from the state, as well as from the city or county, or both, in which he operates. However, much more is involved in becoming a successful contractor than obtaining a license. A successful contractor is a good businessman. He knows business procedures, some business law, bookkeeping and cost accounting, and business organization; and he has all the qualities required of a good foreman, superintendent, and salesman as well. The training necessary for a roofing contractor is available in most evening schools or correspondence courses.

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Many variations in roofing practices as well as differences in jurisdictions exist throughout the United States. Roofers who plan to change locations should find out what skills might be needed in the area to which they plan to move and should acquire these skills as soon as possible.

The ambitious journeyman has many doors open to him. By taking advantage of every opportunity to improve himself, he may feel real pride in his trade and may soon advance to higher goals.

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G. EMPLOYEE AND EMPLOYER ORGANIZATIONS

OBJECTIVE OF ASSIGNMENT:

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify the various employee and employer organizations, and explain how and why they exist.

REFERENCES:

EMPLOYEE AND EMPLOYER ORGANIZATIONS

The development of employer organizations on the one hand and employee organizations on the other has been characteristic of American economic system. Employers have tended to group themselves according to their common interest into associations; employee organizations based on mutal interest have become known as labor unions.

Early labor organizations: Local labor organizations confined to one craft.began to appear in the United States as early as the 1780's and 1790's and increased rapidly during the next thirty years. The first national convention of labor representatives was held in 1834. Like present day unions, these groups were interested in higher wages, shorter hours, and better working conditions. However, they were purely local and never succeeded in forming national organizations. After the end of the Civil War in 1865, the growth of large cities and large industries encouraged the development of much larger and more powerful labor organizations.

The first important national was the National Labor Union. For a few years prior to 1872, this was the outstanding labor organization in the country. The next was the Knights of Labor which grew very rapidly during the late 1870 and early 1880's. This organization was composed of a mixed membership. However, its membership declined rapidly patially because craft groups did not feel it was sufficiently interested in the welfare of the skilled worker. Many of them withdrew to solve their own problems through labor organizations within their own crafts.

American Federation of Labor. While the Knights of Labor was declining in membership and influence, the American Federation of Labor was laying the foundation for what was later to become the outstanding labor organization in the United States. It was particularly successful because it met the needs of the skilled workers for a national organization that would be devoted entirely to the immediate problems of their groups. The AF of L, as it came to be called, originated from a group of cigarmakers led by Samuel Gompers, who became the first president of the national organization. He held that office from 1886 until his death in 1924.

However, the national organized craft groups have been the backbone of the organization.

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In cases where local unions have a national or international organization, they may obtain federal charters from the AF of L. State federations unify and promote the interest of labor in each state.

The objectives of the AF of L have included shorter workdays, higher wages and better working conditions for its members. Besides these specific programs the organization has also had an interest in the promotion of state and national legislation for the welfare of the wage earner and the general public.

Congress of Industrial Organizations. Long before the beginning of the AF of L, there were many who believed that labor organizations should not be organized on the basis of particular skills or crafts. These individuals felt that the interest of all the workers in any given industry were similar and not greatly influenced by the particular jobs the workers performed. In 1935 a group of such leaders within the AF of L formed the committee for Industrial Organization. They were subsequently expelled from the AF of L. To a large extent they represented the workers in industries where mass of employees were semi-skilled or unskilled, who did not feel that there was any place for them in the old craft unions. This organization spread into may fields, adopted a constitution and changed its name to the Congress of Industrial Organizations, or the CIO.

Merger of the AF of L and the CIO. After a number of years of bitter fighting between these two organizations, a willingness to cooperate began to emerge. In 1955 a formal merger took place that gave birth to a single national organization called the AF of L - CIO. This merger established an organization that contains the great majority of organized labor in the United States.

Independent Unions. A certain number of unions are not associated with either of the large national organizations. Outstanding among these are the International Association of Machinists and the United Mine Workers. These are usually referred to as "independent" unions.

Employee Organizations. The United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association came into being through the amalgamation of two organizations chartered by the American Federation of Labor: (1) The International Slate and Tile Roofers Union of America, chartered in 1903, and (2) The International Brotherhood of Composition Roofers Damp and Waterproofers of the United States and Canada, chartered in 1906.

The amalgamation of the two organizations into a single organization took place in 1919 and received its charter from the American Federation of Labor on December 17, 1919 under its present name. The organization is affiliated with the Building and Construction Trades Department of the AF of L - CIO.

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Employer Organizations. The first organizations of roofing contractors in America were informal and grew up when contractors found it necessary to ban together in cases of emergencies such as the Chicago fire. In 1882, a formal organization called the Master Slag and Gravel Roofers of America was founded in Chicago. At the beginning of the century another national organization, the Associated Roofers of America, was formed in Omaha. In 1911, these two organizations merged to form the United Roofing Contractors Association, which in 1948 became the National Roofing Contractors Association. Also in 1911 manufacturers of asphalt and coal tar pitch products organized the Prepared Roofing Manufacturers' Association. Out of this organization grew the Asphalt Industry Bureau, an information bureau of the industry. The Western Asphalt Roofing Bureau serves the same function on the Pacific coast.

The National Roofing Contractors' Association covers all crafts in the roofing industry. However, at present the majority of its members are specialists in built up roofing. Its objectives are to disseminate to members information on trends in the roofing industry on new and improved methods of applications of industry products and on improved methods of estimating, record keeping, merchandising and specifications.

Coordinating Organizations. Since the AF of L - CIO contains unions from different building trades, whose interest in some cases might conflict, the organization provides for local Building Trades Councils to coordinate the interest of these groups. In addition the AF of L - CIO urges all its unions in the larger localities to send delegates to city organizations usually called "Central Labor Councils".

SAFETY

NAME _____ DATE _____

A. SAFETY AND FIRST AID IN THE ROOFING TRADE (Trade professionalism)

OBJECTIVE OF ASSIGNMENT:

OBJECTIVE OF ASSIGNMENT: The apprentice will be familiar with the safety rules and regulations on a local, state and federal level as related to the roofing trade.

The apprentice will exhibit the behavior which demonstrate the basic philosophy of professionalism and safe work habits.

REFERENCES:

1. Local Safety Rules and Regulations (optional - use as available)

2. IC-3 State of Ohio - Specific Safety Requirements of the Industrial Commission of Ohio Relating to Construction, 700 West Third Avenue, Columbus, Ohio 43212.

3. Roofers Safe Working Rules - Construction Industry Safety Committee of Ohio (CISCO), The Industrial Commission of Ohio, Division of Safety and Hygiene, 700 West Third Avenue, Columbus, Ohio 43212.

4. a. The Williams-Steiger Occupational Safety and Health Act 1970.

   b. Federal Register, Volume 36 - Number 75, Part II, Department of Labor, Bureau of Labor Standards. Safety and Health Regulations for Construction. Subparts C, D, E, F, G, H, I, L, M, N.

   Order both documents from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

*NOTE TO INSTRUCTOR:

Appropriate safety instruction will be incorporated in each lesson where applicable.

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B. PERSONAL PROTECTIVE EQUIPMENT

OBJECTIVE OF ASSIGNMENT: The apprentice will demonstrate an understanding of the necessity of protective equipment by complying with the guidelines while on the job.

REFERENCES:

RELATED INFORMATION:

HARD HATS: Hard hats should be worn whenever any kind of activity takes place above your working level, and in almost all cases by any man working on the ground level. IF IN DOUBT, WEAR A HARD HAT.

SHIRTS & PANTS: Wear shirts that have full length sleeves and buttoned cuffs. Wear cuffless pants that are full length and cover the top of the shoes. They should be free of holes, hanging parts or rips.

GLOVES: Wear gloves at all times. It is particularly important that they have no gauntlets or cuffs and are tight at the wrists.

SHOES: Shoes should be ankle high with rubber soles.

GLASSES: All personal glasses on the job should have safety lenses. During cleaning or tear-off operations or when pneumatic equipment is being used, shatter proof goggles should be worn.

Whether you wear glasses or not, protect your eyes. All kettlemen are required to wear eye protection.

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C. ACTIVITY ON THE GROUND

OBJECTIVE OF ASSIGNMENT:

OBJECTIVE OF ASSIGNMENT: The apprentice will demonstrate an understanding of the following guidelines, by strict observance of the guidelines while on the job.

REFERENCES:

RELATED INFROMATION:

UNLOADING & HANDLING OF MATERIAL: Take care to make proper use of skids or other mechanisms for unloading material. Determine for yourself that placement is secure so that the units will not slide. Make an effort to learn and practice the proper procedure for lifting:

a. Get solid footing
b. Stand close to your load
c. Bend your knees and lift with your legs, not with your arms or back muscles

You should not twist your body when turning with a load. Try always to turn with your feet and legs. Always survey the working area to make sure all ditches and holes are covered or planked and that uneven terrain is barricaded off or warning devices are used.

GROUND HOISTING EQUIPMENT: Be sure ground hoist is securely anchored and properly weighted for loading requirements. Check the braking mechanism and all cable lines before operating or loading. When securing loads to the line, you should check hooks and all fastening mechanisms to be certain they are secure. Check for slippage and test load by raising it slightly clear of the ground before sending up. Stand clear of hoist load. Never stand beneath the hoist. Always be alert to the possibility that some inadvertent circumstance may pull the hoist over or loosen the load or its slings. Keep your distance from such work done by others on the job. All chains and sprockets on equipment shall be guarded. All defective wire rope shall be removed from service.

PROPER CARE OF EQUIPMENT ON THE GROUND: Heating kettles should be in good operating condition with covers for the open top of the kettle. If there is any doubt as to the proper operation of the kettle, check with your foreman for directions and safety considerations. Kettlemen should be knowledgeable about the effects of high winds in creating a fire hazard. Care should be taken so that a man's face is never over the flue or confined area when lighting the burner.

Fuel tanks for all heating equipment should be safely located and properly secured.

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Propane tanks should be secured upright and anchored by chains, cable or heavy-duty rope, so that they could not be knocked over during the normal course of activity.

Kerosene should be transferred with a hand pump or spigot type pouring containers. Do not use open type containers, such as hot pails for handling kerosene. Drum kerosene and other flammable supplies should be on the proper stand, and stored in a safe area away from equipment and trucks moving on the job.

Keep the area around kettles and heating equipment clear and clean.

Bulk storage and tanker equipment require special handling and instructions. The movement, transfer and heating of materials should be supervised by knowledgeable people.

When clean-up of job site involves burning materials, make sure fires are located at least 50 feet from the building. Wind conditions have to be watched when burning any material.

Any trucks that are loaded with scrap or trash must be secured so that material does not blow off or fall off in transit. Do not start fires without permission of general contractor and be sure fire fighting equipment is available to fight fires should they get out of hand or threaten to spread. Do not start a fire in high wind.

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D. ACTIVITY ON THE ROOF

OBJECTIVE OF ASSIGNMENT:

OBJECTIVE OF ASSIGNMENT: The apprentice will demonstrate an understanding of the following guidelines by strict observance of the guidelines while on the job.

REFERENCES:

RELATED INFROMATION:

ACCESS TO THE ROOF: Ladders to the roof should be secured at the top to prevent any sliding or fall-out from the building. Ladders should be set at such an angle that the horizontal distance from the top support to the foot to the ladder is one-quarter (1/4) the unsupported length of the ladder rails, unless the ladder is lashed or otherwise held in position to prevent slipping (i.e. a support at the 24 ft. level should be set out 5 ft. from the building at the ladder's base). Ladders must extend 3 feet above the roof level.

Any hoist mechanism used for personnel must be used within their prescribed safety and loading limitations. Make sure you are aware of these limitations before using. Do not use any hoisting equipment for personnel which is not specifically designed for this purpose. Do not haul personnel and materials at the same time. Stay off hoist hooks or loads.

DECK CONDITIONS: All metal or plank decks should be secured (welded, if steel; clipped, if plank) to assure solid footing. When in doubt, test your footing first, before stepping out.

All openings must be covered or safety railings provided. Workmen must be cautious in working near the edge of the roof or around any openings. All personnel must approach any opening walking forward, never walking backward. If vision is not clear because of carrying material or equipment, call for help to guide you. If for any reason a safety railing or covering must be removed to enable use of openings or work near edges, then such railings or coverings should be immediately replaced by the person who originally moved them when work is completed. No one else can do this for you. Protect your fellow worker.

Never cover any type of roof opening with sheets of roofing insulation or other roofing material. Someone may pick these up and step forward into the opening.

When landing material and setting up hoist, check bar joist spacing and the load limits of the deck. Plywood should be used to prevent damage to deck. In adverse weather

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where snow or ice conditions exist, provide for stops at any edge where slipping would be a hazard.

OBJECTIVE OF ASSIGNMENT:

MOVING MATERIALS ACROSS THE ROOF: When using machinery or hand carts or moving material, check for a clear path and maintain a balanced load to eliminate tipping, slidding or other hazardous procedure. Do not overload equipment.

When using ramps, check for any tendency to backslide or any unstable condition of the ramp that would contribute to tipping or sliding.

When transporting hot material across the roof, take special care against tipping or losing control of the rolling unit.

Containers of hot material should be limited to approximately 3/4 full to prevent slopping or splashing of material.

ROOFTOP EQUIPMENT: Rooftop equipment should be kept clean and oiled and in good working condition.

Safety devices employed on equipment should never be removed.

Caution must be used in fueling of machinery; employ only safety approved fuel containers. Equipment shall not be refueled without shutting off equipment.

Operators of machinery shall observe special safety precautions for operations such as spudding, cleaning, operating power brooms or pneumatic equipment.

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E. HAND TOOLS – LESSON TITLE

OBJECTIVE OF ASSIGNMENT:

OBJECTIVE OF ASSIGNMENT: The apprentice will demonstrate an understanding of the following guidelines by the strict observance of the guidelines while on the job.

REFERENCES:

RELATED INFORMATION:

Keep hand tools in good repair and clean. Use the tool only for the purpose for which it was intended. Always be aware of those working around you for the effects of the tool you are using. This is most important with spudding activity. Use caution in carrying any tools in your pockets. Be sure all sharp edges are protected.

Always look behind you before swinging a tool such as an axe. Use special precautions in the use of insulation knives and sharp bladed equipment so that the tool is under control and not likely to slip and slash.

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F. STEEP ROOFS LESSON TITLE

OBJECTIVE OF ASSIGNMENT:

OBJECTIVE OF ASSIGNMENT: The apprentice will demonstrate an understanding of the following guidelines by strict observance of the guidelines while on the job.

REFERENCES:

RELATED INFORMATION:

On slopes where the roof is steeper than a 4 inch rise per foot, special consideration must be given to footing and handling of materials.

Chicken ladders or cleats shall be used on the roof as required for adequate footing. These should be kept clear of all material and dirt so they remain effective. Brackets and planks should be used in eaves with adequate nailing of brackets and roof decking.

Safety lines and safety belts of an approved type should be properly worn and secured with rope. High-type canvas shoes with grip-type rubber soles should be worn when working on steep roofs.

Carrying and transporting materials should be limited to a safe amount so that balance and footing are not impaired.

EAVE CONDITIONS: Eave conditions require special attention in that a stop should be provided if gutter or some other mechanical device is not present at the eave. Where hazardous height is involved, special provisions, such as eave scaffolds or equivalent, should be provided to assure safe working conditions.

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G. SAFETY EQUIPMENT ON THE JOB

OBJECTIVE OF ASSIGNMENT:

OBJECTIVE OF ASSIGNMENT: The apprentice will demonstrate the easiest methods of using safety equipment and be able to recognize the importance of this equipment on the job.

REFERENCES:

RELATED INFORMATION:

FIRE EXTINGUISHER: Fire extinguishers should be present on all jobs requiring heating materials. The size of fire extinguishers shall meet the state fire laws and requirements in proportion to the size of the job, the equipment and the volume of the heated material.

When fire extinguisher powders are used, there shall be more than one box of such powder, each located separately.

Fire extinguisher equipment should be located or arranged so that it will be accessible if a fire develops and not trapped so you cannot get at it.

Locate fire blankets so that they are available at some nearby accessible location.

Know the location of the First-Aid Kit, which should be available on the job for minor accidents.

On any sizeable job know the location of the first-aid blanket and stretcher. These should be available to provide temporary care for severly injured persons until ambulance facilities arrive.

All personnel in the construction industry should be given instruction by some qualified organization on the control of bleeding, respiratory relief, first-aid treatment of burns.

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H. BELOW GRADE WORK

OBJECTIVE OF ASSIGNMENT: The apprentice will demonstrate an understanding of the following guidelines by strict observance of the guidelines while on the job.

REFERENCES:

RELATED INFORMATION:

FOUNDATIONS: On waterproofing and dampproofing work on walls below grade, check access in and out of the excavation and double check for satisfactory footing. Ladders or ramps shall be provided.

Determine that embankments are sloped at the proper angle or a bracing system used to prevent cave-ins or earth slides. This will depend on soil conditions at the site.

Maintain reasonable working space between the wall and the excavation with a minimum of 3 feet of such space.

TUNNELS AND CHAMBERS: When working in confined areas, such as tunnels, assure yourself of adequate ventilation and that sufficient air is moving in and out of the confined area.

Be sure that adequate ventilation is available to allow for fumes.

Wear air masks when the confinement limits the air supply, when the air has possible contamination, or if there is any doubt about air safety.

Use safety lines where access is hazardous.

Have another man present, removed from the dangerous area, to provide notice and help if needed.

Don't be part of the problem. Become a part of the solution; work and live safely.

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I. FIRST AID THEORY AND SKILL

OBJECTIVES OF ASSIGNMENT: The apprentice will recognize the importance of being knowledgeable in the field of first aid since he is now associated with a craft of a hazardous nature.

The apprentice will be capable of demonstrating and explaining basic first aid theory and skills.

REFERENCES:

Local chapter of the American Red Cross. This organization upon the request will furnish your program with a qualified instructor. Prior to Red Cross instruction a basic familiarization program by the roofing instructor is recommended. Ref. Standard First Aid Handbook. Any instructor giving this training should be certified American Red Cross Instructor.

*NOTE TO INSTRUCTOR:

During the course of instruction an emphasis should be placed on the transporting of a victim from the roof deck area to the ground.

RELATED INFORMATION:

Be reluctant to make statements to the victim and bystanders about the injuries. It is not the first aider's province to diagnose, evaluate, and predict. Upon questioning from the victim, you can answer that you would rather have the physician give information. Helpers must be given necessary information, however.

Obtain the victim's name and address: When calling for a physician or ambulance be sure to give the exact location of the injured person, and such information as you have concerning the nature of the injuries. Be sure that the physician or ambulance driver knows where to go. Take advantage of the telephone call to obtain good advice concerning first aid. To avoid missing questions or advice, wait until the physician or driver hangs up.

Reassure the victim by telling him what first aid steps you are going to take and how they will help him.

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If the victim is unconscious, loosen clothing about his neck. If there is no fracture, turn the patient on his side, maintaining this position by flexing the leg or legs and place a pillow under the head so that secreations may drool from the corner of the mouth. This will usually allow good respiration.

THE HOW AND WHY OF FIRST AID: First aid is defined as the immediate and temporary care given the victim of an accident or sudden illness until the services of a physician can be obtained.

First aid commences with the steadying effect upon the stricken person when he realizes that competent hands will help him. The victim suddenly has new problems and needs. Often he cannot think well temporarily. Events may seem unreal and remote. His mind may be dull. The emotional reaction associated with a serious accident subsides only gradually. Therefore, first aid is more than a dressing or a splint. It relates to the victim's mind and spirit as well as to his physical injuries. Its contributions include the well selected word of encouragement, the expression of willingness to help, and the uplifting effect of the first aider's evident capability. The thoughtful suggestions made to solve the immediate problems, the information given concerning nearby physicians and hospitals, the telephone call to summon medical help or an ambulance or to notify a relative - these too are first aid.

The good first aider deals with the whole situation, the person, and the injury. He knows what to do as well as what not to do. Thus he avoids the errors so commonly made through well-meant but misguided efforts. He confines his procedures to what is necessary, recalling that the handling of injured parts should be kept to a minimum.

THE VALUE OF FIRST AID TRAINING: Value to self: Although many people study first aid in order to help others, the training primarily helps the student himself. It enables him to give proper immediate care to his own injuries. If he is too seriously injured to help himself, he may be able to direct others toward proper care. He need not entrust his injured body to the first aid knowledge of random passersby.

First aid training also helps the student by developing his safety consciousness. Most people recognize the gravity of our accident problem. Their efforts towards safety, however, may be occasional and hit-or-miss rather than a part of a carefully organized plan developed by them for safe living. The first aid course sharpens the desire for safety, shows how accidents occur, and focuses attention upon many specific ways to avoid accidents. A good way to guide anyone toward safety is to have him take a first aid course.

Value to others: Having studied first aid, one is more likely to assist family members wisely if they are stricken, to give them some instruction in first aid, and to promote

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among them a reasonable safety attitude. While the principal benefits are to the student and his family, they extend farther, usually, to co-workers, acquaintances and strangers. There is always an obligation on a humanitarian basis to assist the stricken, the helpless.

Value in civil defense: First aid training is recognized as an important aspect of civil defense. In case of catastrophe, with medical and hospital service curtailed, citizens must rely largely upon themselves for a time, caring for their own injuries and for those of others. Possession of first aid knowledge is a civic responsibility.

Value in fostering safety consciousness: Disabling accidents, severe enough to cause loss of time from the usual duties for at least one day after the day of injury, occur annually in from one-fifth to one-fourth of our family units. After the first year of life, all through childhood and early adulthood, accidents are the commonest cause of death: thereafter they are one of the leading causes. The rate is about twice as high among males as females, with many wage-earners affected. The annual costs for medical and hospital service and direct property damage alone total slightly less than one percent of national personal income.

When all wage losses and insurance costs are added, the total is about three percent. Such costs, year after year, greatly affect welfare expenses and rehabilitation needs. They reflect the fact that many daily serious accidents represent an enormous expense and a large number of personal tragedies.

How can first aid help us avoid accidents? Some reasons have already been given. When we spend some hours studying fractures, head injuries, and burns, we appreciate with more force what it means to suffer injury. Thereafter, safety programs seem more important and we personalize their message better. Thus first aid training fosters forcefully the safety consciousness that we all need.

General Directions for First Aid: Most accidents are minor and the first aid needed is obvious to a trained person. In case of serious injury, the following sequence of action is usually applicable; give the urgently necessary first aid, have the victim lie down, check for injuries, plan what to do, and carry out the indicated procedure.

Give urgently necessary first aid: Act quickly for injuries where each second of delay is important: (a) Severe bleeding (b) Stoppage of breathing where artificial respiration helps (c) Poisoning. The proper first aid will be described later. While the first aider's time and attention are devoted to the patient, someone else should go or call for a physician.

Certain injuries require prompt help - severe burns, for example - but the immediate

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danger to life is not so great. The urgent cases are seldom encountered; they can usually be recognized and the first aid requirements are relatively simple. With most serious accidents, the first aider commences with the next step.

Keep the victim lying down: Protect him from unnecessary manipulation and disturbance. Do not heat the patient but keep the body temperature from falling. Blankets beneath are usually more important than above, but there is a hazard in placing them before you know where the injuries are.

Check for injuries: Your clues are the story of what happened, the victim's reactions after the accident, his own ideas about his injuries, and your findings upon examination. The direction and extent of examination should be guided by the kind of accident and the needs of the situation. Have a reason for what you do. If the urgent first aid has been given and the patient is properly protected pending early arrival of a physician, a detailed examination is unnecessary. If you must move the victim even a short distance before the physician comes, you should first learn what body parts are injured so that you can support them adequately during the transfer.

Suppose, however, you must carry through with first aid and perhaps transport the victim. Here you must check carefully for injuries. Sometimes the task is simple because it clearly involves exposed part, or because, by the nature of the accident there is no possibility of fractures, lacerations and the like. An example is poisoning. In other cases you recognize that any body part may be injured and require attention. These cases are the accidents by force: for example, traffic accidents, falls, gunshot wounds, blows. With them you should assure yourself, through consideration of the above mentioned clues, about every body part the neck, head, trunk, each extremity in turn. Remember always to consider head injury and back injury. With each part, think of surface injury, of fractures, and of internal organ injury. In addition, note the patient's general condition and state of consciousness.

Surface injuries are readily evident. Fractures and internal organ injuries present greater difficulties. Visual evidence may be lacking with the former and almost always is with the latter. Therefore, your objective in checking for them is simple: find what body parts are, or possibly may be, injured. Your first aid should aim to keep these parts immobile.

Checkup for injuries is far more accurate when the body part is exposed. Such exposure may be possible in the home. Utmost caution should be used when clothing is removed, lest added injury result. In public places, with strangers as victims, exposure of body parts that may be injured is generally not advisable. In such cases you must act in the light of such knowledge as you can obtain from the story of the accident, the victim's ideas and reactions, and whatever checkup you can make. When in doubt about a body part, keep it from twisting, bending and shaking and do not jackknife the patient. Do not pick him up by the head and heels.

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Plan what to do: Get to a physician or ambulance or obtain medical advice by telephone. This should be one of the first moves. Discuss the problem with responsible relatives or friends of the victim who are at hand or briefly with the victim. If helpers are needed, instruct them carefully in their duties.

Carry out the indicated first aid: Knowing what to do presents few difficulites, once the nature and location of the injuries are learned. Do not attempt to save time and effort by using second-best methods of first aid for this person entrusted temporarily to you in his distress. First, stop profuse bleeding and determine whether artificial respriation is necessary. After that, one may take time for a more general examination.

Selected additional pointers: Find all the injuries. The checkup is often incomplete or sketchy after the first injury is found - especially if it is a major injury.

Give first aid to minor as well as major injuries: For example, a common error upon finding a fracture of a large bone and one of a small bone is to splint only the large bone.

Do not give fluids to an unconscious or partly conscious person: Because they may enter the windpipe. Do not attempt to rouse an uncounscious person by shaking him, talking or shouting.

Following injury, do not lift a gasping person by the belt: This is done very often and may aggravate injuries of the back or internal organs. Gasping is not always caused by insufficient oxygen but may be due to injury of back or chest.

With indoor accidents, use judgement about opening windows when weather is cold except when noxious gases are present and may have caused the accident. Indoors or out, the victim has enough air and cold air may be too chilling.

SHOCK: Objective: To prevent or reduce shock by keeping the victim lying down and comfortable.

Shock is a term used with many meanings. Of most importance to first aiders is traumatic shock, which is a depressed condition of many of the body function due to failure of enough blood to circulate through the body following serious injury.

Decidedly different conditions are electric shock, discussed elsewhere, insulin shock, caused by an overdose of insulin; the temporary shock of simple fainting and the psychiatric condition formerly called shell shock.

CAUSES AND DANGERS OF SHOCK: Traumatic shock is associated with injury to body tissue from burns, wounds or fractures. In most instances, it is caused by loss of large quantities of blood either externally or into the tissues or body cavities. In general the greater the damage to flesh and bone and the larger the blood loss, the

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greater the danger that shock will occur.

Shock may be produced or made worse by any manipulation that increases hemorrhage or causes it to recur. Rough handling of the patient should be particularly avoided. The aged and the debilitated do not withstand shock as well as others.

If a person develops shock and remains in it, death may result even though the injury causing the shock would not be fatal otherwise. Therefore, proper first aid to help prevent or to deal with shock is essential when caring for any seriously injured person.

SIGNS AND SYMPTOMS OF SHOCK: The most improtant evidence is the victim's weakness coupled with a skin that is pale and moist and cooler than it should be.

Beads of perspiration may be noted about the lips, forehead, palms and armpits. The patient may vomit or complain of nausea. His mental reactions may appear normal at first. Later, he may be restless or lose alertness and interest in his surroundings. Thirst is commonly present.

The pulse is fast but may be weak or impossible to feel. The patient may breathe faster than usual and occasionally take deep breaths. These signs may not appear at once. Especially in cases of severe hemorrhage, they may develop only after an hour or more.

Shock should not be confused with simple fainting. Individuals with minor injuries may faint. Even persons who have not been injured may faint at the sight of a serious accident, particularly if blood is visible. One who has fainted will be pale and often covered with perspiration. He may be nauseated. The pulse will usually be slow. If he is allowed to lie flat, recovery will occur promptly.

Since the evidence of shock may not be present, even when the injuries are severe, the first aider may fail to apply proper measures. The victim may seem alert and react optimistically but suddenly he may collapse. Sometimes only a few signs of shock are noted and the first aider may think there is little need for concern. He may even permit transportation of the victim in the sitting-up position. The proper course is simple. Give first aid for shock to all seriously injured people.

FIRST AID FOR SHOCK: The same first aid measures apply to both prevention and care of shock.

Position: Keep the patient lying down. The lying-down position favors the flow of a greater amount of blood to the head and chest, where it is needed most. It places less demand upon the body than the sitting or standing positions. It is the most favorable position if there is injury to the internal organs and the head, or in case of

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a fracture. There is one exception to the horizontal position: if there is difficulty in breathing, the patient's head and chest should be elevated.

Except as noted below, elevate the lower part of the body if the blood loss is great or the injury severe. Raise the foot of the bed or stretcher eight to twelve inches. If the victim is on the floor or ground, place pillows or substitutes beneath the lower extremities. This elevation should not be done: (1) if there is a head injury; (2) if breathing difficulty is thereby increased or (3) if the patient complains of pain when it is attempted. That is, pain at a fracture site in the lower extremity or abdominal pain. For lesser injuries such as: a fracture of the wrist, elevation is unnecessary, though not harmful.

HEAT: If the victim is lying on the ground or floor, place a blanket beneath him. Cover him only sparingly according to the temperature of the environment. Do not cause sweating. It is better if he is slightly cool than toasting warm. On warm days little or no surface covering is needed.

Application of external heat by hot water bottles and heating pads is usually harmful in shock. They may be used in cold weather if sufficient blankets are not available to prevent freezing. If so use utmost care not to burn the patient. Remember that you test the warm object for only a second or so, whereas it may be in contact with his skin for a long time. Normally his skin will not withstand heat, further, he usually does not recognize that a burn is developing whether he unconscious or not. The warm object should have a temperature only slightly above body temperature. The over-all principle relating to heat in shock is this: do not add heat; simply prevent a large loss of body heat.

FLUIDS: If the patient will be under medical care within a half hour or less, the first aider need not concern himself with fluids except to allay thirst. Fluids have value in shock. Nevertheless, they should not be given if the patient is unconscious or only partly conscious, if he is nauseated, has a penetrating abdominal wound or probably faces early operation.

Plain water, neither hot nor cold, is the best fluid. Other drinks may cause nausea, a feeling of fullness and hiccups. Do not give alcoholic drinks. A set rule concerning the amount of fluid to give cannot be stated, because individual cases vary so much. If there will be delay until medical care is available, administer a few sips at first. Observing the patient's tolerance and thirst, increase the amount to a half glass at a time. In case of large blood loss, the patient is usually thirsty and will take drinks at short intervals. Your concern should be to see that he does have fluids but at such doses and intervals that he does not vomit. If he vomits or is nauseated, do not give fluids.

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If medical care will be unavailable or considerably delayed, give half glass doses of water, to which has been added one-half level teaspoon salt and one-half level teaspoon of baking soda per quart at about fifteen minute intervals.

Within an hour medical advice should be obtained. The problem of fluid administration is not great in first aid usually because the patient will have medical attention fairly soon.

OTHER MEASURES AGAINST SHOCK: The underlying injuries should receive attention. For example, hemorrhage should be controlled and fractures splinted. The victim should not be disturbed by unnecessary questioning, manipulation and noise. Tactful encouragement should be given. Stimulants such as ammonia or coffee have no value in traumatic shock.

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UNIT LETTER – LESSON TITLE

QUESTIONS: FIRST AID:

OBJECTIVE OF ASSIGNMENT:

1. What kinds of fractures are difficult to identify?

2. What should defintely not be done to an infected wound?

3. What are the objectives of first aid care for burns?

4. Tell whether each of the following is a first-degree, second or third degree burn- Blisters develope, Skin reddened, Deep tissue damage?

5. What are the three ways to relieve the pain of a minor first degree or small second degree burn?

6. What fluid should you give to a victim of severre burns if medical help will be delayed?

7. What are two symptoms that help you tell the difference between heat stroke and severre heat exhaustion?

8. How do you apply direct pressure to an open wound if you don't have anything to use as a dressing?

9. List three ways to stop serious bleeding from a deep wound in a victim's arm?

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UNIT TITLE – LESSON TITLE

10. The three steps for preventing shock and for giving first aid for shock are?

OBJECTIVE OF ASSIGNMENT

11. At what rate do you give artificial respiration to an adult; a child?

12. Is the breath pressure used in mouth to mouth resuscitation the same for an adult and a child?

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ALPHA LETTER – LESSON TITLE

QUESTIONS:

OBJECTIVE OF ASSIGNMENT

1. A person holding a valid certificate in first aid is required on a job site under what circumstances?

2. List five basic types of personal protective equipment required on construction sites.

3. What three types of fire extinguisher could be used on a Class B fire?

4. Under the law what is the definition of a barricade?

5. Whenever materials are dropped to any point lying outside the exterior walls of a building, what conveyance shall be used?

6. For what unsafe conditions should all wooden tool handles be inspected prior to use?

7. Should fuel powered tools be refuled while the engine is running?

8. When rope supports are used in roofing, what size and type of rope is required?

9. When is it permissable for a person to ride a material hoist?

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[illegible] – LESSON TITLE

10. What is the maximum height to which a thirty-two foot extension ladder may be extended safely?

OBJECTIVE OF ASSIGNMENT:

11. Name safety factors to be considered when inspecting a ladder for safe condition and use?

12. Why is it required that wooden ladders must be unpainted?

13. Why should all accidents be reported immediately?

14. Who is responsible for reporting an injury?

*Note: Additional questions should be developed and used by the instructor with regard to local safety rules and regulations.

APPLIED MATH

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A. INTRODUCTION TO APPLIED MATH FOR THE ROOFER

OBJECTIVE OF ASSIGNMENT:

OBJECTIVE OF ASSIGNMENT: The apprentice will realize the importance of mathematics to the trade, and will be able to explain the many uses of math for the roofer.

REFERENCES:

INTRODUCTION: The roofing foreman who wishes to be successful must learn to work accurately with numbers. On the job he encounters problems of layout and spacing that he must be able to solve accurately. He must be able to make accurate subtractions in checking roofing materials ordered, and used. Multiplication is of particular importance in calculating area, an operation that is performed many times by a roofer.

The ability to divide whole numbers is needed by the roofer on a job for the solution of a great many problems.

While it is not the intention of this topic to teach mathematics to the roofing foreman, it does give him an opportunity to acquaint himself with the amount of mathematics that is considered necessary to his trade and should he fall short of the requirements, he can then if he desires, take the necessary steps to bring his mathematical ability up to the required industry standard.

The following mathematical problems, if properly answered, will give an indication to the foreman as to whether or not his mathematical ability is sufficient to perform the day-to-day mathematical tasks that come within the scope of his work. If he feels that it is lacking, he may wish to seek aid from any one of the many excellent texts that are available. Consult your local library or bookseller.

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12. 437 x 47

13. 271 x 2100

14. 421 x 103

15. 2929 x 989

DIVISION OF WHOLE NUMBERS:

Divide the following:

16. 720 ÷ 5

17. 7581 ÷ 21

18. 151,202 ÷ 173

19. 8908 ÷ 34

20. 8272 ÷ 752

ADDITION: The specification calls for Built-up roofing on a Main Building, a Garage and a Tool House. From the Plans you can learn that the Building will require 124 rolls, the Garage 32 rolls and the Tool House 4 rolls. How many rolls of Felt should you tell the Office to have delivered to the job-site?

SUBTRACTION: The area of the Roof of a Building is 4,700 square feet. There is a Penthouse on the Roof which has an area of 200 square feet that will have a pyramid, galvanized roof. What area of built-up roof will you have to install?

MULTIPLICATION: The Nailing of shingles requires 2-1/2 pounds of nails per square. If you have to lay 130 squares of shingles, how many pounds of nails will you need?

DIVISION: If you have 12 equal size canopies with a total area of 36 squares which you have to roof, how many squares should you have delivered to each canopy site?

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B. WHOLE NUMBERS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to correctly complete problems involving the addition, subtraction, multiplication, and division of whole numbers.

REFERENCES:

ADDITION OF WHOLE NUMBERS:

Add the following:

1. 15 + 3 + 6 + 17 + 11 + 12
2. 864 + 124 + 13 + 191 + 9
3. 116 + 109 + 167 + 153 + 96 + 46
4. 1261 + 2097 + 4036 + 3921 + 983
5. 9783 + 126 + 8791 + 5 + 73 + 53,479

SUBTRACTION OF WHOLE NUMBERS:

Subtract the following:

6. 73 - 31
7. 1000 - 28
8. 940 - 367
9. 6605 - 3903
10. 8541 - 7963

MULTIPLICATION OF WHOLE NUMBERS:

Multiply the following:

11. 87 x 21

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C. FRACTIONS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to correctly complete problems involving the addition, subtraction, multiplication, and division of fractions.

REFERENCES:

FRACTIONS

The use of linear measurements in terms of yards, feet and inches, results in the need to make calculations involving common fractions. Engineers work with feet and inches divided into tenths, which enables them to solve problems by decimals. However, roofers use measuring tools on which feet are divided into twelfths and inches into quarters, eighths and sixteenths and in some cases, thirty-seconds and sixty-fourths.

In spite of the fact that whenever possible, dimensions on buildings are kept in even numbers of feet, many different lengths, sizes and spacings are given in feet and inches and fractional parts of an inch. Therefore, it is important for a roofer to have a knowledge of how to figure problems involving fractions.

A fractional unit is one of the equal parts of a unit. Fractions take their name and the value from the number of equal parts into which the entire unit is divided.

If a unit is divided into 2 equal parts, one of the parts is called one-half.

If a unit is divided into 3 equal parts, each part is called one-third.

If a unit is divided into 9 equal parts, each part is called one-ninth.

To express a fraction in figures, two terms are required: one to denote the number of parts into which the unit is divided, this is called the denominator, and it is placed below the line. The other is to denote the number of parts taken, called the numerator, and placed above the line.

Therefore:

one half is written: 1/2

one third is written: 1/3

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two thirds is written: 2/3

one eighth is written: 1/8

five eighths is written: 5/8

Multiplying both terms of a fraction by a number does not change its value, thus 1/2 is equal to 2/4 or 3/6 or 5/10, etc.

ADDITION OF FRACTIONS: All denominators must be reduced to a common multiple. Then change the numerators to corresponding value and add numerators.

Example: Add 1/3, 1/4, 2/3 and 1/2

In this you will note that the least common denominator is 12.

1/3 = 4/12
1/4 = 3/12
2/3 = 8/12
1/2 = 6/12

21/12 = 1 - 9/12 = 1 - 3/4 answer

SUBTRACTION OF FRACTIONS: To subtract fractions, reduce denominators, to the least common denominator and subtract.

Example: From 3/4 take 2/3

Explanation: We see that 12 is the least common denominator, so we reduce 3/4 and 2/3 to 12ths.

3/4 = 9/12
2/3 = 8/12 therefore, 9/12 minus 8/12 = 1/12 answer

MULTIPLICATION OF FRACTIONS: Multiplying fractions is done by the process of cancellation. The common factors are cancelled from numerators and denominators and the remaining numbers multiplied.

Example: Multiply 5/12 by 3/5

Solution:

$$\frac{\cancel{5}^{1}}{\cancel{12}_{4}} \times \frac{\cancel{3}^{1}}{\cancel{5}_{1}} = \frac{1}{4}$$

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ADDITION OF FRACTIONS

Add the following:

1. 1/2 + 1/16 + 3/4 + 5/8
2. 1 1/2 + 1 1/4 + 1 1/8
3. 3 1/2 + 4 5/16 + 1 1/8 + 3 3/4
4. 2' 2 1/2" + 5' 6 3/4" + 8' 9 5/16"
5. 2/3 + 8/18 + 10/13 + 9/7

SUBTRACTION OF FRACTIONS

Subtract the following:

6. 3/4 - 7/16
7. 6' 6 1/2" - 3' 3 1/4"
8. 10' 5 1/2" - 2'6"
9. 10' 2 9/16" - 5' 3 1/8"
10. 18' 6" - 7' 1 1/2"

MULTIPLICATION OF FRACTIONS

Multiply the following:

11. 1/8 x 2/3
12. 3/4 x 7/16
13. 2 5/8 x 19 3/4
14. 5' 2 3/8" x 24
15. 14 3/4 x 16 5/8

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D. MEASUREMENT

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to correctly compute problems using the various units of measurement.

REFERENCES:

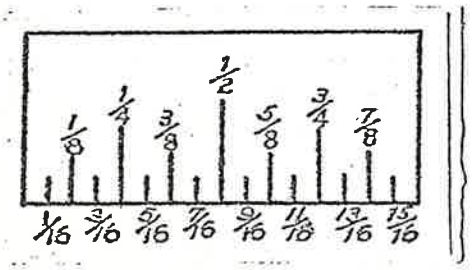
MEASUREMENT: The roofing foreman encounters daily problems that require the use of measuring.

A few examples follow:

> The roofer wishes to know how many square feet of roofing are left to be done, this necessitates him measuring the area involved which may be rectangular, triangular, a series of small penthouses that are different sizes, etc. These must be measured and the areas involved calculated.

Another typical problem encountered by the roofing foreman is the required number of lineal feet or square feet of flashing material. While this may be fairly simple, if the flashing material is of the same girth; tapered areas, and areas of different widths present problems. Therefore, we give the following examples showing methods of calculations, actual calculations and their answers.

THE STANDARD RULE: One inch of rule:



1. How many parts in one inch of standard rule?

2. How many inches in one foot of standard rule?

3. a. 1/16 + 1/16 =
   b. 1/16 + 1/8 =
   c. 1/8 + 1/8 =
   d. 3/16 + 1/8 =
   e. 4/16 + 2/16 =
   f. 1/4 + 1/8 =
   g. 1/4 + 3/16 =
   h. 1/4 + 1/4

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i. 5/16 + 1/4 =
j. 5/16 + 5/16 =
k. 1/8 + 1/4 =
l. 6/16 + 1/4 =
m. 1/4 + 3/8 =
n. 7/16 + 1/4 =
o. 2/4 + 1/4 =
p. 1/8 + 5/8 =
q. 3/16 + 4/8 =
r. 3/8 + 3/8 =
s. 7/16 + 3/8 =
t. 1/8 + 9/16 =
u. 3/16 + 9/16 =
v. 4/16 + 1/2 =
w. 6/16 + 1/2 =
x. 2/8 + 4/8 =
y. 5/16 + 5/8 =
z. 1/4 + 11/16 =
aa. 3/8 + 9/16 =
bb. 8/16 + 8/16 =
cc. 1/8 + 7/8 =
dd. 1/4 + 3/4 =
ee. 3/8 + 5/8 =
ff. 1/2 + 1/2 =

4. How many of the following in one inch of standard rule?

a. 1/16 Sixteenths
b. 1/8 Eighths
c. 1/4 Quarters
d. 1/2 Halves

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F. ROOF DECK SURFACING (MEASUREMENT)

OBJECTIVE OF ASSIGNMENT: The apprentice will be familiar with the various methods of computing roof deck area. The apprentice will be able to accurately compute the roof deck area of various roofs.

REFERENCES:

ROOF DECK SURFACING:

Before starting to lay a built-up roof covering, regardless of the type or kind, the surface of the roof deck should be examined to determine if the surface is smooth enough to apply the roofing properly.

The roof surface is what the roofer meets and deals with. If the surface is not smooth enough and clean enough to receive proper application, the roof should not be applied.

The roofer has no jurisdiction over the construction of the roof deck and its supporting structure, but he does see the roof surface and can be held responsible for poor application if the roof surface is not suitable to receive proper application.

FORMULA: Area of gable roof = 2 x width of roof (that is, length of the rafter) x length of roof (or ridges).

SOLUTION FOR GABLE ROOF IN FIG. 2: 2 x 10' x 20' = 400 sq. ft.

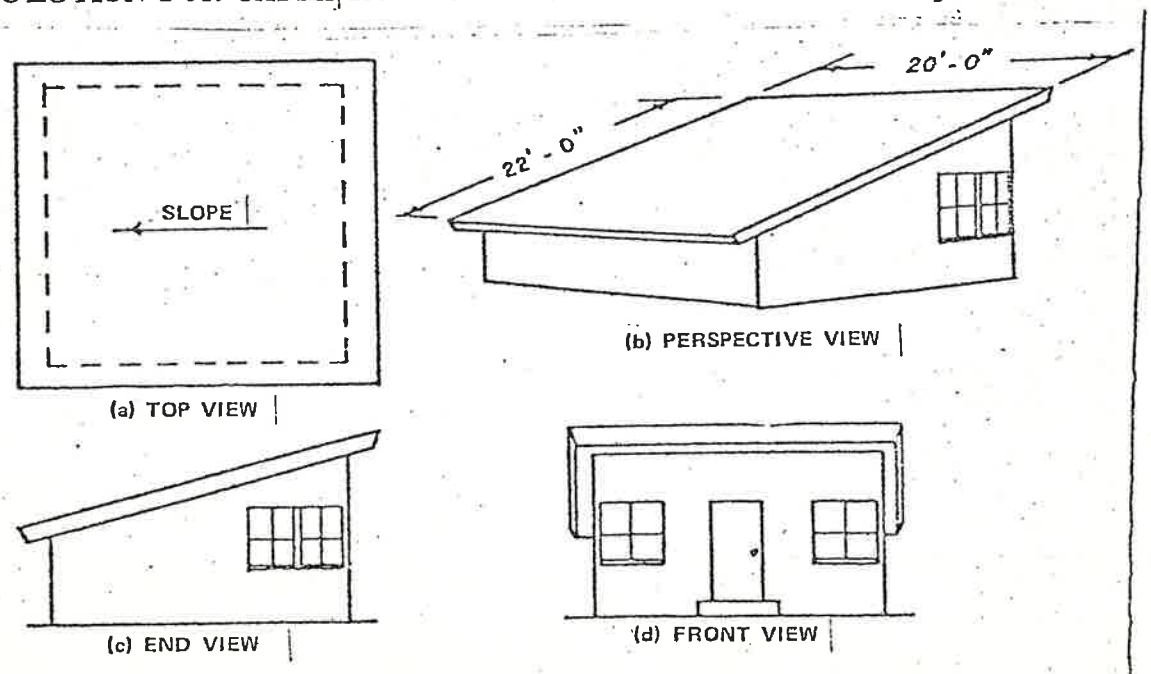

FIG. 1. Shed Roof

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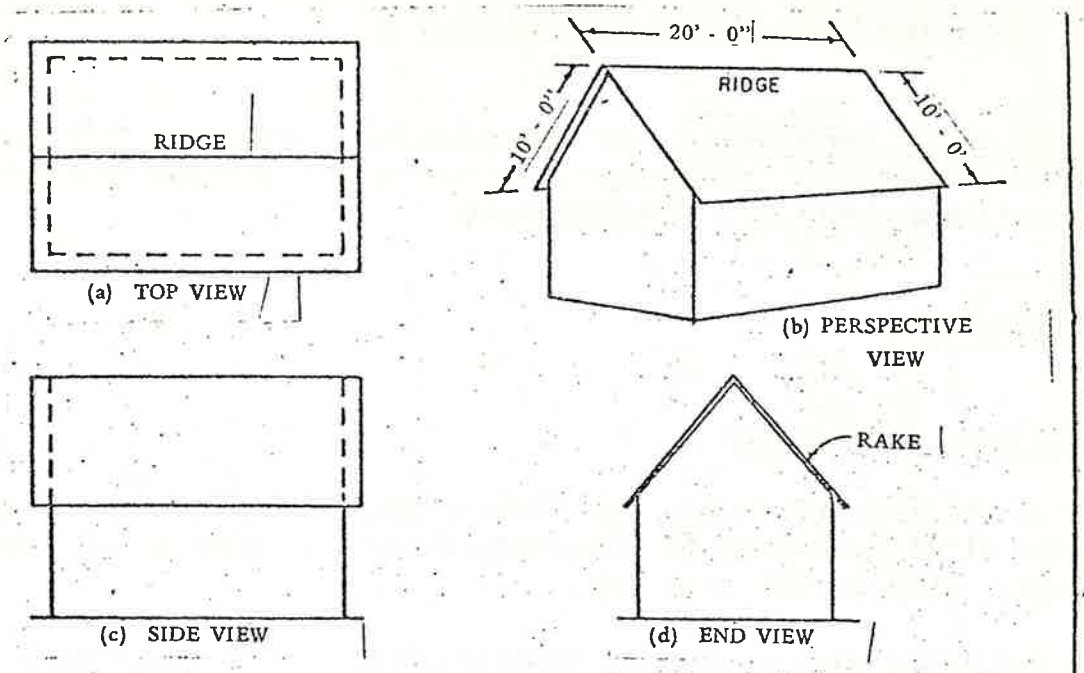
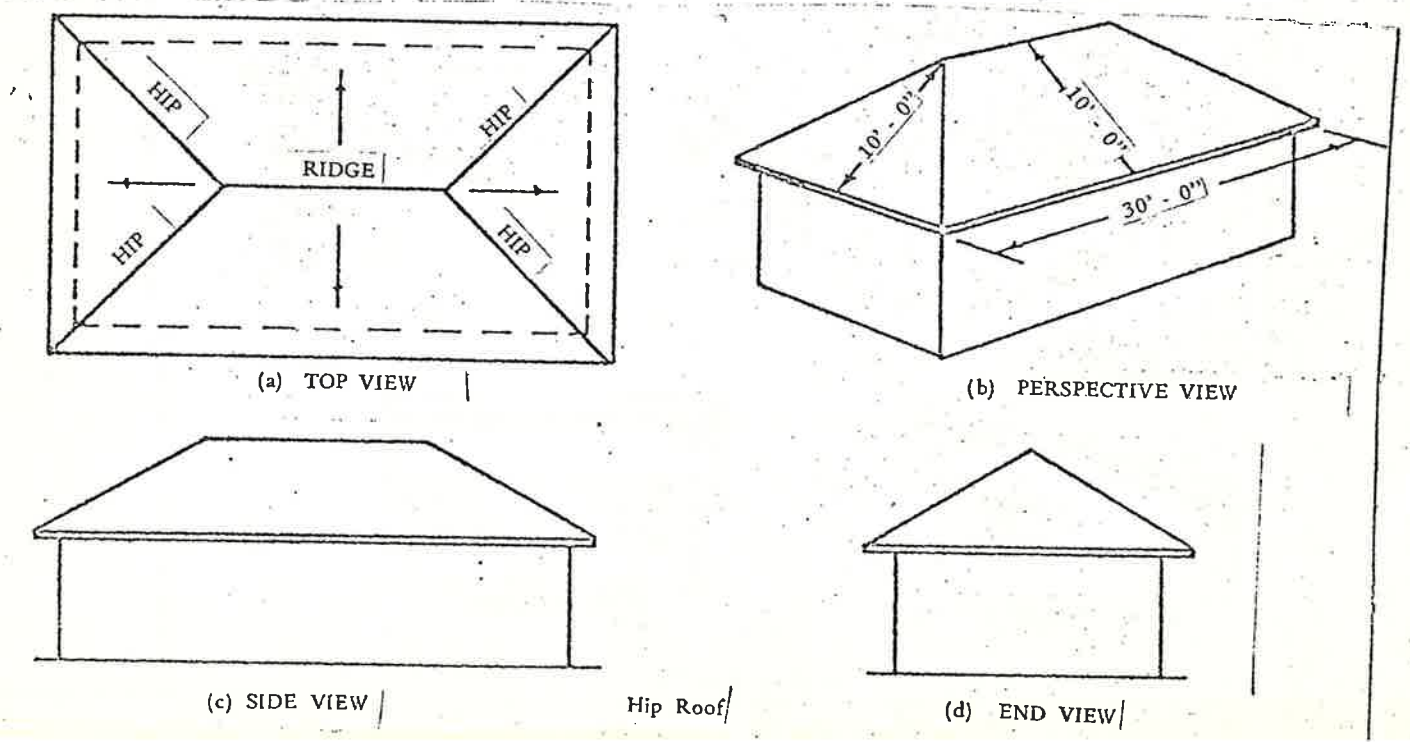


FIG. 2. Gable Roof

AREA OF HIP ROOF: The area of a plain hip roof is the same as the area of a gable roof of the same dimensions. The formula for finding the area of a plain hip roof is as follows:

FORMULA: Area of hip roof = 2 x width of slope x length of roof (at eave).

SOLUTION FOR HIP ROOF IN FIG. 3: 2 x 10' x 30' = 600 sq. ft.



Hip Roof

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AREA OF FLAT ROOF WITH PARAPET WALLS: The area of a flat roof with parapet walls may be found by the following formula:

FORMULA: Area of flat roof with parapet walls (including top of the parapet walls) = length x width.

SOLUTION FOR ROOF IN FIG. 4: 30' x 20' = 600 sq. ft.

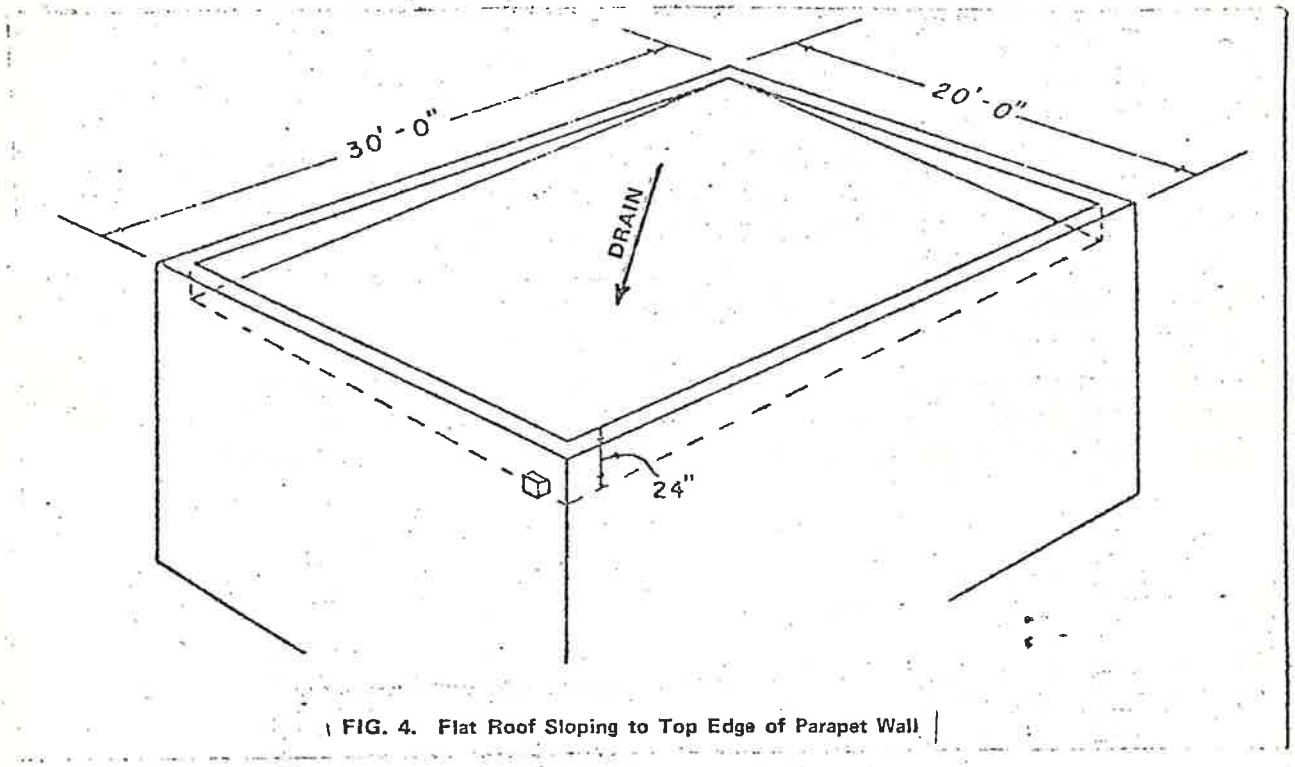

FIG. 4. Flat Roof Sloping to Top Edge of Parapet Wall

VERTICAL AREA OF PARAPET WALLS: The vertical area of parapet walls may be found in different ways, two of which are described in the following paragraph.

If the roof tapers up to the top of the parapet as shown in Fig. 4, the vertical area of the parapet may be thought of as consisting of two right triangles, as shown in Fig. 5. The problem of finding the vertical area of the parapet, then consists of finding the area of the two triangles. (The area of a right triangle = base x altitude x one-half.) Hence, the vertical area of the parapet shown in Fig. 4, may be found by the following steps:

Step 1: To obtain the area of the triangle, or one-half of the vertical area of the parapet, multiply as follows:

1/2 the perimeter of the building (base of right triangle) x height of the parapet (altitude of the right triangle) x 1/2.

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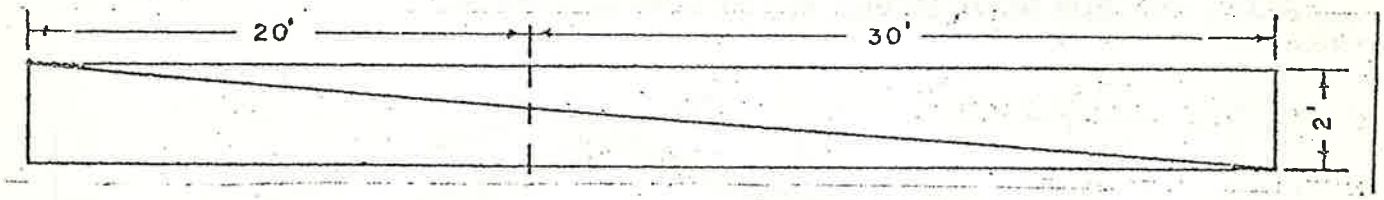
Step 2: To obtain the total vertical area of the parapet, multiply the answer received in Step 1 by 2.

(This procedure may be simplified by thinking of these two triangles as making up the area of a rectangle, as shown in Fig. 5 and then figuring the area of the rectangle.



SOLUTION FOR AREA OF PARAPET WALL SHOWN IN FIG. 4 and 5:
Step 1: 50' x 2' x 1/2 = 50 sq. ft. (area of one triangle)
Step 2: 50 sq. ft. x 2 = 100 sq. ft. (vertical area of parapet)

However, if the highest point on the roof is lower than the top of the parapet wall, as shown in Fig. 6, the vertical area of the parapet may be thought of as consisting of two rectangles and two triangles, as shown in Fig. 7. (Shaded areas represent rectangular area.) The problem of finding the vertical area of the parapet, then, consists of finding the total area of the rectangles and of the triangles.

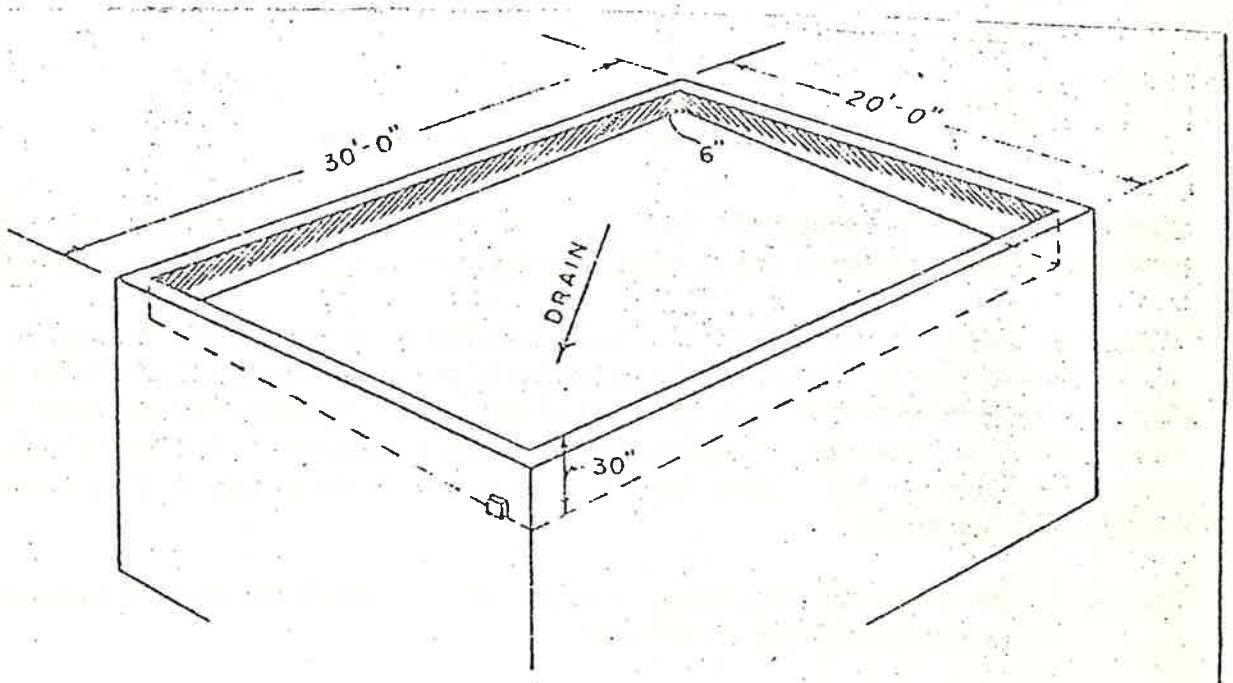


FIG. 6. Flat roof Sloping to within 6" of Top Edge of Parapet Wall

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The area of a rectangle is found by multiplying the width by the length. The width of each rectangle is the distance from the top of the parapet wall to the highest point of the roof (minimum height of parapet.) The length of each rectangle is equal to one-half the perimeter of the building.

It should be remembered that because most roofing felts are 36" wide, it must be taken into account that if the flashings come to a 10" girth, you must either allow them as 12" or there is a possibility that you may have some 6" girth material on the job and the 6" off the end of the end of the roll could be used. However, if this is not the case, it would be wiser to carry your material as 12" instead of 10".

The area of each triangle is found as already described. The altitude of each triangle is found by subtracting the smallest distance from the top of the wall to the roof from the greatest distance from the top of the wall to the roof (maximum height of parapet minus one-half the perimeter height of parapet.) The base of each triangle is one-half the perimeter of the building.

The vertical area of the parapet shown in Fig. 6 may be found by the following steps:

Step 1: To obtain the area of each rectangle, multiply as follows: Minimum height of parapet (width of rectangle) x 1/2 of perimeter of building (length of rectangle).

Step 2: To obtain the area of the two rectangles, multiply the answer received in Step 1 by 2.

Step 3: To obtain the area of each triangle, multiply as follows: Maximum height of parapet minus minimum height of parapet (altitude of right angles) x 1/2.

Step 4: To obtain the area of the two triangles, multiply the answer obtained in Step 3 by 2.

Step 5: To obtain the total vertical area of the parapet wall, add the areas of the two rectangles (Step 2) to the areas of the two triangles (Step 4).

(This procedure may be simplified by putting the two triangles and two rectangles together to form another rectangle as shown in Fig. 7 and then figuring the area of the larger rectangle.)

SOLUTION FOR VERTICAL AREA OF PARAPET SHOWN IN FIG. 6 and 7:

Step 1: 1/2' x 50' = 25 sq. ft. (area of each triangle)
Step 2: 25 sq. ft. x 2 = 50 sq. ft. (area of two rectangles)

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Step 3: 2' x 50' x 1/2 = 50 sq. ft. (area of each triangle)
Step 4: 50 sq. ft. x 2 = 100 sq. ft. (area of two triangles)
Step 5: 50 sq. ft. + 100 sq. ft. = 150 sq. ft. (total vertical)

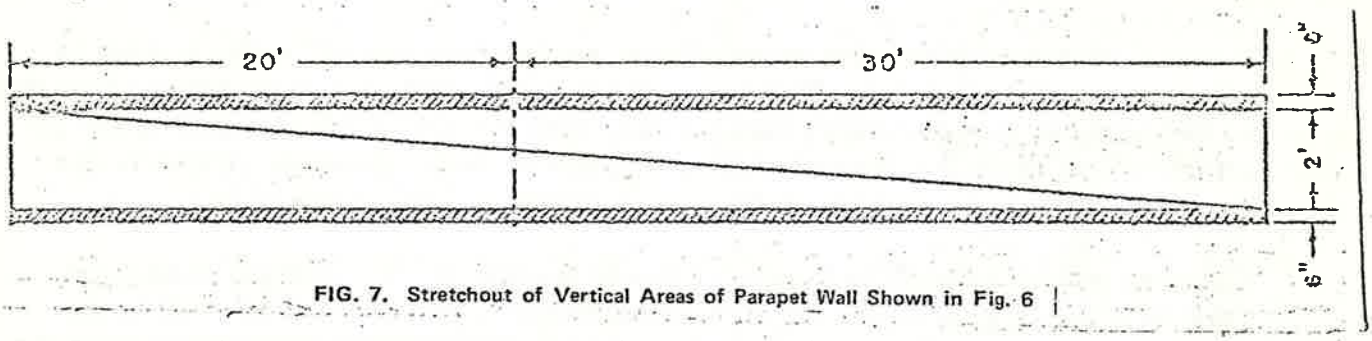

FIG. 7. Stretchout of Vertical Areas of Parapet Wall Shown in Fig. 6

LENGTH OF HIP OR VALLEY: The length of a hip or valley may be found by the following steps:

Step 1: Using the plain rule or architect's scale, draw a horizontal line equal in inches to one-half the width of the roof in feet: for example, if the width of the roof is 20', the line drawn would be 10" long. (see Fig.8)

Step 2: Draw a line perpendicular to the line drawn in Step 1. The perpendicular line is equal in inches to the length of the common roof rafter in feet. (Can be scaled off the elevation plans.)

Step 3: Draw a line connecting the end of the line drawn in Step 1 and the perpendicular line. This line represents the hypotenuse of a right triangle, which is the length of the hip of corresponding valley in inches.

Step 4: Measure the length of the hip. (If this is accurately done with a sharp pencil, the margin of error for all practical purposes is negligible.)

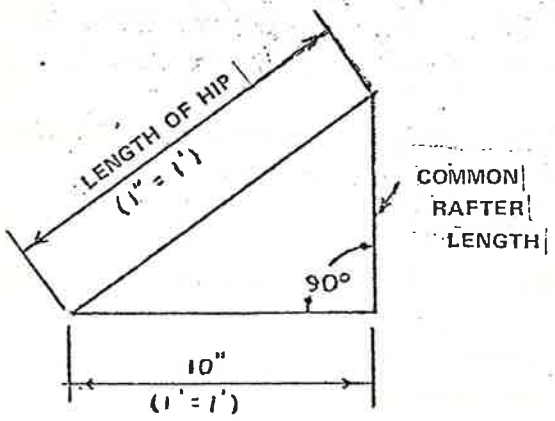

FIG. 8. Triangle Used in Determining Length of Hip

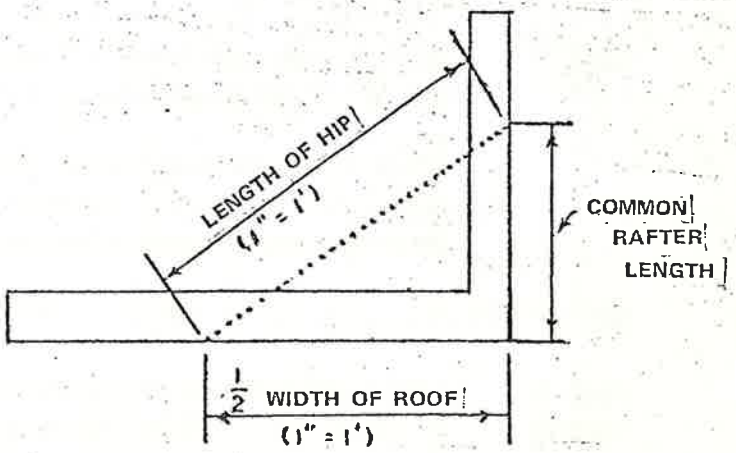

FIG. 9. Shortcut Method of Determining Length of Hip

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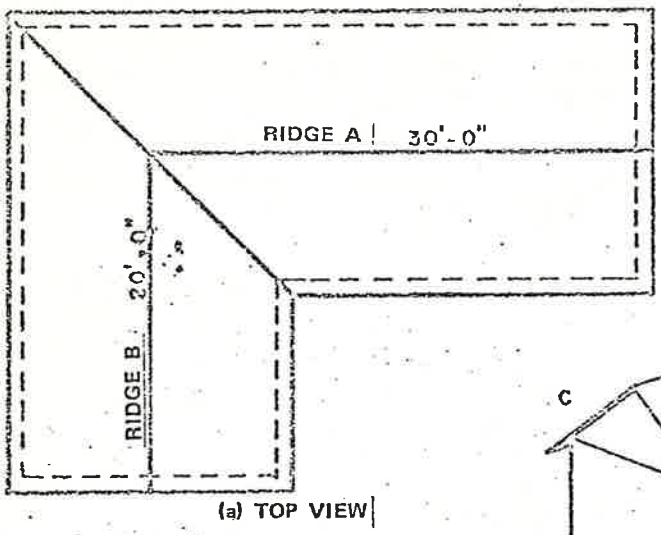
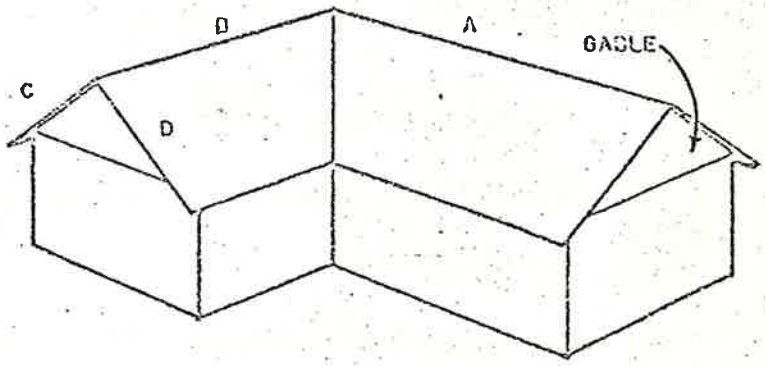
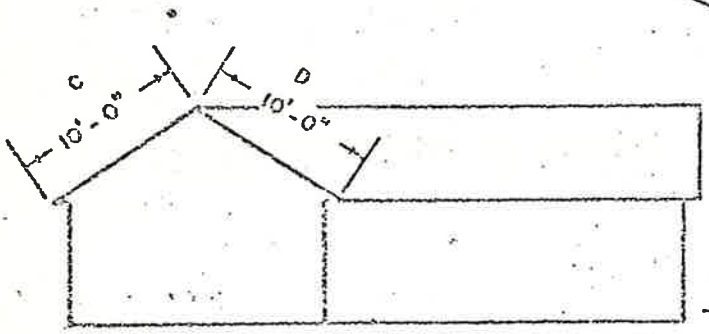


(a) TOP VIEW



(b) PERSPECTIVE VIEW



(c) SIDE VIEW

FIG. 11. Ell Roof

AREA OF AN ELL ROOF: The area of an ell roof may be found by the following formula:

FORMULA: The area of an ell roof = Total length of two ridges x length of rafter x 2.

SOLUTION FOR ELL ROOF IN FIGS. 11 a, 11 b, 11 c:
Step 1: 20' + 30' = 50'
Step 2: 10' x 2 = 20'
Step 3: 50' x 20' = 1000 sq. ft. or ten squares

SURFACE AREA OF CYLINDRICAL BUILDING: The roofer is often concerned with cylindrical buildings when damp-proofing or waterproofing is to be done on silos or tanks or on many modern structures. To find the surface area of a cylindrical building, the area of the circular roof and the area of the circular walls must be found. The total of these two areas make up the total surface area of a circular building. Roofers are often concerned with only the area of the circular.

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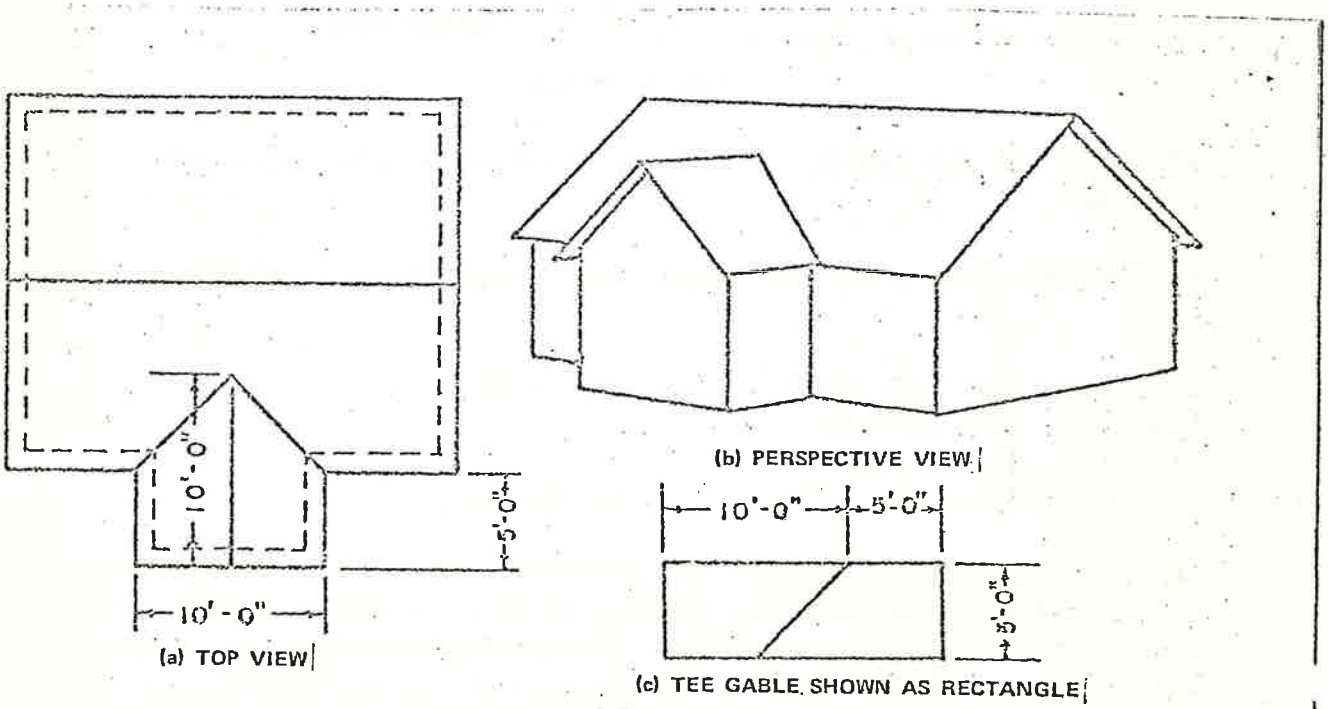
SHORTCUT FOR FINDING THE LENGTH OF A HIP OR VALLEY: A carpenter's framing square (steel square) may be used in place of the precedure just mentioned, since on one face it is divided into inches that are already graduated into twelfths. One-half the width of the roof and the length of the common roof rafter are laid out in inches. The length of the hypotenuse can then be determined by measuring the distance between the ends of the two lines. (See Fig. 9)

AREA OF A TEE ROOF (GABLE OR HIP): The area of a tee roof (gable or hip) may be found by the following formula:

FORMULA: The area of a tee roof (gable or hip) = length of ridge + length of eave of wing x length of rafter.

SOLUTION FOR TEE ROOF IN FIGS. 10 a, 10.b, 10 c:
Step 1: 10' + 5' = 15'
Step 2: 15' x 5' = 75 sq. ft.

This problem may also be solved by considering the roof area to be the area of a rectangle. If the two halves of the roof are put together as shown in Fig. 10 c, a rectangle results. The area of the roof, then may be obtained by multiplying the length of the rectangle (15') by its width (5').



(a) TOP VIEW

(b) PERSPECTIVE VIEW

(c) TEE GABLE SHOWN AS RECTANGLE

FIG. 10. Intersecting Roof with Tee Gable

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The formula for finding the surface area of a cylindrical building may be stated as follows:

FORMULA: Surface area of a cylindrical building = Area of circular roof and area of cylindrical walls.

Since the formula for finding the area of a circle is r^2 (x radius squared), the area of the circular roof on the tank shown in Fig. 12 - may be found by the following steps:

Step 1: 3.1416 x (50' x 50')
Step 2: 3.1416 x 2500 sq. ft. = 7854 sq. ft. (area of circular roof)

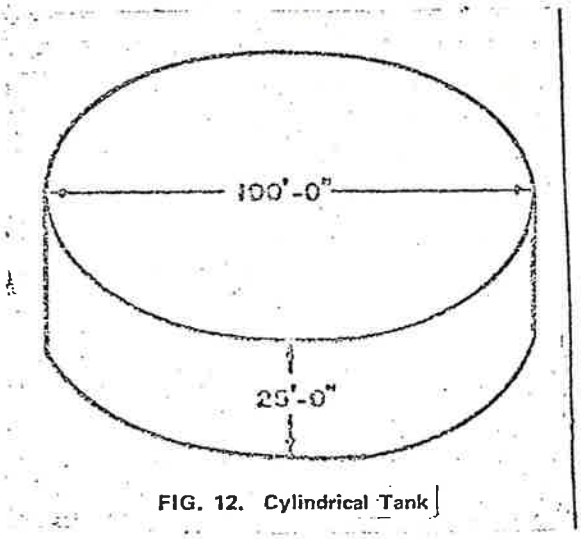

FIG. 12. Cylindrical Tank

The area of the circular walls may be found by multiplying the circumference of the building by the height. Hence, the area of the circular walls of the tank shown in Fig. 12 may be found by the following steps:

Step 1: Find the circumference of the tank (circumference = πd) or (pi x diameter) 3.1416 x 100' = 3141.6'

Step 2: 3141.6' x 25' = 78,540 sq. ft. (area of circular walls)

The total surface area of the tank shown in Fig. 12 therefore, is: 7854 sq. ft. + 78,540 sq. ft. = 86, 394 sq. ft.

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AREA OF CONICAL ROOF: The surface area of a conical roof may be found by the following formula:

FORMULA: 1/2 slant height x circumference of the base = Surface area of conical roof.

SOLUTION FOR CONICAL ROOF IN FIG. 13:
Step 1: 1/2 x 10' = 5'
Step 2: 5' x 31 1/2' = 157 1/2 sq. ft.

AREA OF DOME ROOF: The area of a dome roof consists of half of the area of a sphere. Since spherical roofs are being encountered more frequently by the roofer in his work, he should learn the following formula for finding the area of a sphere and should learn how to use it in making calculations.

FORMULA: Area of a shpere = $4 \pi r^2$
Area of dome = 1/2 x area of sphere.

SOLUTION FOR DOME ROOF IN FIG. 14:
Step 1: $4 \times 3.1416 \times 50'^2 = 31,416$ sq. ft.
Step 2: 31,416 sq. ft. ÷ 15,708 sq. ft. (area of dome roof)

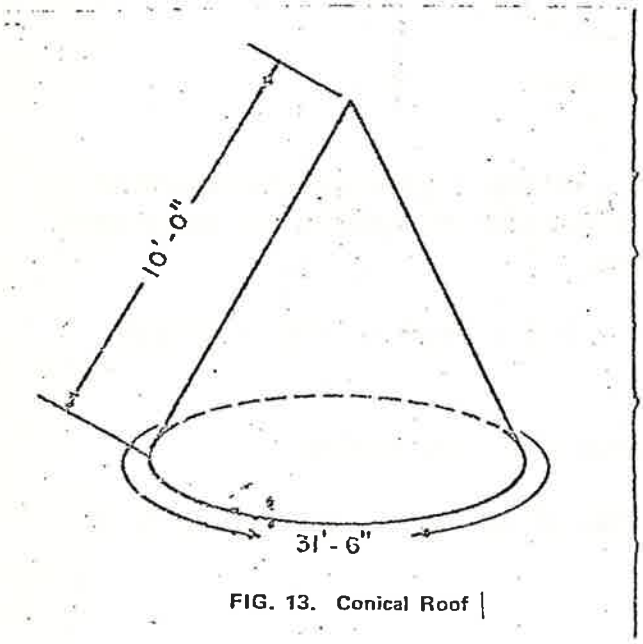

FIG. 13. Conical Roof

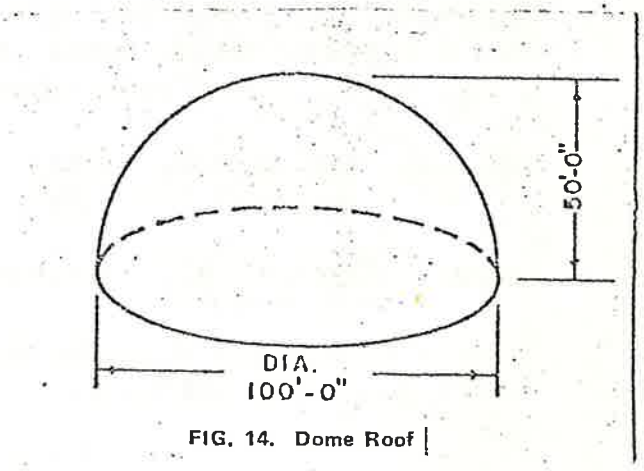

FIG. 14. Dome Roof

BLUEPRINT READING & SPECIFICATIONS

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A. BLUEPRINTS AS USED IN THE ROOFING INDUSTRY TO PRESENT A DRAWING OR DIAGRAM

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to list four uses of the blueprint to the roofer.

REFERENCES:

RELATED INFORMATION:

1. Blueprints are used in the roofing industry to present a drawing or diagram diagram showing:

   A. The type and structure of the roof desired and specified.

   B. The application and installation of the roof deck (important to the roofer when deck is other than metal).

   C. The details of the roofing application for specific areas which require special attention and application.

   D. Dimensions and sizes which are necessary in order to calculate or determine the amount of materials needed to complete the roof application.

2. Roofing is measured in squares. One roofing square is equal to an area measuring ten feet by ten feet (10' x 10') or one hundred (100) square feet.

3. Flashing is a term used in roofing which refers to the making of a water-tight connection or joining between the roof surface and a vertical penetration, such as a wall, pipe or any other projection above the roof surface. Flashing is accomplished in various ways, depending upon the materials used and the conditions encountered. Normally, flashing is measured in lineal feet.

PROBLEMS: Using the information provided in the sample blueprints for Plates 1, 2, and 3, calculate the answers for the questions as indicated.

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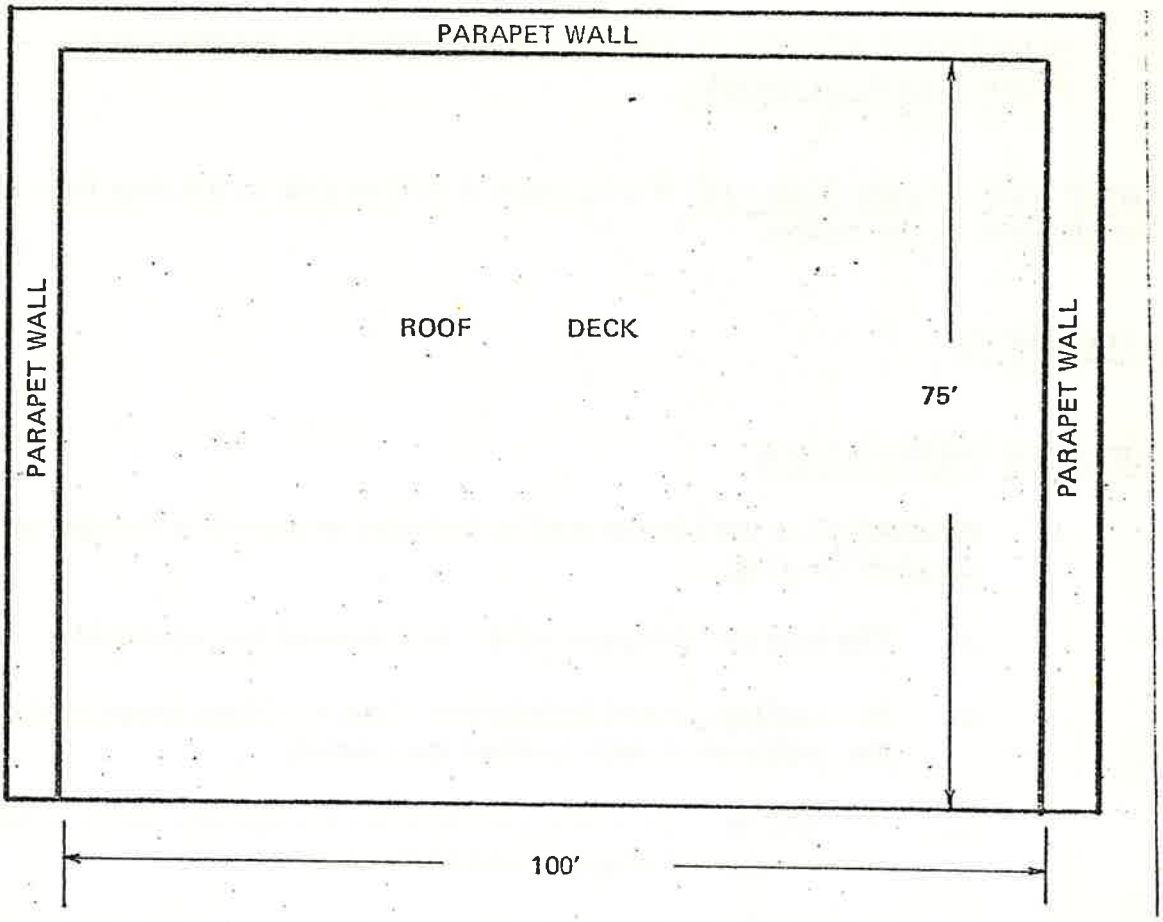

SOLVE THESE PROBLEMS:

1. What is the total number of square feet in the roof area?

2. How many roofing squares in the roof area?

3. How many lineal feet of flashing is required to flash the parapet wall?

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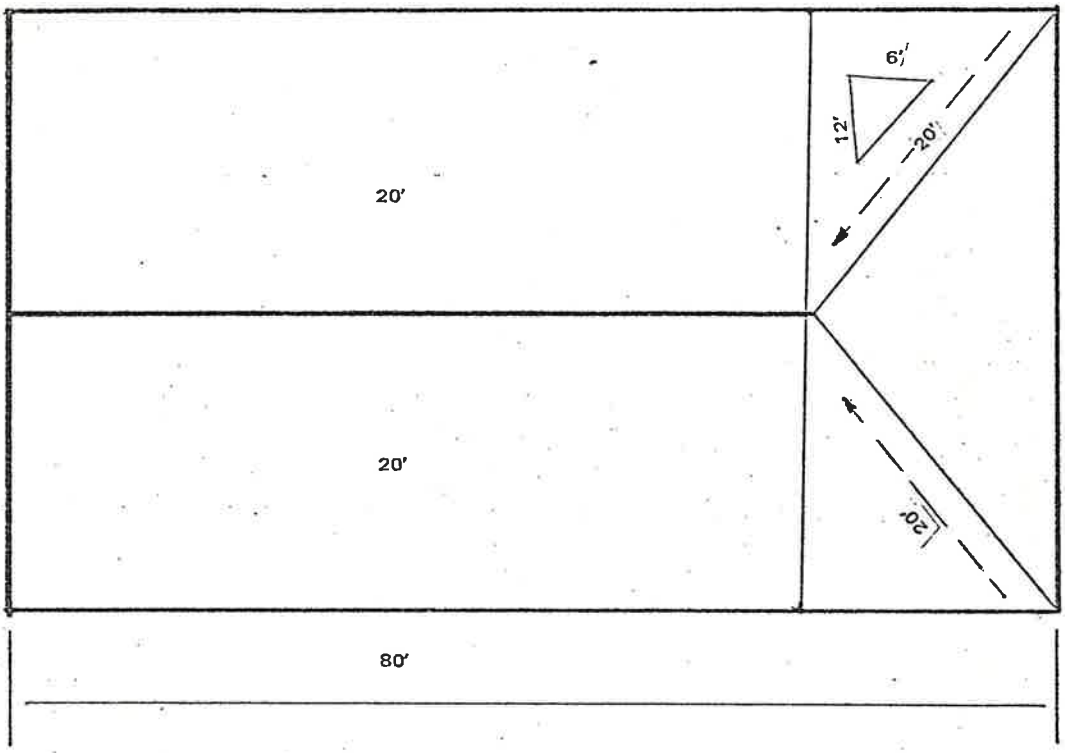
NAME _____ DATE _____



STEEP ROOF

SOLVE THESE PROBLEMS:

1. What is the total number of square feet in the roof area?

2. How many roofing squares in the roof area?

3. How many lineal feet of flashing is required for this roof?

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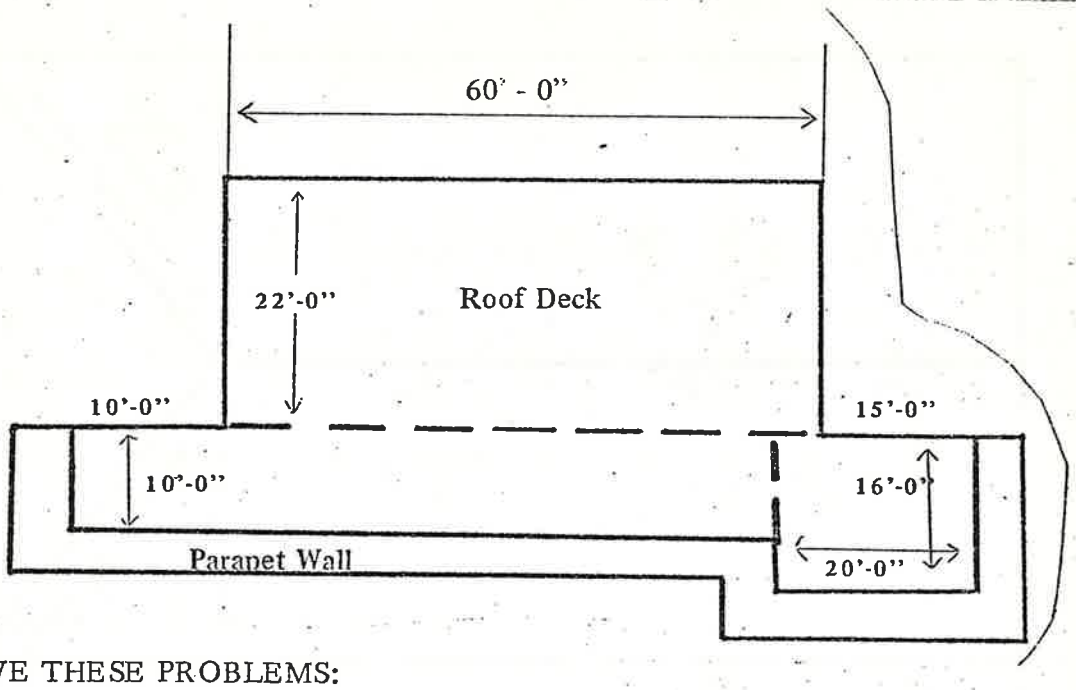
NAME _____ DATE _____



SOLVE THESE PROBLEMS:

1. What is the total number of square feet in the roof area?

2. How many roofing squares in the roof area?

3. How many lineal feet of flashing is required for this roof?

NAME _____ DATE _____

B. USE OF ARCHITECT'S SPECIFICATIONS

OBJECTIVE OF ASSIGNMENT: The apprentice will be familiar with the use of specifications used in the roofing trade as exhibited by correctly solving problems using data from architect's specifications.

REFERENCE: Sample architect specifications A, B and C

RELATED INFORMATION:

1. Architects specifications are used in the roofing industry to verbally:

   A. Describe the type of roof required.

   B. Define the scope of the work for the trade.

   C. Describe the type and quality of material required.

   D. Describe the quality of workmanship and material application required.

   E. Establish the bond and guarantee requirements for the finished product.

2. Roof insulation is a material used to prevent the passage of heat and as a method of reducing fire hazards. Insulation can be obtained in one inch (1") or three quarter inch (3/4") thickness (other thicknesses available) and in sheets measuring three feet by four feet (3' x 4'). The material is shipped in bundles; five sheets per bundle for one inch material; and six sheets per bundle for three quarter inch material.

3. Coated base sheets can be made from an organic felt or an asbestos felt, in any case, it is used as the first ply in the construction of many built-up roofs. Base sheets are coated with asphalt with a finished weight of between forty to forty five pounds per square. They are normally available in rolls containing two (2) squares.

4. Felts used in built-up roofing may be asphalt felt, tarred felt or asbestos felt, depending upon the product utilized in coating or saturating them. Felts are designed by poundage which refers to the amount of the coating agent utilized; for example, a fifteen (15) pound asphalt felt refers to a felt which has been coated or saturated with an amount of asphalt which equals

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fifteen (15) pounds per square. Felt is purchased in rolls of two (2) or four (4) squares per roll.

5. Mopping agent for built-up roofing could be a bitumen (a mineral pitch or asphalt) or coal tar pitch. It is used as a waterproofing and bonding agent for the other elements of the roof. The type of agent required is specified along with the amount of material required per square.

6. Surfacing material of a built-up roof is used to hold the surface waterproofing bitumen in place, to protect the underlying waterproofing from the damaging rays of the sun, and to reduce the hazard of the spread of fire. Materials used in surfacing are slag, gravel or other roofing aggregate. These materials are purchased by weight. A rule of thumb is slag weighs approximately 300 pounds per square and gravel weighs approximately 450 pounds per square.

7. Asphalt shingles are utilized in most steep roof applications. Shingles are shipped in bundles. Thick butt shingles normally require three (3) bundles per square.

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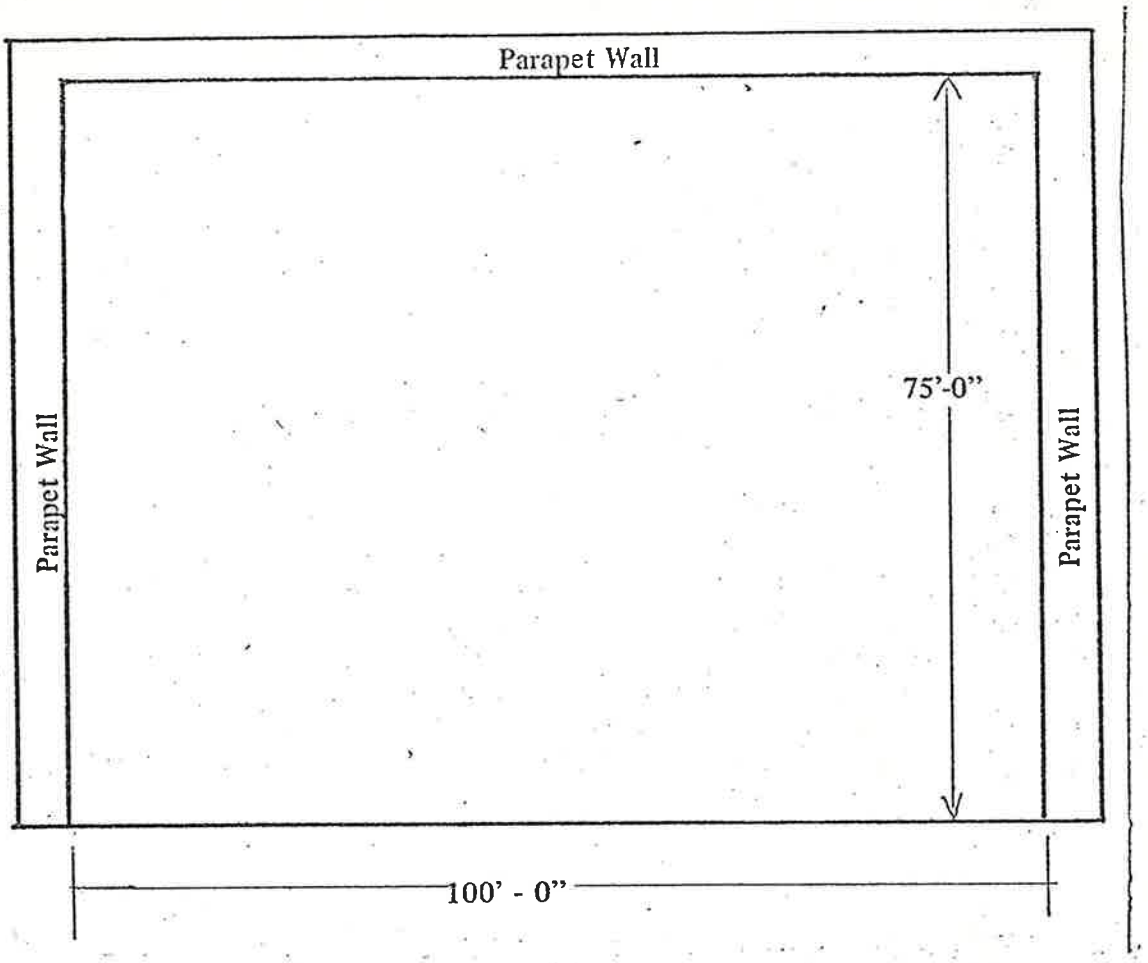

SOLVE THESE PROBLEMS:

1. The architect's specifications call for one inch (1") insulation in three foot by four foot (3' x 4') sheets. How many bundles of insulation are required? How many bundles of three quarter inch (3/4") insulation would be required?

2. The architect's specifications call for a one-ply, 40 pound base sheet (using 2 square rolls). How many rolls of base sheet are required?

3. The architect's specifications call for a three-ply (3-ply), fifteen (15) pound tar felt roof (using 4 square rolls). How many rolls of felt are required?

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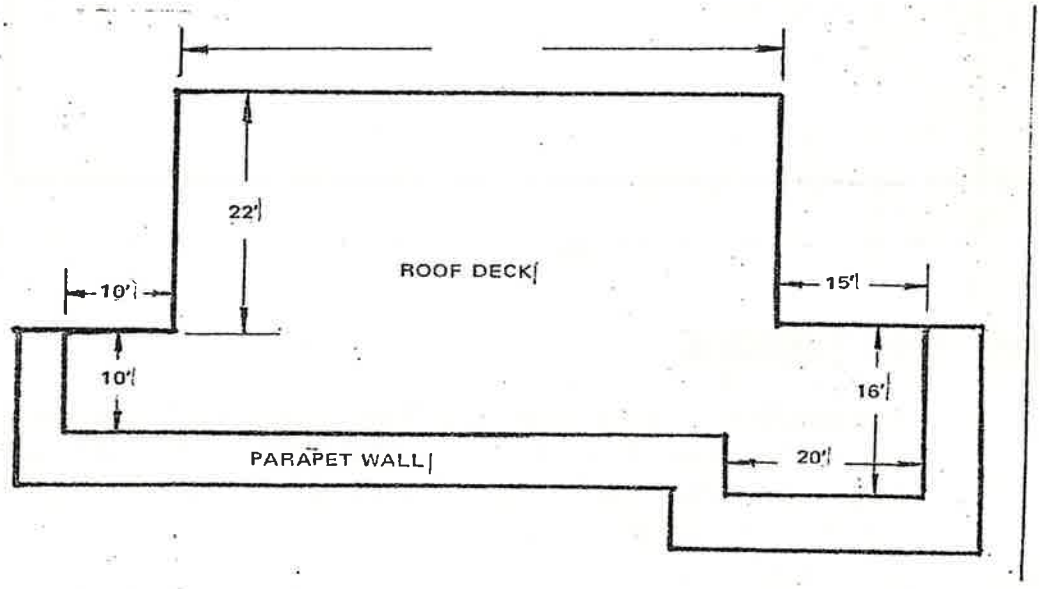
4. The architect's specifications call for 35 pounds of pitch per mopping (square). How many pounds of pitch are required for four piles?

5. The architect's specifications call for a slag surface. How many pounds of slag are required? How many pounds of gravel would be required?



SOLVE THESE PROBLEMS:

1. The architect's specifications call for one inch (1") insulation in three foot by four foot (3' x 4') sheets. How many bundles of insulation are required? How many bundles of three-quarter inch (3/4") insulation would be required?

2. The architect's specifications call for a one-ply 40 pound base sheet, (using 2 square rolls). How many rolls of base sheet are required?

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3. The architect's specifications call for a three-ply (3-ply), fifteen (15) pound tar felt roof, (using 4 square rools). How many rolls of felt are required?

4. The architect's specifications call for 35 pounds of pitch per mopping. How many pounds of pitch are required for four piles?

5. The architect's specifications call for a gravel surface. How many pounds of gravel are required? How many pounds of slag would be required?

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SAMPLE SPECIFICATION A

1. Substitutions:

   A. The materials or products specified herein and indicated on Drawings by trade name, manufacturer's name or catalogue number shall be provided as specified.

2. Compliance with Standard and Industry Specifications:

   A. Any material operation specified by reference to the published specifications of a manufacturer, The American Society for Testing and Materials, The Copper and Brass Research Association, and other published standard, shall comply with the requirements of the current specification or standard listed. The Contractor, if requested, shall furnish an affidavit from the manufacturer, certifying that the materials or product delivered to the job meets the requirements specified.

3. General Requirements:

   A. Proper Surfaces: Surfaces to which roofing and sheet metal are to be applied shall be even, smooth, sound, thoroughly clean and dry and free from all devects that might affect the application.

   B. Materials to be Built-In: Materials furnished under this section which are to be built-in by other trades shall be delivered to the site in time to avoid delays to construction progress.

   C. Accessories: All accessories or other items essential to the completeness of the flashing installation, though not specifically shown or specified, shall be provided. All such items, unless otherwise shown on the Drawings or specified, shall be of the same kind of material as the item to which applied. Nails, screws, and bolts shall be of the types best suited for the purpose intended, and shall be of a composition that is compatible with the metal to which it will contact.

   D. Workmanship: Except as otherwise shown on Drawings or specified the workmanship of flashing work, method of forming joints, anchoring, clean provisions for expansions, etc., shall conform to the standard details and recommendations of the Copper and Brass Research Association in effect on the date of the Specification.

NAME _____ DATE _____

4. Flashing Materials:

A. General: The type and locations of the various kinds, gauges, thickness and finish of flashing to be used is specified hereinafter under the individual items. However, where flashing is indicated on Drawings and kind or type of metal is not definitely specified or noted, .064" aluminum shall be provided.

B. Aluminum Alloy: Aluminum alloy flat sheet shall be alloy 3003, conforming to Federal Specification QQ - A0359d, and not less than 0.064" thick. Aluminum alloy shall be used throughout.

C. Lead: Lead shall be hard type, weigh not less than 2-1/2 pounds per square foot, and conform to Federal Specification QQ - L201a. Lead shall be used for small vent pipes.

D. Solder for aluminum shall be of composition as recommended by the metal manufacturer.

5. Metal Shingles on Structural Steel Roof System:

A. Furnish and install Perma-Clad Shingles and accessories as manufactured by Perma-Clad Products Corp., 201 Velasco Street, Houston, Texas, or an approved equal.

B. Shingles shall have a thick-butt shake texture, with eight shingle modules. Each full shingle shall have a 10" x 60" exposure to the weather.

C. Shingles shall be produced from 30 gauge hot-dipped galvanized steel.

D. The color shall be Perma-Clad Charcoal-Grey.

E. Snap-lock purlins shall be installed 10" on center in a direction perpendicular to the steel angle roof system to provide a support structure for the shingles, continuously supporting and locking both upper and lower horizontal edges of shingles.

F. Perma-Clad shingles and accessories shall be installed by skilled mechanics in strict accordance with factory instructions.

NOTE: The steel angle roof system is not a part of this Section. For the lay-out of this system see Sheet No. 11 of Drawings.

NAME _____ DATE _____

6. Flashing Around Roof Drains, Pipes and Other Projections:

A. Provide metal flashings and make proper connections to roof drains; the drains are set under this Section of the Specifications. Flashings around drains and projections shall be water tight and shall consist of a 30" x 30" sheet of four-pound sheet lead properly installed around drains, and built-in under at least one layer of roofing.

Scope: The work required under this Section consists of all roofing and flashing and related items necessary to complete the work indicated on the Drawings and Described in the Specifications.

Work Included:

1. All Roofing

2. All Flashing

3. All flashing around mechanicals to receive their counterflashing as required.

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MOISTURE PROTECTION - SAMPLE SPECIFICATION B

General and Supplementary Conditions are a part of this entire Division.

Scope of Work: Provide all labor, tools, materials and equipment necessary to do all Built-Up Bituminous Roofing, Sheet Metal Work, Wall Flashing, Roof Accessories and Caulking and Sealants as shown on the plans and specified hereinafter.

Lead flashing for roof drains and plumbing vents extending through the roof shall be furnished and installed by the Mechanical Contractor.

Built - Up Bituminous Roofing

Scope of Work: Furnish and apply the following where indicated:

All materials composing the built-up roofing membrane and surfacing, i.e., all bitumen for priming, mopping, flood coats, all roofing felts, dry sheets, base sheets, vapor barrier and adhesives, cant strips, pitch pockets, flashings for roof projections, all nails and fasteners for flashings, and all primers, bitumen, felts and cements for composition base flashing, also, pitch dams and preventatives against bitumen drippage on interior or exterior.

Qualification: This Contractor (roofer) shall be licensed by the roofing manufacturer and experienced with application of the products specified.

Furnish three copies of manufacturer's printed specifications and one specimen copy of the Manufacturer's Guarantee Bond.

At a reasonable time, before any work under this contract, this Contractor shall arrange a job site meeting to include the Architect, the General Contractor and the Roof Manufacturer.

The application of any materials by this Contractor on the roof and flashing shall be considered an acceptance of the deck and any repair or replacement required to correct the deck shall be made without cost to the City.

Materials: 1. The bitumen for the built-up roofing shall be Coal Tar Pitch and the felts shall be 33-pound coated base sheet and 15-pound

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Tarred Felts. Application of these materials shall be 4-ply shingle fashion as specified by Koppers Company, Inc., The Celotex Corp., Phil Carey Corp., or an approved equal, in their latest published manual for built-up roofing.

2. Composition base flashing shall be as required by the roofing manufacturer.

3. Coal Tar Pitch shall comply with ASTM D 450, Type A, Federal Specification R.P. 381, Type 1, Underwriters Laboratories, Inc.

4. Tarred Felts shall comply with ASTM D 227, Federal Specification HH-R-595, Type 1, Class 1.

5. Primer for wall flashing shall comply with ASTM D 41 - 41.

6. Steep Asphalt for wall flashing, curbs, expansion joints, or as adhesive on metal deck for insulation shall comply with ASTM D 312, Type 111.

7. Asphalt Saturated Flashing Felt for composition base flashing shall comply with ASTM D 226-60.

8. Number 90 Mineral Surfaced Roofing Felt, Asphalt for surface of flashing shall comply with Federal Specification SS-R-630.

9. Bituminous cements for flashings shall comply with Federal Specification SS-C-153, Type 1.

10. Bituminous cements for roofing shall comply with Federal Specification SS-C-152, Type 1.

11. Roof insulation shall be perlite-urethane type, Carey's Milox or approved equal, having a total conductance (C) not more than 0.10 with a thickness not to exceed two inches. Insulation shall be rated by U.L. for class A roof.

12. Non-combustible Vapor Barrier and Adhesive for metal decks shall be Lexsuco Vapor Barrier applied in Lexsuco Adhesive No. R-907-T, or an approved equal.

13. Roof Pathway Material shall be Carey-Tred or an approved equal.

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Quality Control:

1. All insulation and felt rolls shall be stored indoors; if outside, be protected with "tarps" or equal. They shall be set off the ground or deck on timbers or pallets. Felt rolls must be standing on ends. This condition applies from delivery until completion of this contract.

2. Before starting any work, protect in an approved manner all paving and face of building walls adjacent to hoist and kettles. The protection shall remain in place for the duration of roofing work.

3. The Coal Tar Pitch shall not be heated above 400 degrees F at any time. The kettles used shall be thermostatically controlled and this Contractor (roofer) shall have and use frequently a thermometer - separate from the kettle. Material in the kettle, heated above 400 F will be disposed of. Any roofing applied when material was too hot will be removed from the roof at the Contractor's expense.

4. Lay no roofing during weather that will prevent the bitumen from being applied: (1) at the right temperature; (2) on a dry deck; and/or, (3) over dry insulation that will keep the roofing from being properly applied.

5. Each day's work shall be planned so that vapor barrier, insulation base sheet and tarred felt will be flood coated and aggregate applied the same day. If conditions do not permit aggregate application the same day, then all exposed felts shall be glaze coated with mopping of hot coal tar pitch.

6. This Contractor shall install dams around deck projections, at gravel stops and wherever there is potential bitumen drippage, either to interior of building or at gravel stops.

7. One ply of 4" fabric and flashing cement shall be applied along the top edge of base flashing, unless counter flashing, ventilators, smoke vents or other capping is installed immediately.

8. At the end of each day's work, the manufacturer's prescribed "cutoffs" shall be installed to cover the edges of insulation. They shall be removed when work continues.

9. Test: Cuts of the membranes, 4" x 36" shall be taken, if necessay, under the supervision of the Architect, Manufacturer or City. No more than one cut for each 5000 square

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feet of roofing will be required to be processed under this contract. The cut should be made before surface bitumen or aggregate is applied. The extent of test shall be governed by reason for taking the test.

Installation:

Do all work in accordance with Factory Mutual's and Underwriter's Laboratory specifications for best rating.

Installation and attachment of vapor seal and insulation shall be as recommended by the respective manufacturers.

Application of bitumen and felts shall be as recommended by the manufacturer.

Manufacturer's latest published manual for architects, engineers and contractors shall be used as basis of all roofing procedures and recommendations unless otherwise stated in these contract specifications and detailed blueprints.

Application shall be by experienced workmen only.

Apply roofing so that the direction of water flow will be over and not against laps. Lay layers of felt immediately behind the mop and free them from all wrinkles and buckles. As each course of felt is mopped into the coal tar pitch, carefully broom in the felt surfaces with a soft fiber floor broom to obtain complete adhesion between piles and to close out any air pockets. Each solid mopping shall completely cover the area over which it is applied.

Overlap ends of all connecting plies by not less than ten (10) inches. End stripping or taping of laps shall not be permitted.

Carry and mop each layer of roofing felt up, abutting vertical surfaces at least four inches or to two inches above the top of cants at vertical surfaces.

Guarantee:

The bituminous built-up roofing composition, expansion joints and base flashing shall be guaranteed by the Contractor for five years after completion of this contract. The guarantee will not be acceptable if it either states or if it is implied that ponding of water on the roof relieves the Contractor of liability for repair.

At completion of this contract, it shall be the responsibility of the General Contractor to prevent damage to roofing and

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flashing by proper protection to the roofing; protection to the extent of preventing trades or craftsmen to use the roof areas for storage or work.

Sheet Metal Work

Standing Seam Sheet Metal Roofing — Shall be made from Titanaloy "A" as made by Matthiessen & Hegler Zinc Company, or Terne-coated stainless steel as made by Follansbee Steel Corporation.

Workmanship: Shall be equal to the best modern practice in accordance with the manufacturer's recommendations and the standards of the Sheet Metal and Air Conditioning Contractors National Association and as set forth in their "Architectural Sheet Metal Manual" hereinafter referred to as "The SMACNA Manual." All assembling shall be as indicated and detailed on the drawings. Where no details are shown, the work shall be as detailed for similar work in accordance with the recommendations in the "The SMACNA Manual".

Fabricate and install sheet metal with lines, rises and angles sharp and true, and plane surfaces free from objectionable wave, warp or buckle. Exposed edges of sheet metal shall be folded back to form a 1/2 inch wide hem on the side concealed from view.

Finished work shall be free from water leakage under all weather conditions. The workmanship and methods employed for forming anchoring, cleating and the expansion and contraction of sheet metal work shall conform to applicable details and description as indicated in current edition of the above publication unless other methods are indicated on project drawings or specified herein.

Thickness of metal shall be in accordance with the manufacturer's printed specifications and "The SMACNA Manual" but in no case less than 0.015 inches for terne coated stainless steel and 0.027 inches for Titanaloy "A".

Accessories — All accessories or other items essential to the completeness of the sheet metal installation, though not specifically shown or specified, shall be provided. All such items, unless otherwise indicated on drawings or specified, shall be of the same kind of material as the item to which applied and the thickness shall conform to recognized industry standards of sheet metal practice.

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Provisions for Expansion and Contraction	All sheet metal work shall be installed so as to provide sufficient allowance for expansion and contraction. Expansion joint shall be fabricated in accordance with details on project drawings.
Solder:	Solder shall be fifty-fifty with the flux recommended by the manufacturer.
Preparation of Roof Deck:	Over the structural wood deck where shown on the plans provide insulation as specified under "Built-Up Roofing". Over the plywood sub-deck or wood structural provide one layer of acid-free roofing felt with 2" laps and nailed every 6". Over the roofing felt, provide one layer of resin sized paper.
Shopdrawings:	Submit shop drawings for sheet metal work to Architect for approval prior to proceeding with fabrication. Shop drawings shall indicate thickness and dimensions of all parts, fastening and anchoring methods, details and locations of all seams, joints and other provisions necessary for thermal expansion and contraction.
Sample:	A five foot long mock-up of the roofing system showing seams, clips fasteners, details, quality of workmanship, etc., shall be made for approval by the Architect and shall be used as a standard on the job.
Gutters:	Shall be the same material as the metal roof and shall be installed as detailed.
Expansion Joint:	Shall be the same material as the metal roof and shall be installed as detailed.
Metal Roof Flashing and Trim:	Provide all wall counter flashing, wall caps, reglets, flashing around all openings in roof membrane, gravel stops, and other specialties required. Metal shall be as specified for metal roof.
Reglets:	Shall be Chinc No. 16 ounce Type C for concrete as made by Cheney Flashing Company of Trenton, New Jersey, or approved equal with 45 degree slot 1 - 1/8" deep with 1/4" opening.
Metal Louvers:	Where indicated on the drawings shall be Airolite Type 685, or an approved equal, formed metal sightproof inverted "V" blade type, 1" thick with Type "F" mouldings. Louvers shall be factory finished in color as selected by the Architect.
Vent Grilles	Shall be Titus Type RH-50 grille with American Warming Type

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and Shutters in Soffits: SHW-P-230 adjustable aluminum shutter with aluminum insect screen and 110 volt electric 2-position motor operator.

Vent Grilles Louvers in Walls and Fascias: Shall be Standard Stamping and Perforating Company, No. C-7, 13/16" mesh with 3/16" bars of 1/4" thick standard mill finish aluminum with American Warming Type LW-P-771 adjustable louver with "J" blades, channel frame, aluminum insect screen and 220 volt electric two-position motor operator.

Roof Ventilators: Shall be low profile gravity type 18 gage aluminum Penn "Airette", 30" x 30" square as made by Penn Ventilator Company, Inc., or an approved equal. Units shall be complete with aluminum insect screens, snow screens 16 ga. prefabricated base and FBO-12 shutter with 110 Volt electric two-position motor operator.

Caulking and Sealants

Scope of Work: Provide and apply all sealants as required by the drawings and as specified herein.

1. In general, seal all openings as shown on the drawings, and at all other locations which normally require sealants, including but not being limited to the following:

   Joints around windows, interior and exterior door frames, louvers, and other openings in the exterior wall, interior lintels, fire extinguisher cabinets, light panels and plumbing fixtures.

   All expansion joints and control joints in the masonry walls, concrete pool walls and floor, and concrete deck around pool.

Excluded Work: All caulking work by other trades as specified in other sections of this specification.

Materials: Gun or pourable grade, as applicable shall be:

1. All areas except pool and concrete deck areas.

   One part gun grade sealant. Polysulfide base; acrylic base or silicone base, all meeting Federal Specification TTS230a.

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Two part gun grade sealant; Polysulfide base; or polyurethane base meeting ASA 116.1 and Federal Specification TTS 227b.

One or two part pourable grade; Polysulfide base; or polyurethane base, meeting ASA 116.1 and TTS 227b.

2. Expansion Joints in pool walls and floor and all joints in concrete deck areas around pool interior shall be finished with Stan Pro Sealant No. 101 as manufacturered by the Standard Products Company, Port Clinton, Ohio. Sealant shall have a cure hardness of 70 (Shore A). Sealant shall be gray in color and shall be non-sag grade for vertical joints. All joints shall be thoroughly cleaned and primed with Stan Pro Primer before sealing. Primer and sealant shall be applied in strict accordance with the manufacturer's instructions.

Preparation: All openings, joints, or channels to be caulked and/or sealed shall be thoroughly clean, dry, and free from all oil, grease or any other foreign matter.

Surfaces with protective coatings with which the sealant and/or caulking compound will come in contact, such as new aluminum or bronze, shall be wiped with xylol, or a metal ethyl keytone solvent to remove the protective coating or oil deposit that may be left on the metal surfaces.

Joints shall be cleaned of loose mortar. Where joints are deeper than 1/2" a closed-cell polyethylene joint backing shall be used, A size shall be used so as to allow for a 30% compression of the joint backing, when inserted in the joint. Where joints are larger than 1/2" in width, the backing shall be placed so that the depth of the joint is not greater than 1/2 of the width. Precast or masonry surfaces should be brushed clean. If the masonry surfaces such as precast concrete are to be treated with a waterproofing material, then the joint should be masked to prevent contamination of the joint area by the waterproofing.

Application: All materials shall be applied by skilled workmen according to manufacturer's direction.

Caulking shall be done with standard hand guns or air-powered guns.

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Apply caulking and sealing materials under pressure to expel air and provide solid filling. Surfaces shall be uniformly smooth and free of wrinkles and sags, flush with adjacent surfaces or slightly concave.

All beads shall be tooled to insure full contact with sidewalls of joints and the backing material. Tooling stick or knife shall be used to strike off excess material and properly shape the head.

Clean-up: Remove smears, excess material adjacent to the joint as work progresses. The job shall be left in a neat and workmanlike manner.

Miscellaneous: Any questions regarding application of sealant, preparation of joint, or handling of material shall be referred directly to a qualified field representative of the manufacturer.

Guarantee: The Caulking Contractor shall guarantee this work to be satisfactory for a period of two years from the completion of caulking work covered under this caulking section.

Foundation Waterproofing:

Scope of Work: Provide all labor, tools, materials, and equipment necessary to complete all foundation waterproofing as herein specified.

Materials: As follows:

1. Mastic: Hydrocide 128 as manufactured by L. Sonneborn Sons, Spray Mastic as manufactured by Euclid Chemical Company, Spray Mastic as manufactured by Philip Carey Company, Spray Mastic as manufactured by Lewis Asphalt Company or approved equal.

2. Fabric: 11 ounce asphalt saturated cotton fabric, Tarzan as manufactured by American Associated Company, Atlanta, Georgia, or Karnak as manufactured by Asphalt Engineering Corporation, New York, New York, or approved equal.

3. Protective Board: 1/8" premoulded membrane as manufactured by W. R. Meadows Company, or Elastibord, as manufactured by Philip Carey Company.

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Application: To the exterior concrete foundation walls below grade of all basement areas, this Contractor shall apply one thorough coat of mastic troweled to a uniform thickness of 1/16" thick, into which is embeded one ply of fabric, making sure that all bubbles and wrinkles are troweled out. Over the fabric apply a second coat of mastic to a thickness of 1/16", thoroughly covering the fabric and making sure that no fabric weave is visible. Into this coat embed a layer of 1/8" premoulded membrane, butting all joints and sealing with mastic. The application of mastic and fabric shall be applied in strict accordance with the manufacturer's printed instructions.

Roof Hatch

Scope of Work: Provide all labor, tools, material and equipment necessary to install the roof hatch in Mechanical Room 12 as detailed on the drawings.

Material: The roof hatchway shall be Babcock Davis Model 6-204, insulated, Easy Access hatchway for roof opening 2' - 6" x 4' - 6", or an approved equal. Curb and cover shall be aluminum and hatchway shall conform to manufacturer's printed specifications. See details on the drawings.

Batt Insulation

Scope of Work: Furnish and install batt insulation above all acoustical grid ceilings at entrance and window wall soffits where detailed and at all sound baffles above folding partitions as detailed.

Material: Insulation shall be 4" thick Kraftfaced fiberglass batts as manufactured by Certain-teed Products Corporation, or an approved equal. Thermal conductivity of insulation shall be 0.32 or less at a mean temperature of forty degrees Farenheit. All insulation shall be installed in accordance with manufacturer's recommendations.

1. Over plaster ceiling, insulation shall be in continuous batts.

2. Over lay-in acoustical tile ceilings, insulation shall be 2' x 4' batt to provide access to space above ceiling.

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ROOFING AND SHEET METAL - SAMPLE SPECIFICATION C

NOTE: The Contractor for this work is referred to the Instructions to Bidders, the General Conditions and the Supplementary General Conditions as a part of this specification.

Extent of Work:

1. This Contractor shall supply all equipment, labor, and material necessary to furnish and install the following:

   a. Roof Insulation
   b. Cant strips
   c. Composition built-up roofs
   d. Flashings and counter flashings
   e. Roof access doors (hatchway)
   f. Copper roofing, rib seamed
   g. Skylights
   h. All other items of miscellaneous sheet metal work or roofing shown on the drawings or as specified and necessary for a complete job.

Insulation:

1. a. Roof deck shall be dry and clean
   b. Under insulation lay one ply of fifteen pound asphalt saturated Rag Felt (unperforated), lapping each sheet six inches over the preceding one, mopping the full width under each with thirty pounds of asphalt per square. The felt applied under the insulation shall be turned upon, but not cemented to, all vertical surfaces to a height six inches greater than the thickness of the insulation.
   c. A total of two inches of insulation is required. It shall be installed by using two one-inch thicknesses. Insulation board shall be rigid plain FESCO BOARD as manufactured by John's Manville, 22 East Fortieth Street, New York, New York or approved equal.

   Lay one layer of one inch insulation on deck and cut out for all electrical conduit and mopping full width under each sheet using forty pounds of asphalt per layer, per square. After this is layed, lay the second layer of one inch insulation over the entire roof, staggering all joints with the first layer of insulation and mopping this layer

NAME _____ DATE _____

to the first layer using a minimum of forty pounds of asphalt per layer, per square.

The upturned felt at vertical surfaces shall be turned down and mopped solidly to the insulation.

Cant Strips:

1. Install fiber 3" x 3" Cant Strips around all curbs, cornices and chimney. It shall be plain uncoated fiber and shall vary from 3" x 3" to 4" x 4" as best fits the conditions of the job. It shall be asphalt mopped into place and where used with existing flashing, shall be trimmed to fit the existing condition. All Cant Strips shall be kept absolutely dry.

Composition Built-Up Roof:

1. Apply one layer of J-M No. 45 Asbestos Base Felt, lapping each felt two inches over the preceding one. Mop the full width under each felt with J-M asphalt using a minimum of 20 pounds per square.

2. Starting at the edge, apply one 12" wide, then over that one 24" wide, then over both a full 36" wide J-M Asbestos Finishing Felt. Following felts are to be applied full width over-lapping the preceding felt by 24 2/3" in such a manner that at least 3 plies of felt cover the base felt at any point. Each felt shall be firmly and uniformly set without voids into hot J-M Aquadam applied just before the felt at a minimum rate of 23 pounds per square uniformly over the entire surface.

3. Finish the entire surface with a uniform mopping of "Aquadam" at a minimum rate of 20 pounds per square.

4. This Contractor shall furnish to the owner a 20-year Bond on the roof with an endorsement on all flashings.

Flashings and Counter Flashings:

1. Base Flashing - Install asbestos base flashing around the perimeter of each roof area and at all cant strips. All base flashing materials shall extend not less than 6" high on the vertical surfaces which shall be primed and not less than 4" on the roof. Such dimensions shall be measured from the top and bottom edges of the cants. On the exterior cornices, carry the material over and down to the exterior edge. (See large scale detail on drawings.)

NAME _____ DATE _____

Starting 3" below the point where the metal flashing enters the wall, or at the outside edge of cornice, mop with hot J-M 190 Asphalt the area to receive the backer felt of J-M Asbestos Finishing Felt. Press it into place, lapping the ends of the felt 3". Mop with hot J-M 190 Asphalt the surface of the backer felt just applied. Then mop the back surface of the J-M Asbestos Base Flashing (reinforced) and press it into place. Nail the flashing at 4" centers along the top edge using 1" long concrete nails. (Use a galvanized roofing nail in coping.) Lap the ends of the flashing 3" and nail the lap on 4" centers vertically. Cover the lap with Three Course Asbestile (a 4" wide strip of J-M Asbestos Finishing Felt embedded in and troweled over with layers of Asbestile 1/8" thick.)

The exposed area after the metal cap flashing or the angle cornice is installed shall be finished with Topgard Type "C".

2. Cap flashing and miscellaneous flashings - all flashings around vent hoods, chimney, coping, walls where interior heights change, etc., shall be Type 302/304 stainless steel, 2-D finish, and in a minimum thickness of .018 (26 gauge). This material shall be used as flashings across heads of windows and exterior doors. Provide 6" coverstrips of same material where flashings lap. Set lap in sealer. Lap minimum of six inches.

Copper Roofing, Rib Seamed:

This Contractor shall furnish and install rib seamed copper roofing on the two porches.

All copper shall be in accordance with ASTM Spec. B 370 cold rolled temper, weighing not less than 16 ounces per square foot.

All nails and fasteners including rivers, screws and bolts shall be of hard copper, brass or bronze. All nails shall be flathead, barbed, wire slating nails not less than No. 12 gauge, 1" long.

Apply a layer of fifteen pound roofing felt over entire area to be covered. This shall be followed by a layer of building paper. Lay each ply 2" with the slope and nail with large flathead copper nails. The battens on the roof should be installed prior to installing the roofing felt.

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

Turn up sides of sheets to top of batten plus 1/2" additional which shall then be turned at right angles to the batten. Form cross seams with a 3/4" fold (under) on the lower end and a 2" fold (over) on the upper end. Slit folds in cross seams at each corner, 1" in from batten to form a tab. Hook 3/4" fold on lower end of pan into 2" fold on upper end of underlying pan. Apply sheet metal roofing beginning at eaves with half-length sheets, staggering transverse seams. Space cleats 12" o.c. nailed to vertical face of battens.

Place cover strips over battens, locking edges with flanges of pan malleted down against sides of battens. Cover batten ends with a cap folded and locked into extensions of batten covers and vertical legs of pan.

Ridges and hips shall be copper covered battens similar to roof battens. At intersection of roof slope with ridge or hip battens, edges of roof pans shall turn up against ridge or hip battens and terminate in a 1/2" horizontal flange at top of battens. Install cover strip of copper over top of hip and ridge battens.

Cover South Gable end of porch roof with similar treatment but on a vertical surface.

Hatchway: Furnish and install roof scuttle Model S as manufactured by The Bilco Company, New Haven, Connecticut.

Skylights: Furnish and install all skylights as noted and scheduled on the drawings. Skylights are the product of Vasco Products, Inc., P.O. Box 350, Wakefield, Massachusetts, and shall be of size shown on drawings.

Skydome shall be double-domed acrylic, white translucent with 9" insulated curb with 1" of insulation. Entire frame of Skylight shall be aluminum with integral condensation weepage gutter and integral 3" roof nailing flange.

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

C. DETAIL DRAWINGS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to read and interpret various types of detail drawings utilized in the roofing industry.

REFERENCES: Samples of various detail drawings relative to roof penetrations, flashings and expansion joints. (Also, refer to glossary)

RELATED INFORMATION:

1. The specifications call for the installation of three Wasco Skylights Model A-1, what is the length of the roof flange?

2. When utilizing pitch pockets, what material is placed in the pocket prior to pouring the bitumen?

3. Why are expansion joints utilized in roofing?

4. What is the purpose of flashing?

5. What is a curb?

6. What is a cant?

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

7. What is a counter flashing?

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

D. USE OF MANUFACTURER'S SPECIFICATION MANUALS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain the relationship between the architect's specifications and the manufacturer's specifications.

REFERENCES: It is essential that the instructor contact the below manufacturers or the local roofing contractors for the current manufacturer's specification manuals. (revised and additional questions should be developed with regard to current manufacturers specifications)

Barretts Division of Celotex Corporation Manual of Built-Up Roof Specifications
Bird & Son, Inc., Built-Up Roofing Specifications
Philip Carey Built-Up Roofing
Johns - Manville Built-Up Roofs
Koppers Built-Up Roofing Specifications Manual
Ruberiod Built-Up Roofing

RELATED INFORMATION:

1. The architects specifications call for a Barrett No. 120-C, 20-year bond roof, how many plies are involved, including the base sheet?

2. The architect's specifications call for a Bird 52 CA-10 roof, is this a hot or cold roof application? What is the maximum specified amount of adhesive per square?

3. The architect's specifications call for a Philip Carey No. 1-DZ roof (nailable), what is the specified spacing between nails? What is the maximum total weight of the roof per square?

4. The architect's specifications call for a Johns - Manville No. 603, 15-year bondable roof, on the application of the base sheet what is the specified amount of felt

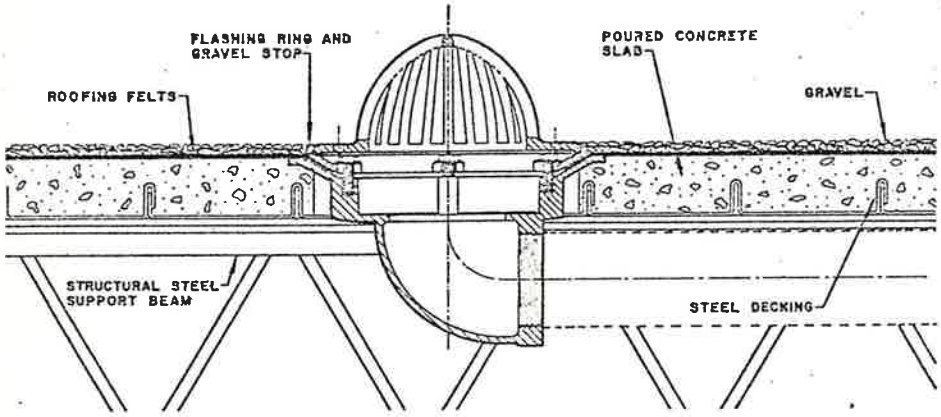
NAME _____ DATE _____

overlap? How many pounds per square of slage are specified for this roof application?

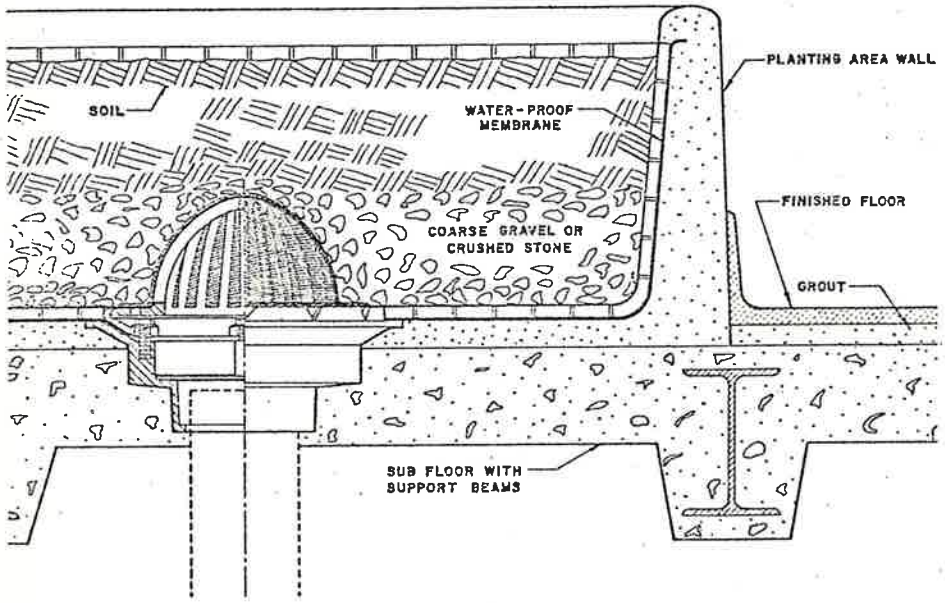
5. The architect's specifications call for a No. 27-4 ply - 20 year Koppers roof, what type of deck is this roof to be applied over? How many pounds of pitch specified per square?

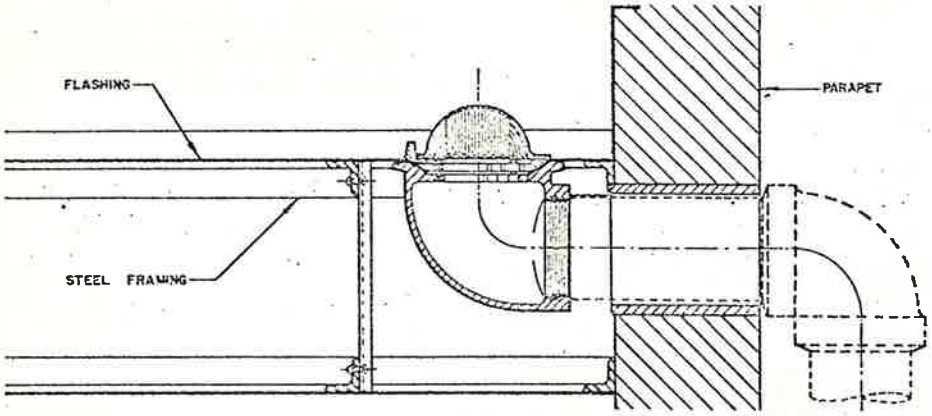
Installation Details

W-3220-A series roof drain installed in steel and concrete deck. Side outlet permits use in shallow deck construction.

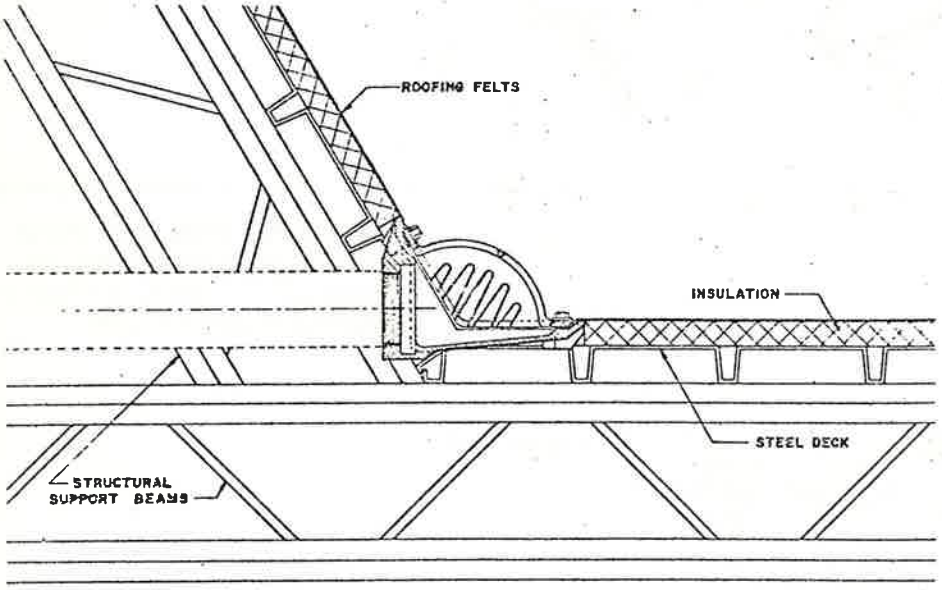


W-3220-PA series drain shown installed in typical planting area. Heavy wire screening is securely attached to dome strainer.

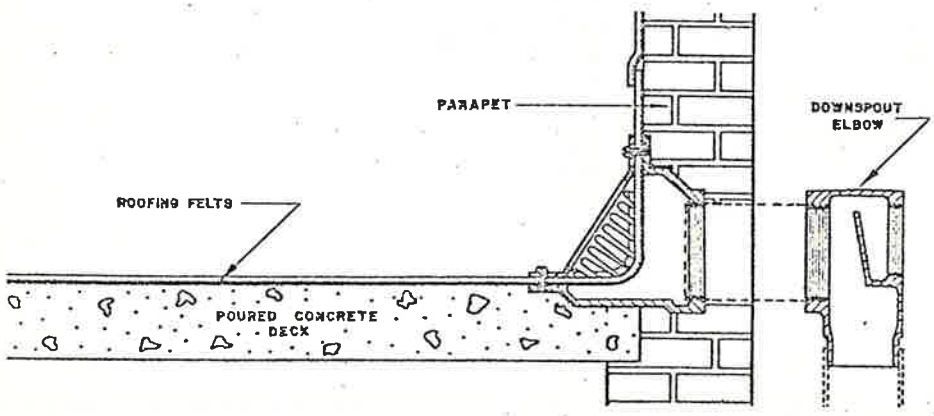




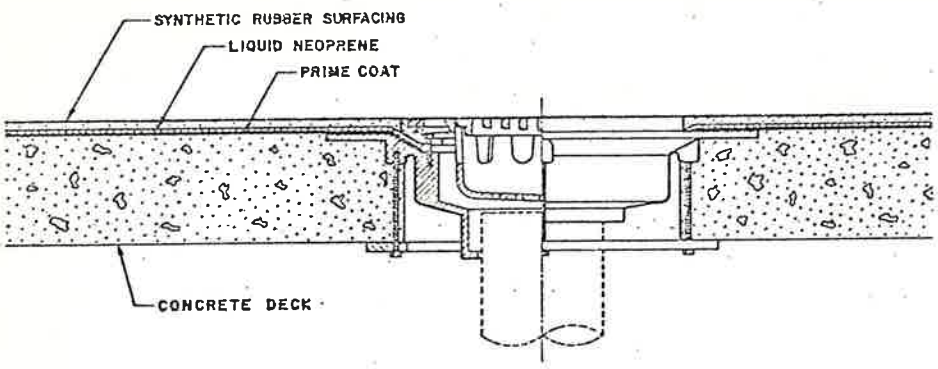
W-3230 series canopy drain installed in metal deck with outlet through parapet wall.



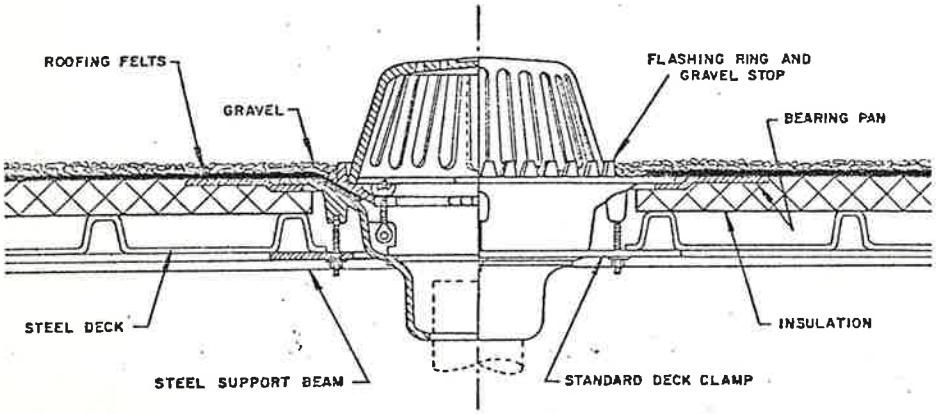
W-3230-U series drain shown installed in typical overhanging balcony or cornice.



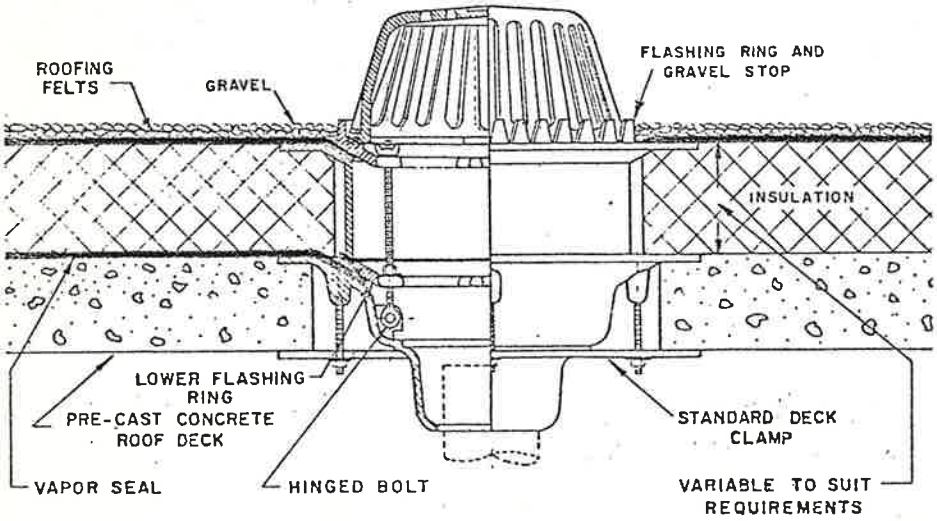
W-3270 series parapet drain shown installed through wall and used in conjunction with downspout elbow.



W-3300-D series drain installed in concrete slab or deck with shallow latex or neoprene roofing or flooring flashed and clamped into drain.



W-3500 series roof drain shown installed in insulated steel deck with built-up roofing. Metal flashing can be installed under felts and over bearing pan.



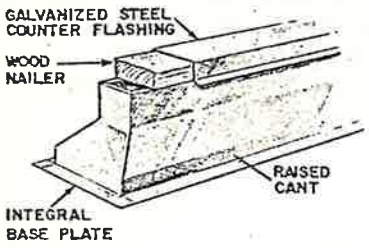
W-3500-DF series roof drain shown installed in concrete roof deck with built-up insulation and roofing. The versatility of this drain is clearly detailed. A vapor seal can be installed over the deck, on top of which roofing membranes are applied, flashed into the drain and secured by the secondary flashing ring, making a water tight connection. Later, the insulation and roof covering can be applied and flashed in the usual manner.

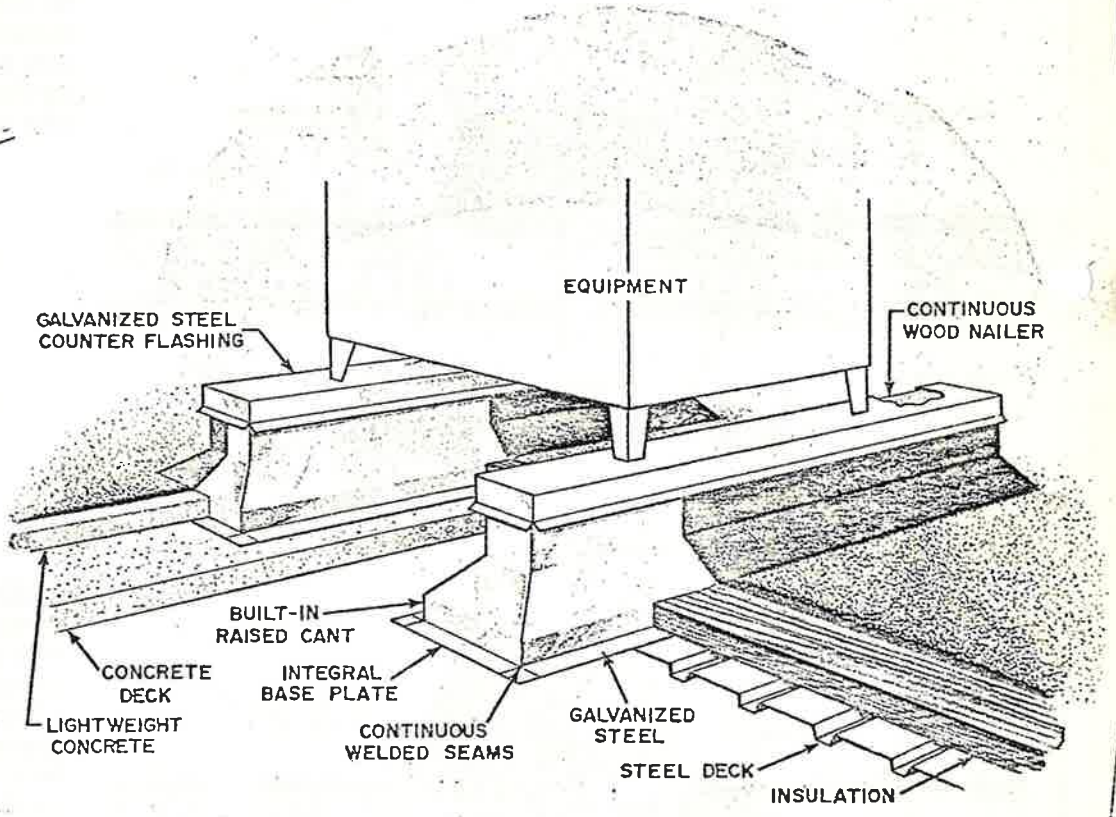
BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

EQUIPMENT SUPPORTS

RAISED CANT STYLE



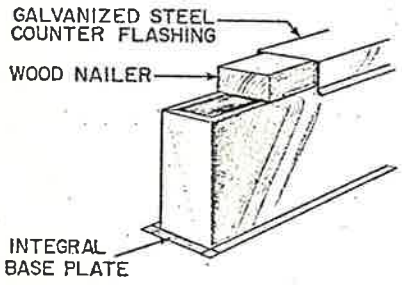


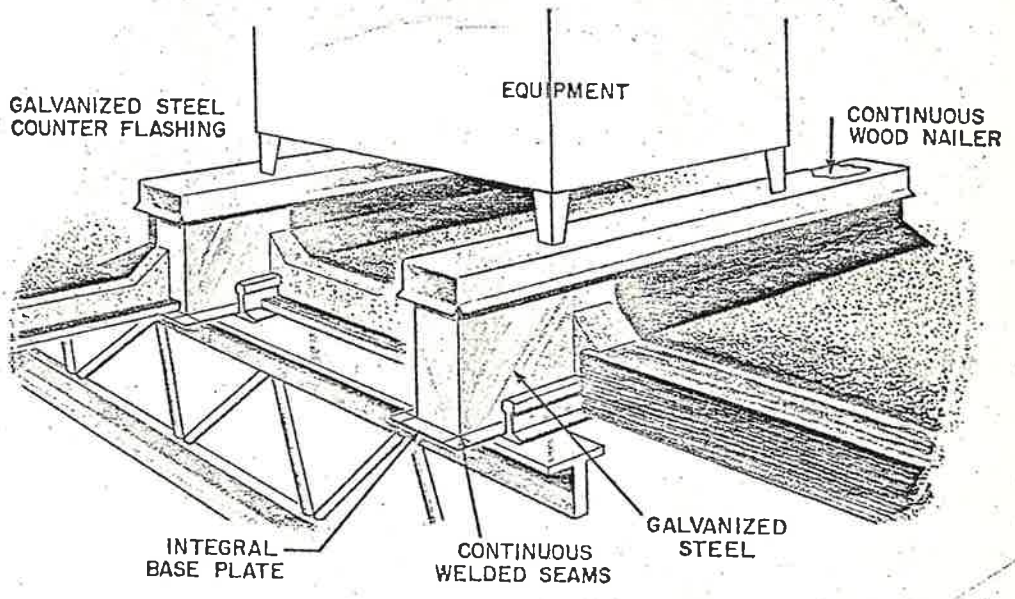
BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

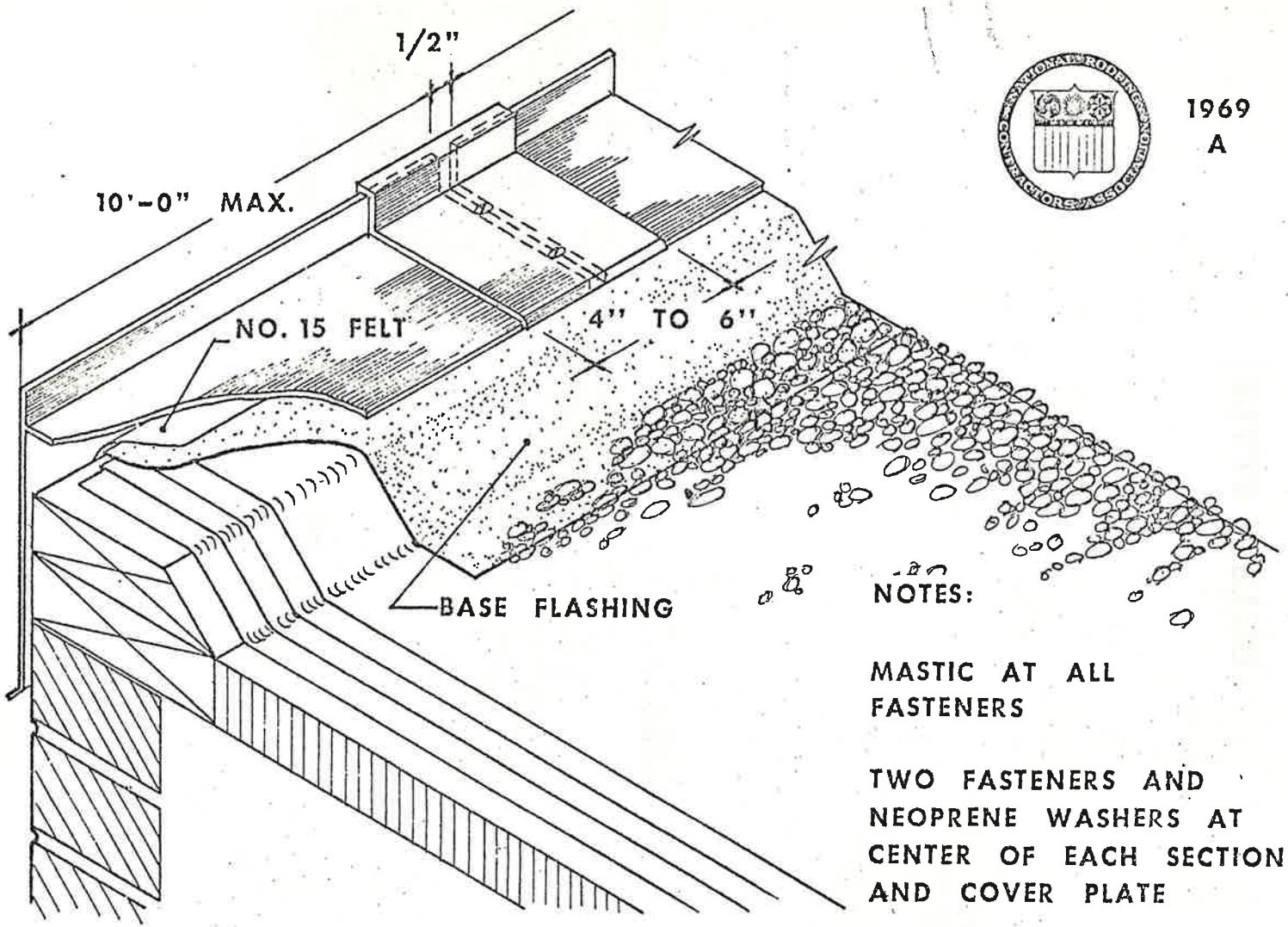
EQUIPMENT SUPPORTS

BULB T STYLE





HEAVY METAL ROOF EDGE DETAIL



1969
A

NOTES:

MASTIC AT ALL FASTENERS

TWO FASTENERS AND NEOPRENE WASHERS AT CENTER OF EACH SECTION AND COVER PLATE

This type of detail should be used with metals of 22 ga. steel, 0.050" aluminum, 24 ga. stainless steel, or heavier. Metals of this weight are very rigid when formed, and fastening at the center-line and joint cover will allow expansion and contraction without damaging the base flashing material.

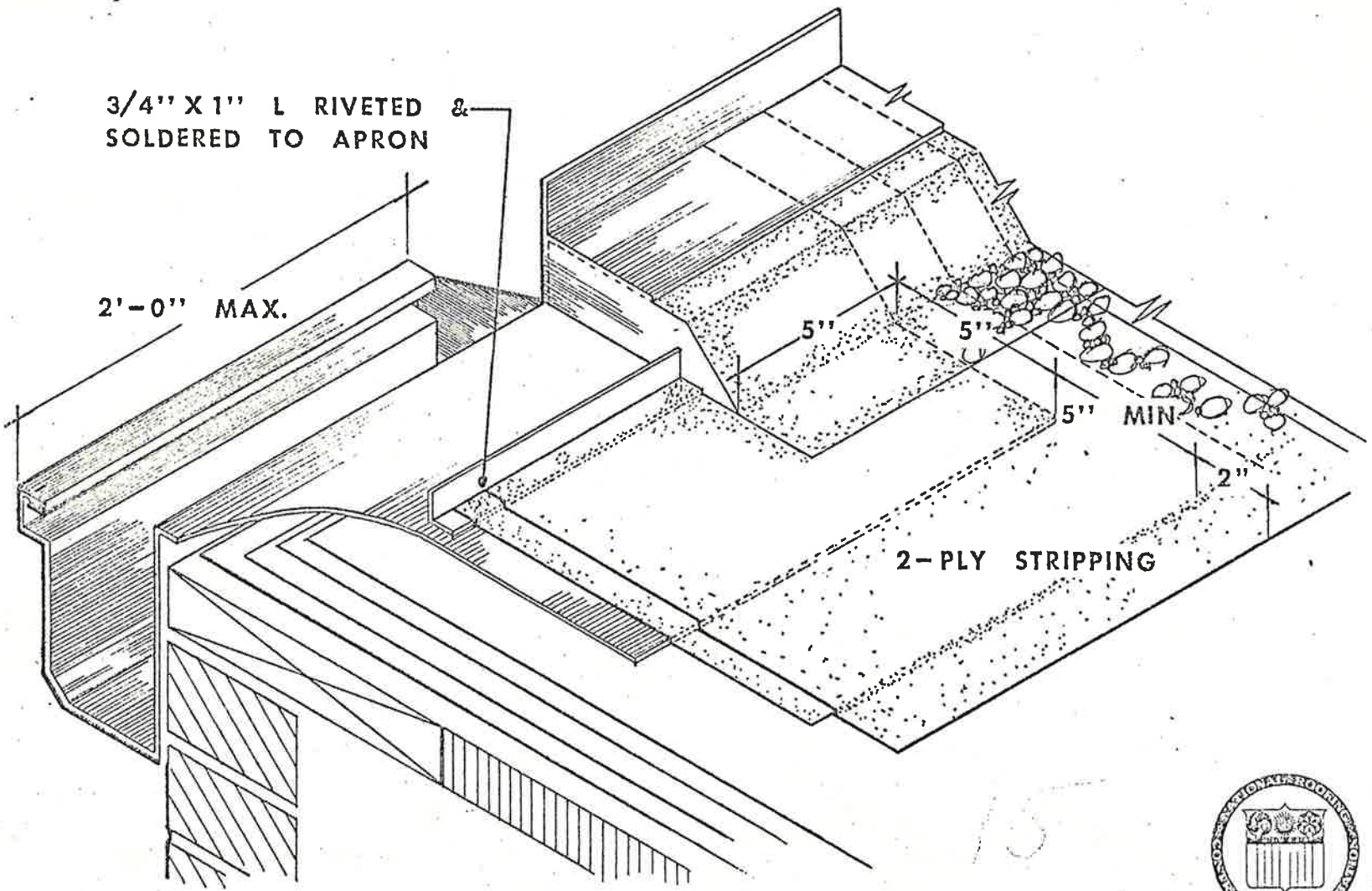
Restraining the metal by additional fastening can result in one or more of the following:

1. Buckling of the face.
2. Enlarging of the fastener holes.
3. Loosening of the fasteners from the wood nailer.
4. Shearing of the fasteners.

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

SCUPPER THROUGH ROOF EDGE



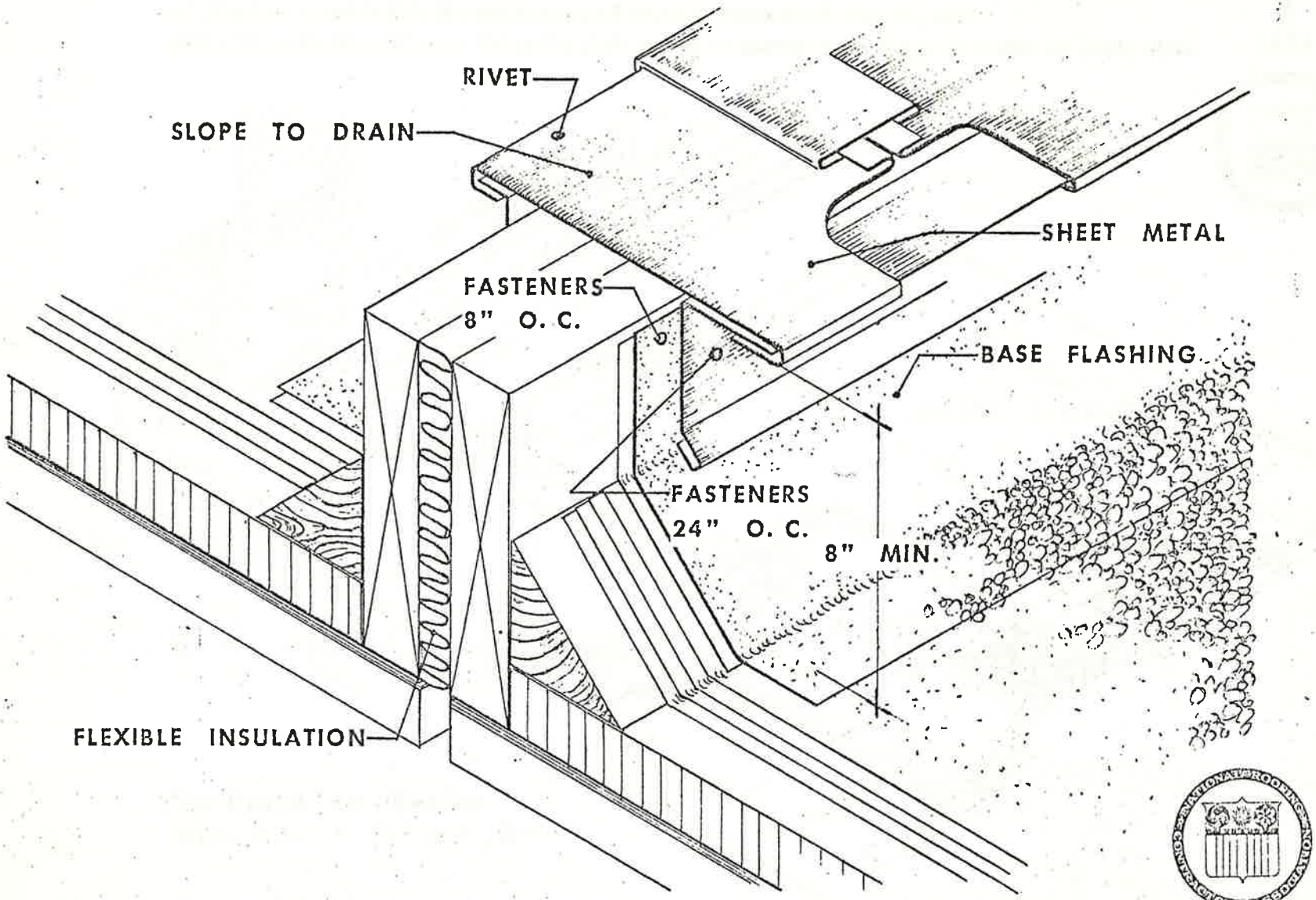
This detail can be used with the Roof Edge shown in Details G, O and P. It is easy to install after the building is completed to relieve standing water in areas along the roof edge.

1969
B

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

EXPANSION JOINT



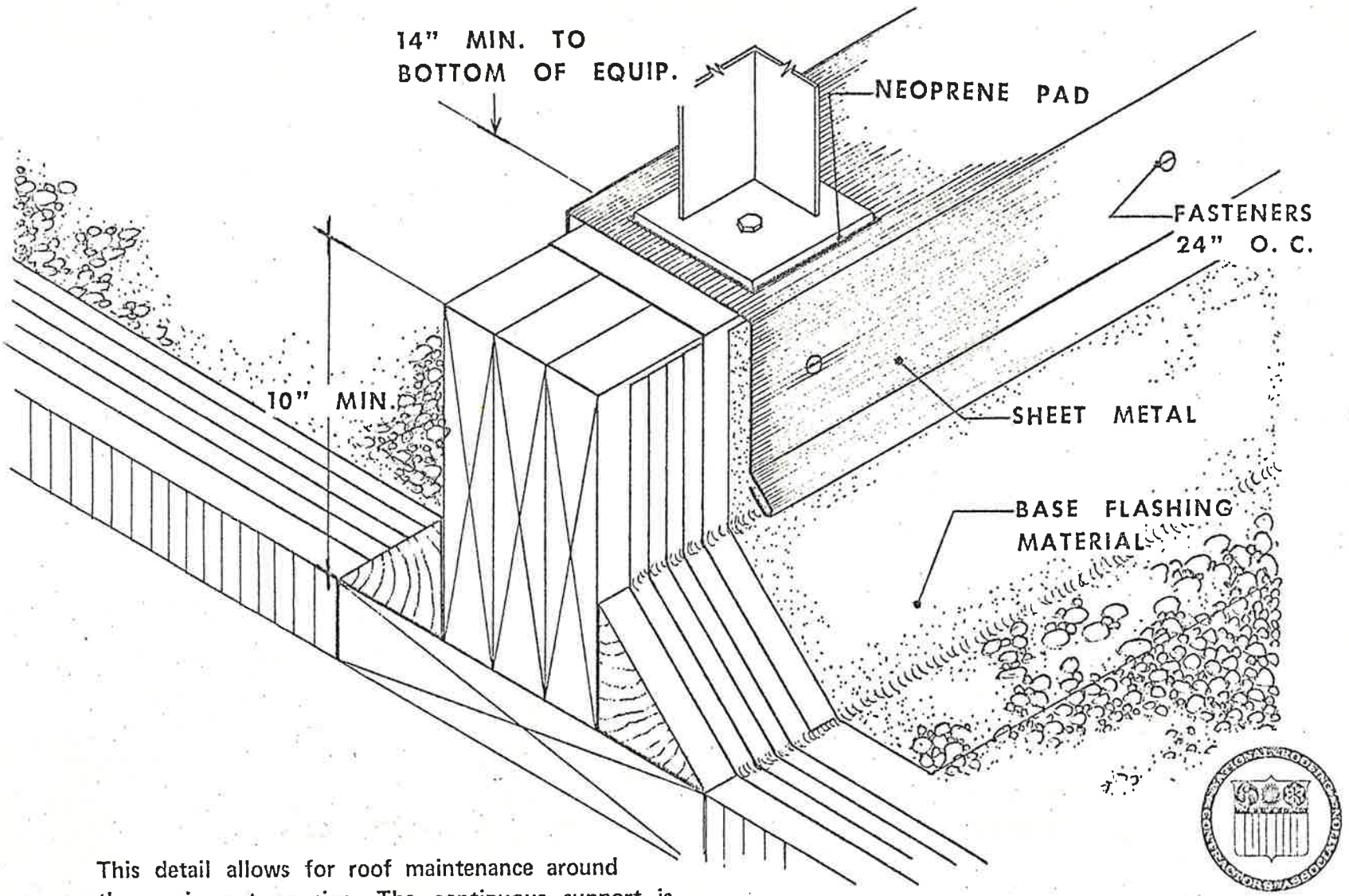
This detail allows for building movement in both directions. It has proven successful with many contractors for many years.

1969
C

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

EQUIPMENT OR SIGN SUPPORT



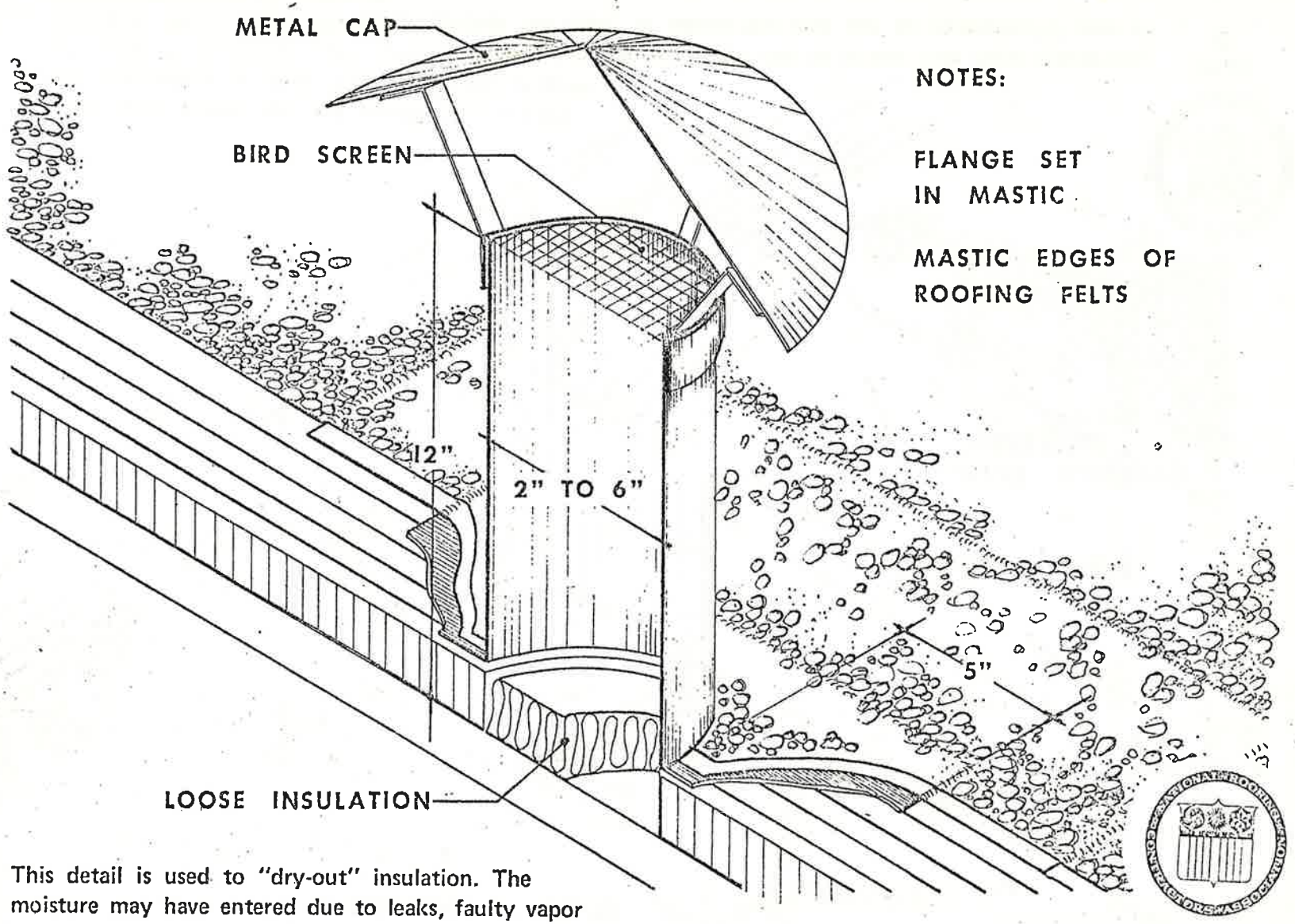
This detail allows for roof maintenance around the equipment or sign. The continuous support is preferred in lightweight roof systems since the equipment weight can be spread over more supporting members. Where heavy structural systems are used, or where the load can be concentrated over a column, Detail "N" is preferred.

1969
D

NAME _____ DATE _____

BLUEPRINT READING & SPECIFICATIONS

ROOF RELIEF VENT



NOTES:

FLANGE SET IN MASTIC

MASTIC EDGES OF ROOFING FELTS

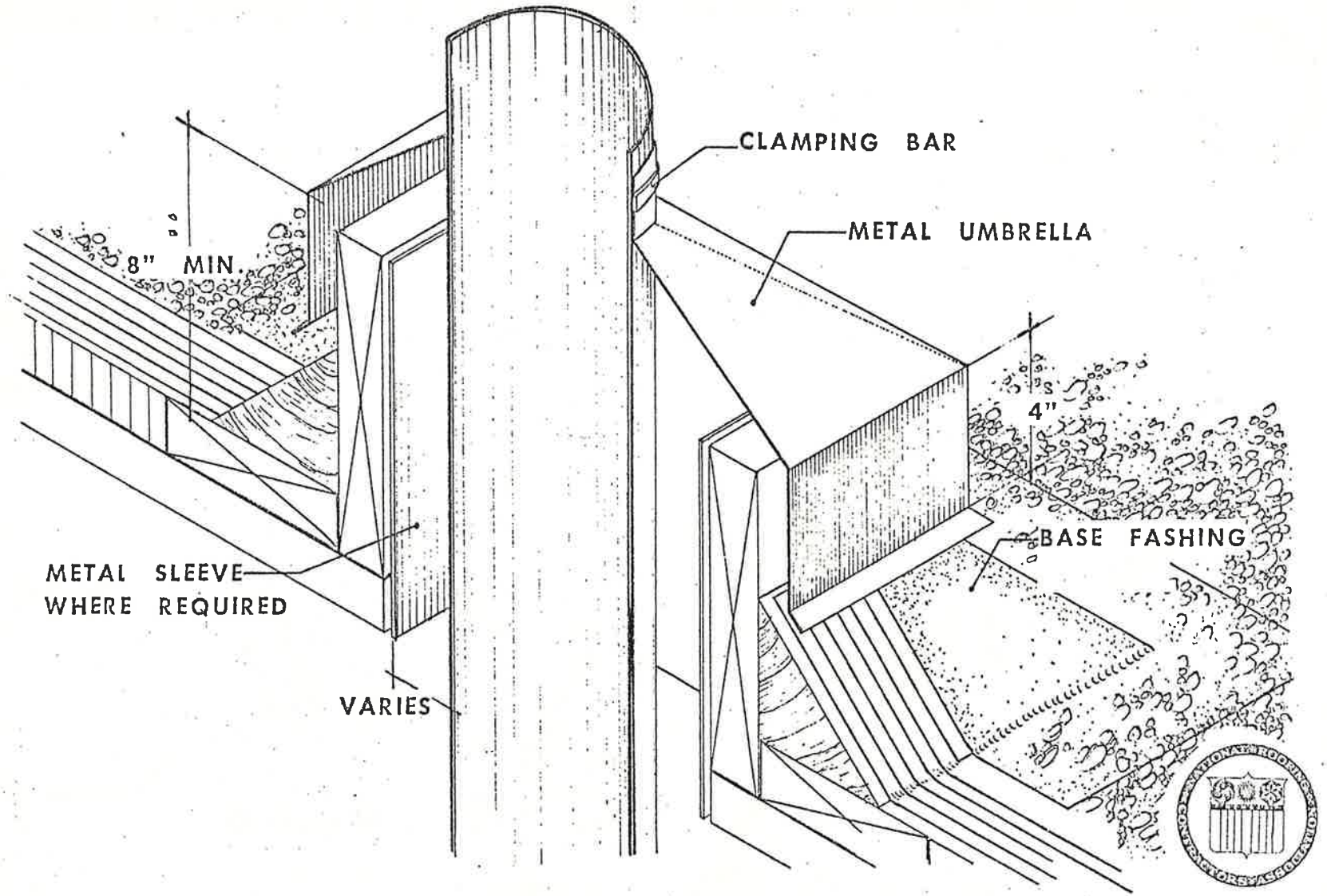
This detail is used to "dry-out" insulation. The moisture may have entered due to leaks, faulty vapor barrier or during construction. The spacing is determined by the type of insulation used and the amount of moisture to be relieved. It is sometimes used for new roofs when vapor barriers are used and a venting system is desired.

1969
E

NAME _____ DATE _____

BLUEPRINT READING & SPECIFICATIONS

STACK FLASHING



This detail allows the opening to be completed before the stack is placed. The metal sleeve and the clearance necessary will depend on the temperature of the material handled by the stack.

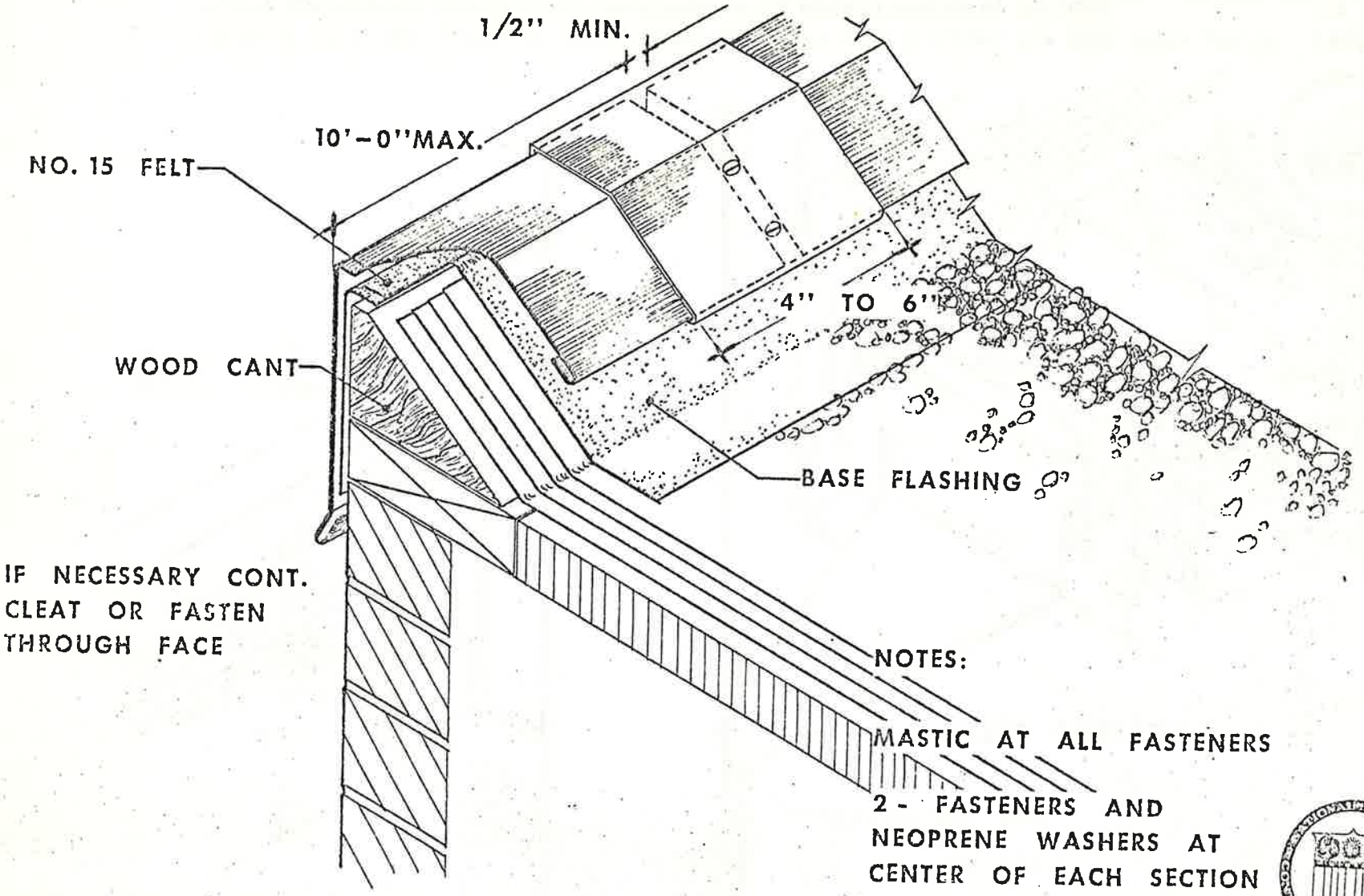
1969
F

NAME

DATE

BLUEPRINT READING & SPECIFICATIONS

METAL ROOF EDGE



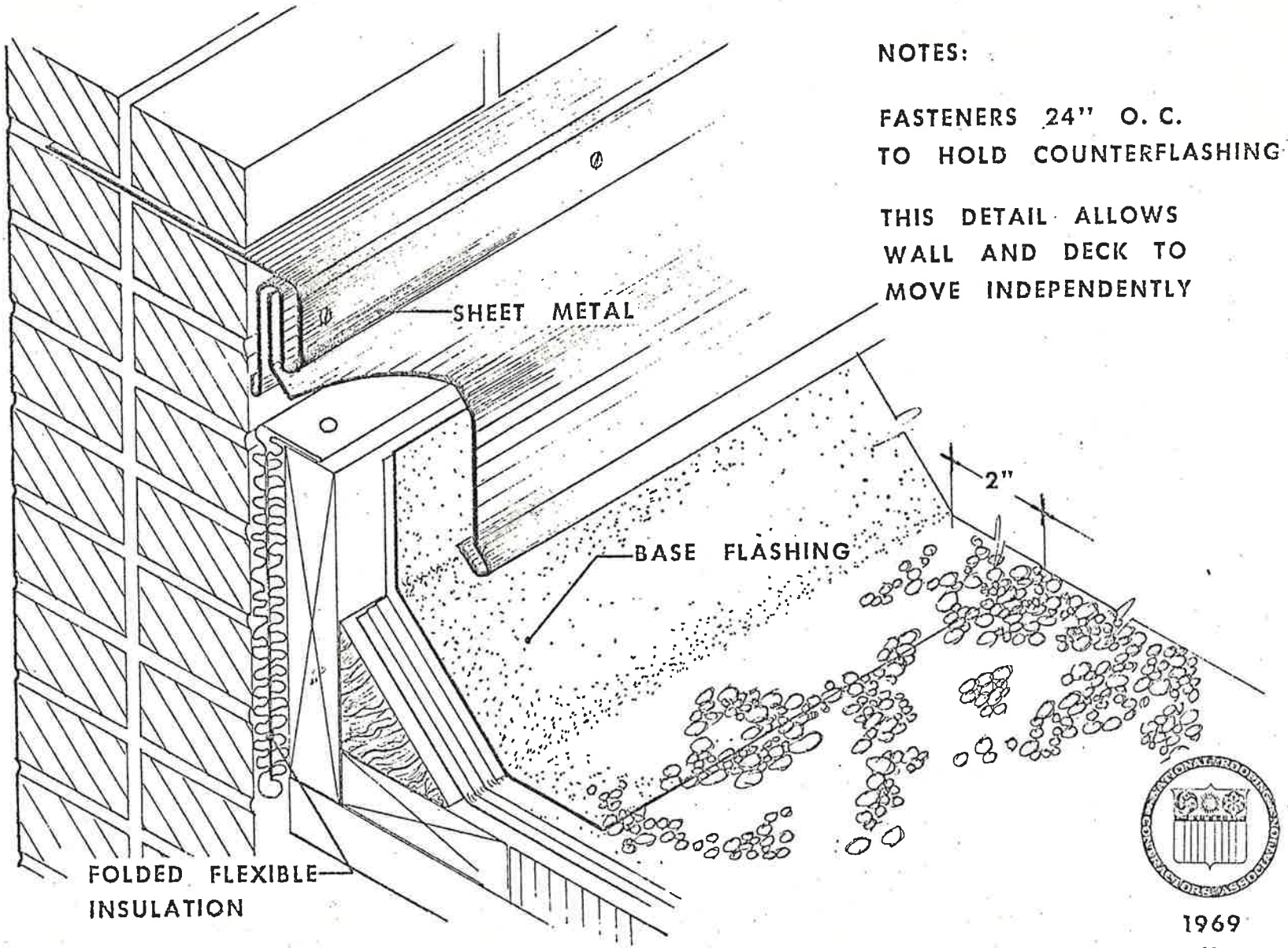
This detail is similar to Details A & O. The cant, placed as shown, will result in a higher fascia line. The No. 15 felt shown behind the fascia provides protection for the flashing edge and seals the system until the metal work is installed.

1969
G

NAME _____ DATE _____

BLUEPRINT READING & SPECIFICATIONS

WALL FLASHING DETAIL



NOTES:

FASTENERS 24" O. C.
TO HOLD COUNTERFLASHING

THIS DETAIL ALLOWS
WALL AND DECK TO
MOVE INDEPENDENTLY

1969
H

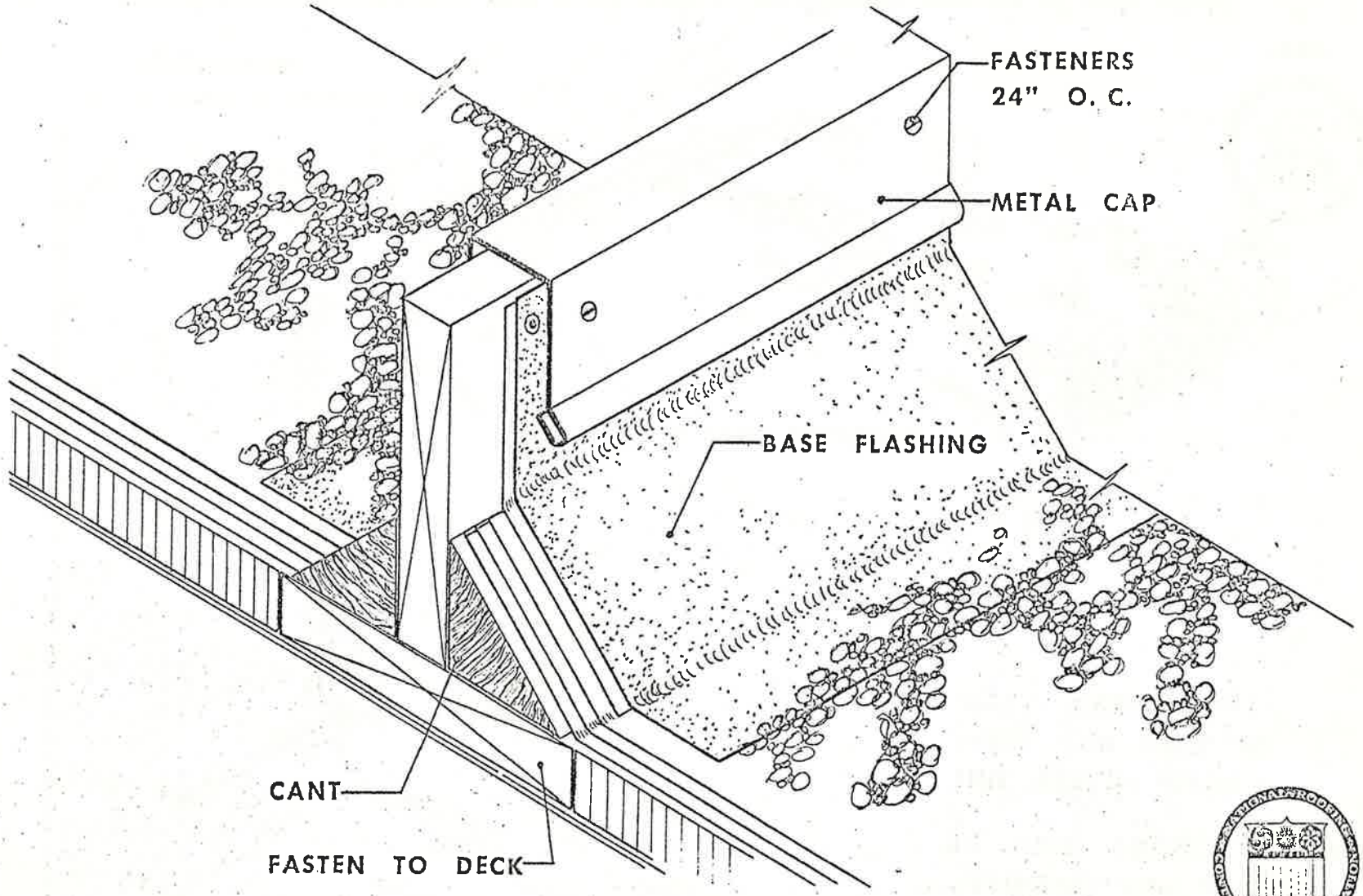
This detail should be used where there is any possibility that differential movement will occur between the deck and vertical surface, such as at a penthouse wall. The vertical wood member should be fastened to the deck only. It is possible to use a different method of joining the two-piece flashing system. This is one satisfactory method — others are possible.

NAME

DATE

BLUEPRINT READING & SPECIFICATIONS

ROOFING RELIEF JOINT



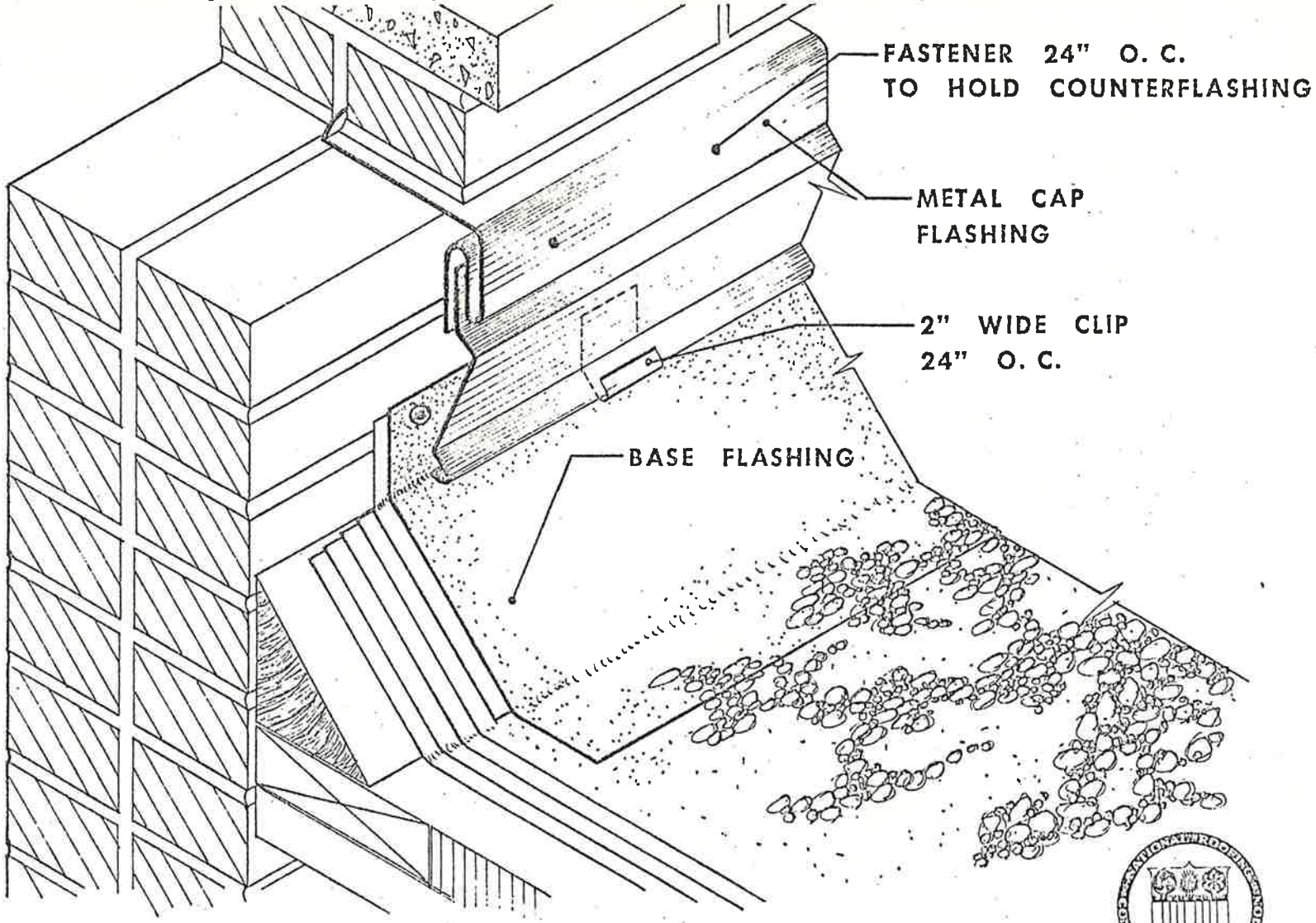
This detail is used only to break up large areas of roofing. Where roof expansion joints are needed, use Details C & Q.

1969
K

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

BASE FLASHING & INSERT WALL COUNTER FLASHING



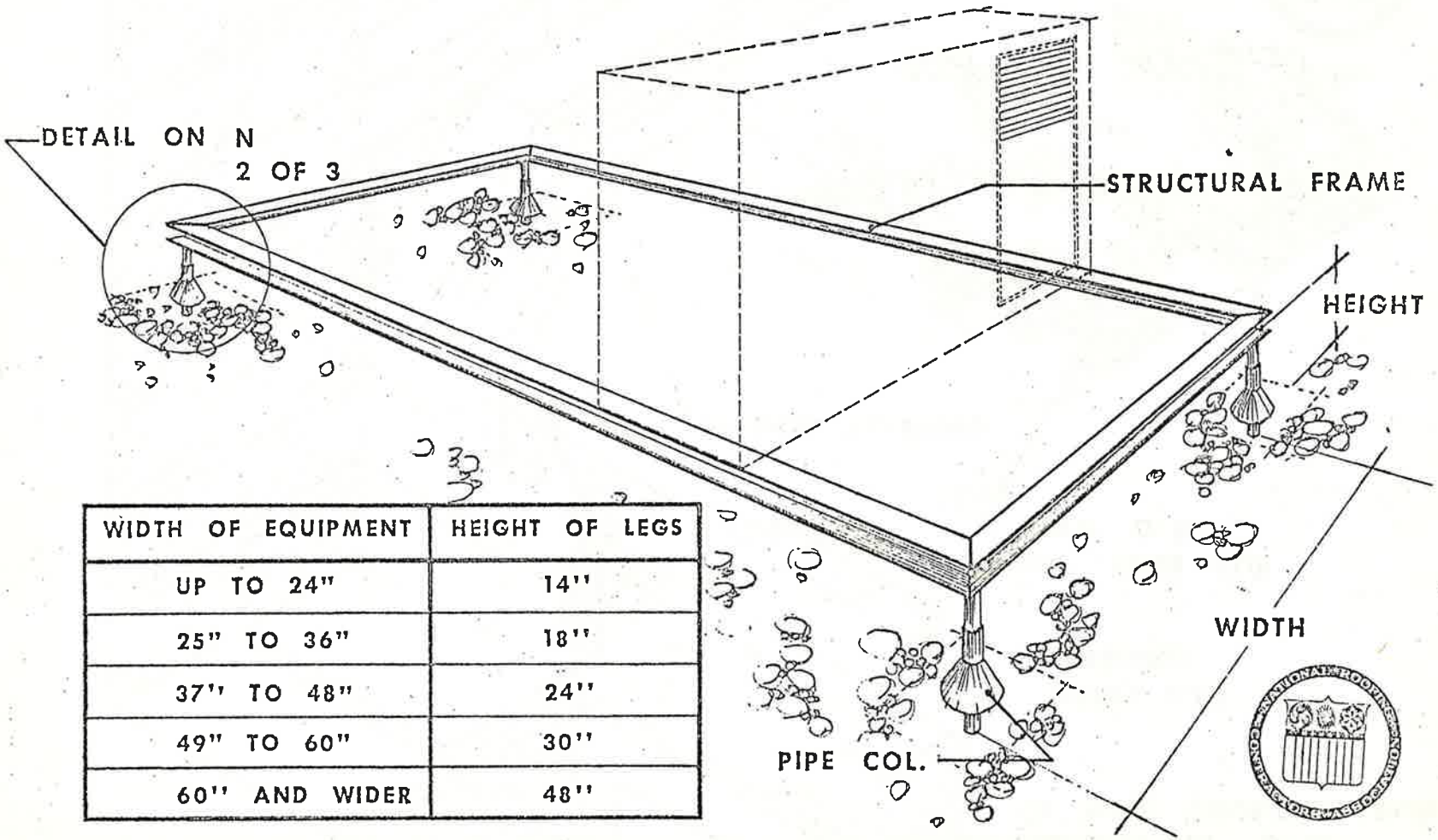
This detail is similar to Detail H. The joints in the two piece flashing should not be soldered. Breaks in soldered joints could channel water behind the flashing. Clips at the bottom of the flashing are not necessary on flashings 6" OR LESS'

1969
J

NAME _____ DATE _____

BLUEPRINT READING & SPECIFICATIONS

MECHANICAL EQUIPMENT STAND



WIDTH OF EQUIPMENT	HEIGHT OF LEGS
UP TO 24"	14"
25" TO 36"	18"
37" TO 48"	24"
49" TO 60"	30"
60" AND WIDER	48"

This detail is preferable to Detail D when the concentrated load can be located directly over columns or heavy girders in the structure of the building. This detail can be adapted for other uses such as sign supports.

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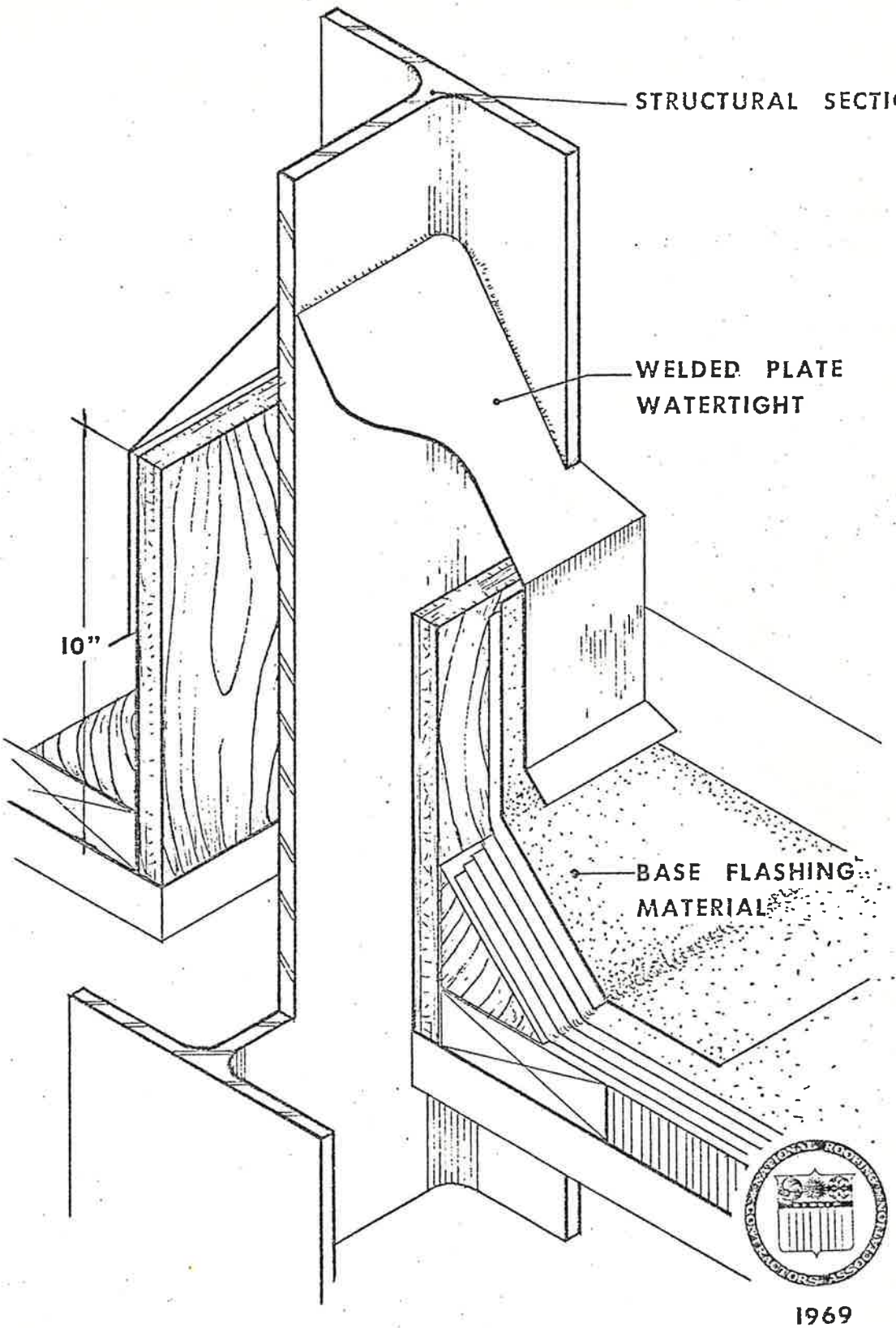
N
1 OF 3

BLUEPRINT READING & SPECIFICATIONS

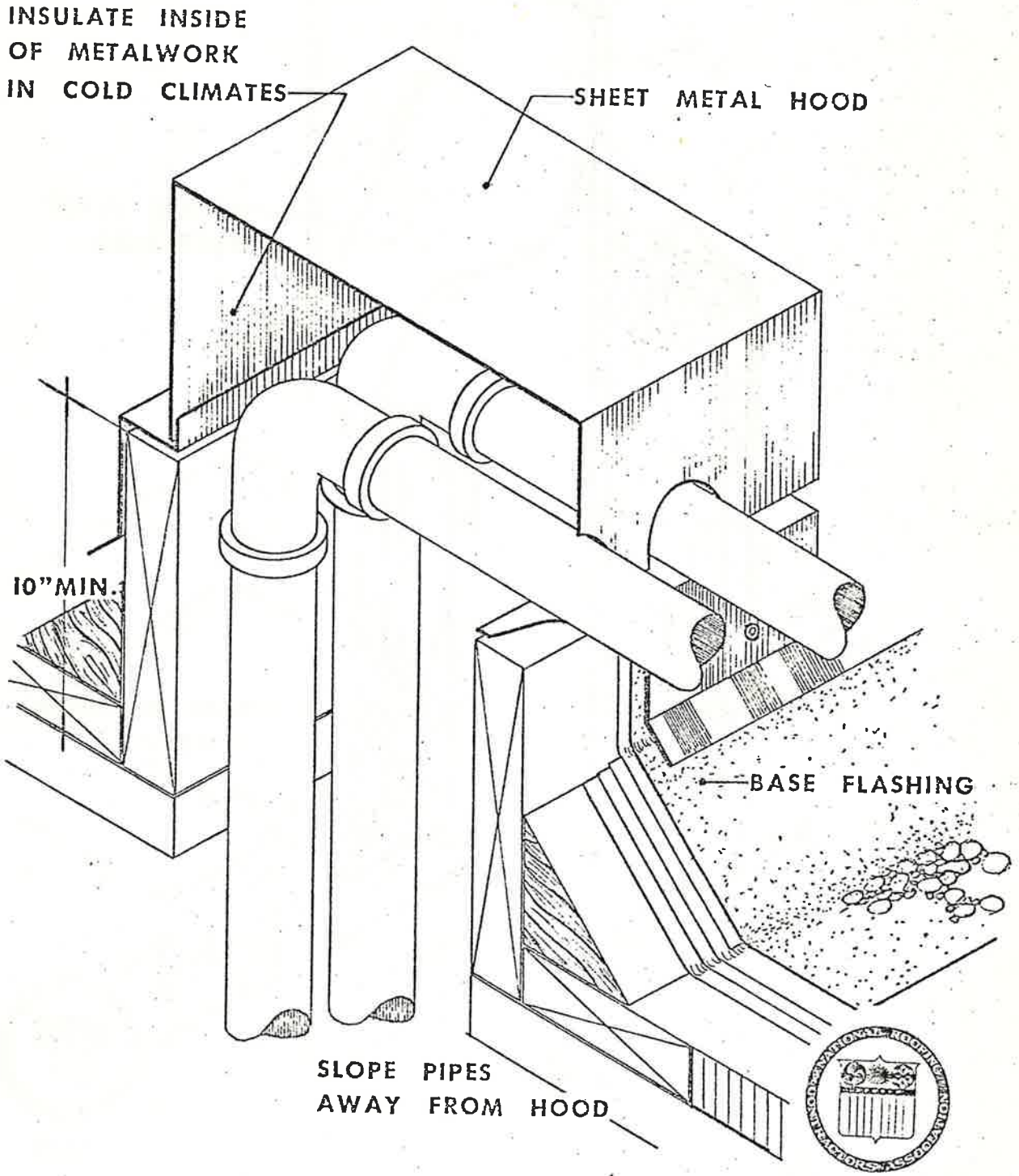
NAME _____ DATE _____

FLASHING STRUCTURAL MEMBER THROUGH ROOF DECK



This detail illustrates one method of eliminating pitch pockets. The curbed system allows for movement in the structural member without disturbing the roofing system.

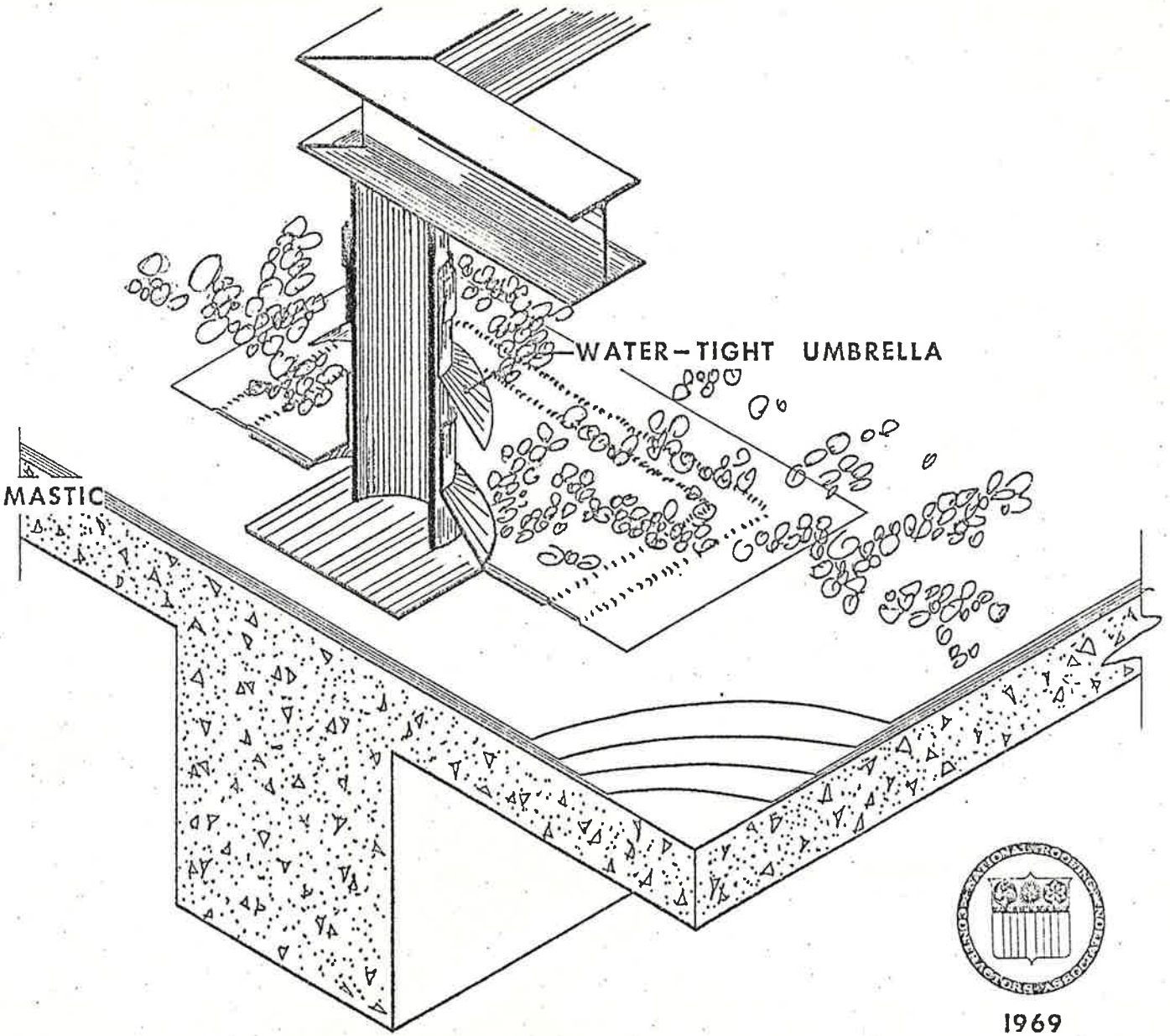
PIPING THROUGH ROOF DECK



Another method of eliminating pitch products. This detail illustrates a satisfactory method of grouping piping that must come up above the roof surface.

1969
M

CONCRETE DECK AND FRAME



NOTE :

FLANGE SET IN MASTIC OVER ROOFING

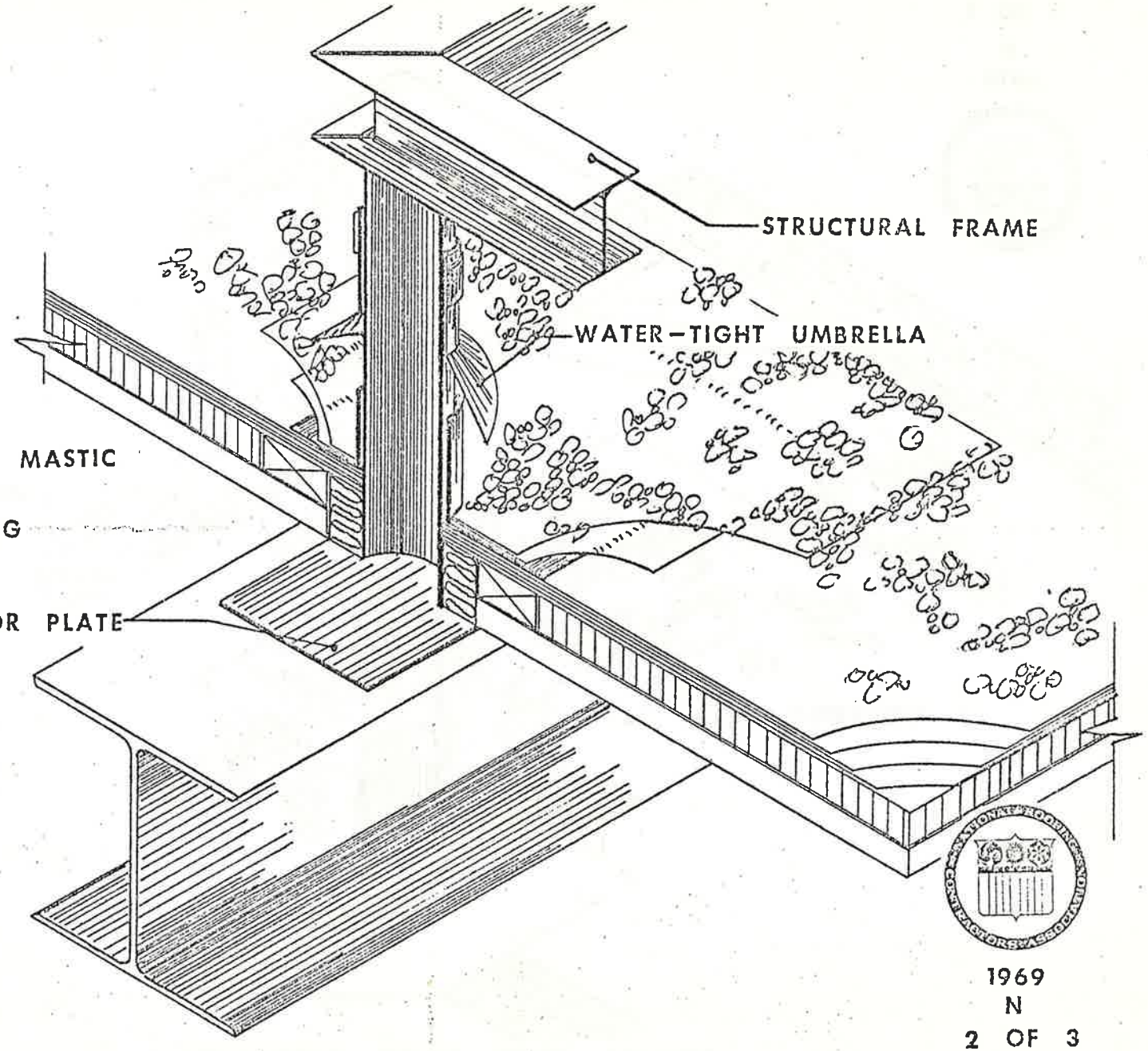
2-PLY STRIPPING OVER FLANGE

1969
N
3 OF 3

NAME _____ DATE _____

BLUEPRINT READING & SPECIFICATIONS

INSULATED DECK STEEL FRAME



NOTE :

FLANGE SET IN MASTIC
OVER ROOFING
2-PLY STRIPPING
OVER FLANGE

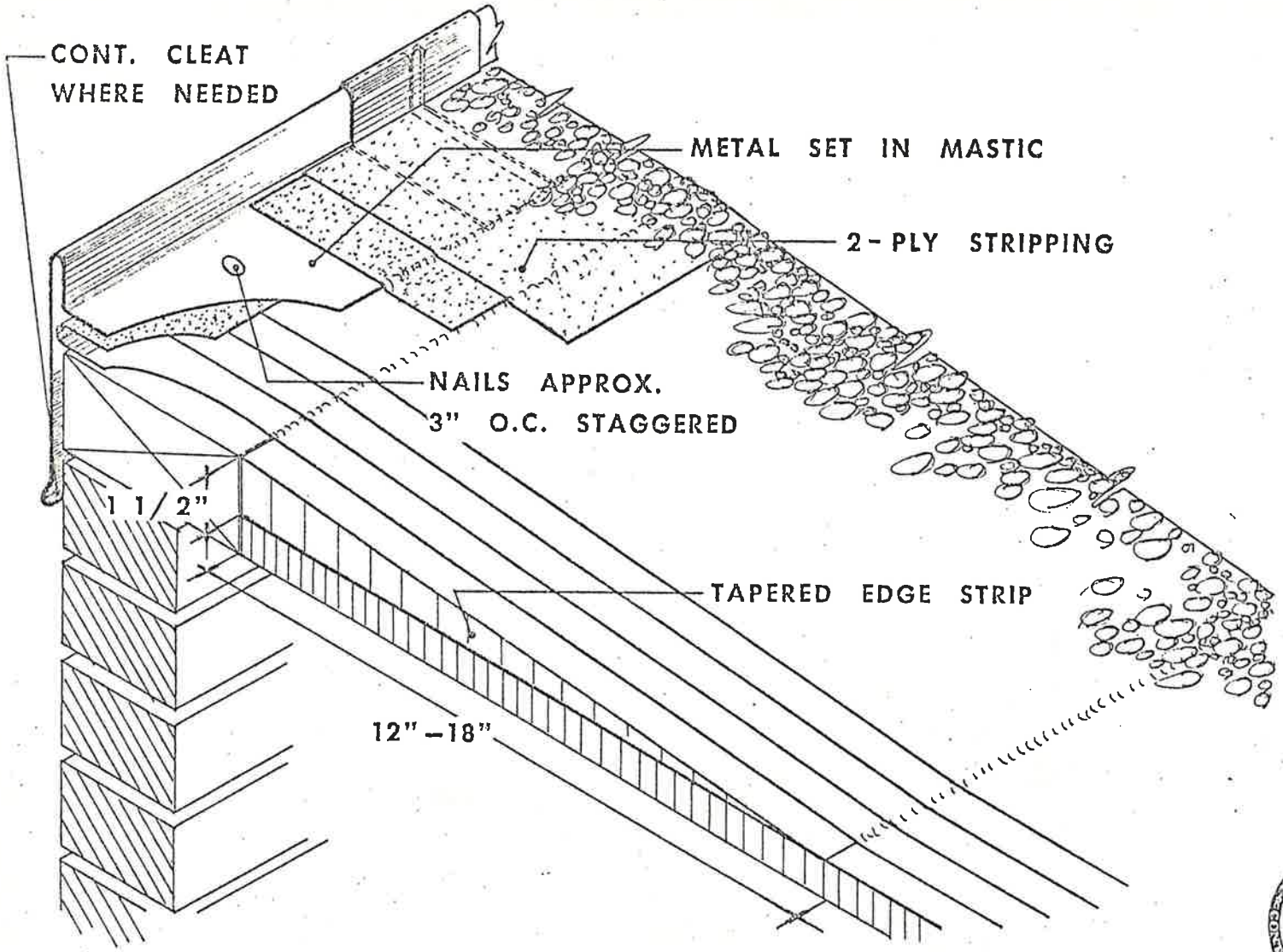
WELDED ANCHOR PLATE

1969
N
2 OF 3

NAME _____ DATE _____

BLUEPRINT READING & SPECIFICATIONS

LIGHT METAL ROOF EDGE DETAIL



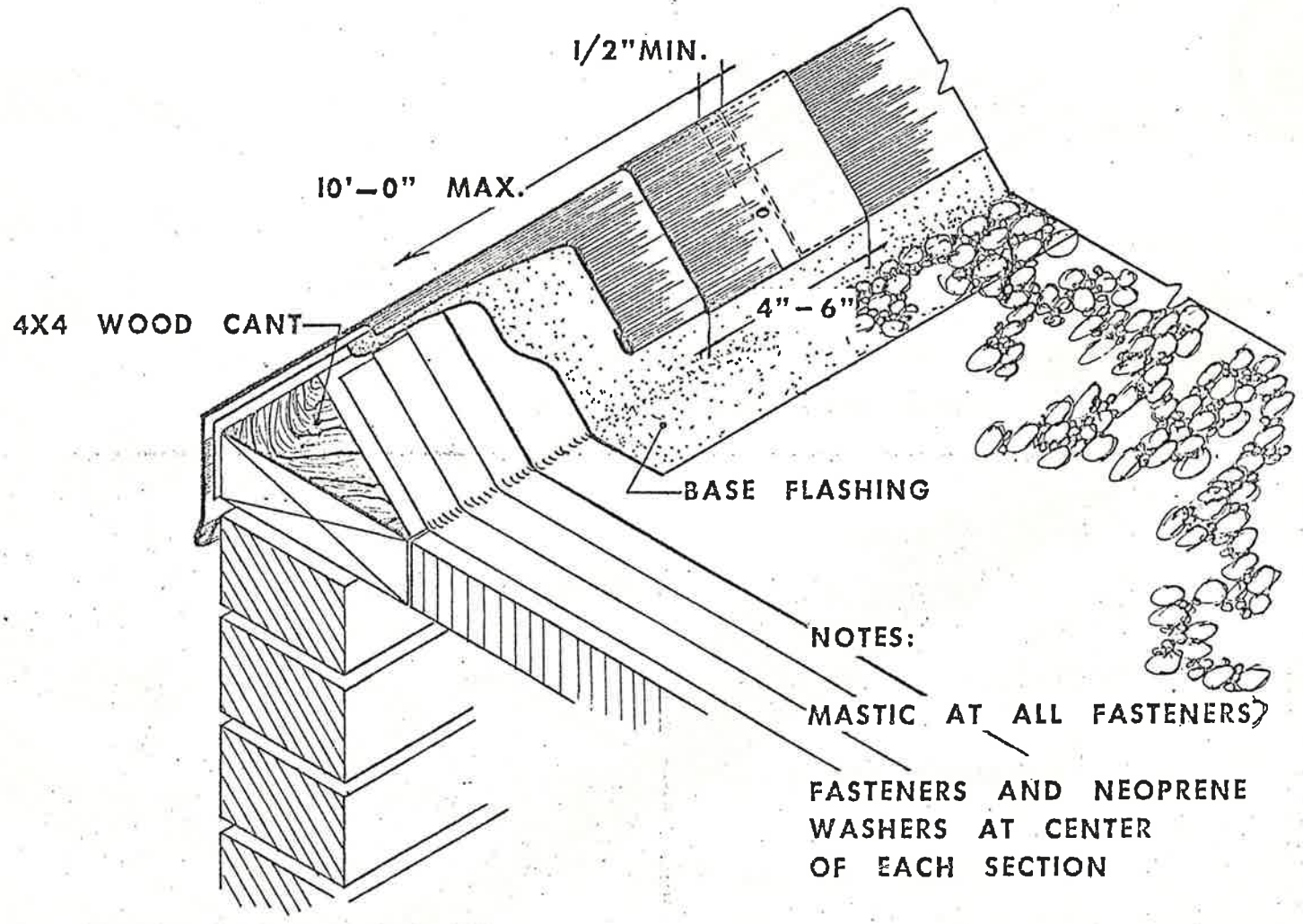
This type of detail should be used with light gauge metals such as 16 oz. copper, 24 ga. galvanized, or 0.040" aluminum. This detail uses a tapered edge strip to raise the gravel stop. Frequent nailing is necessary to control thermal movement. Joint covers may be used as shown or the edge may be doubled at laps.

1969
O

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

LOW PROFILE ROOF EDGE



This detail allows a raised edge with minimum apparent additional height. This detail can be used to correct a condition where the gravel stop was installed too low.

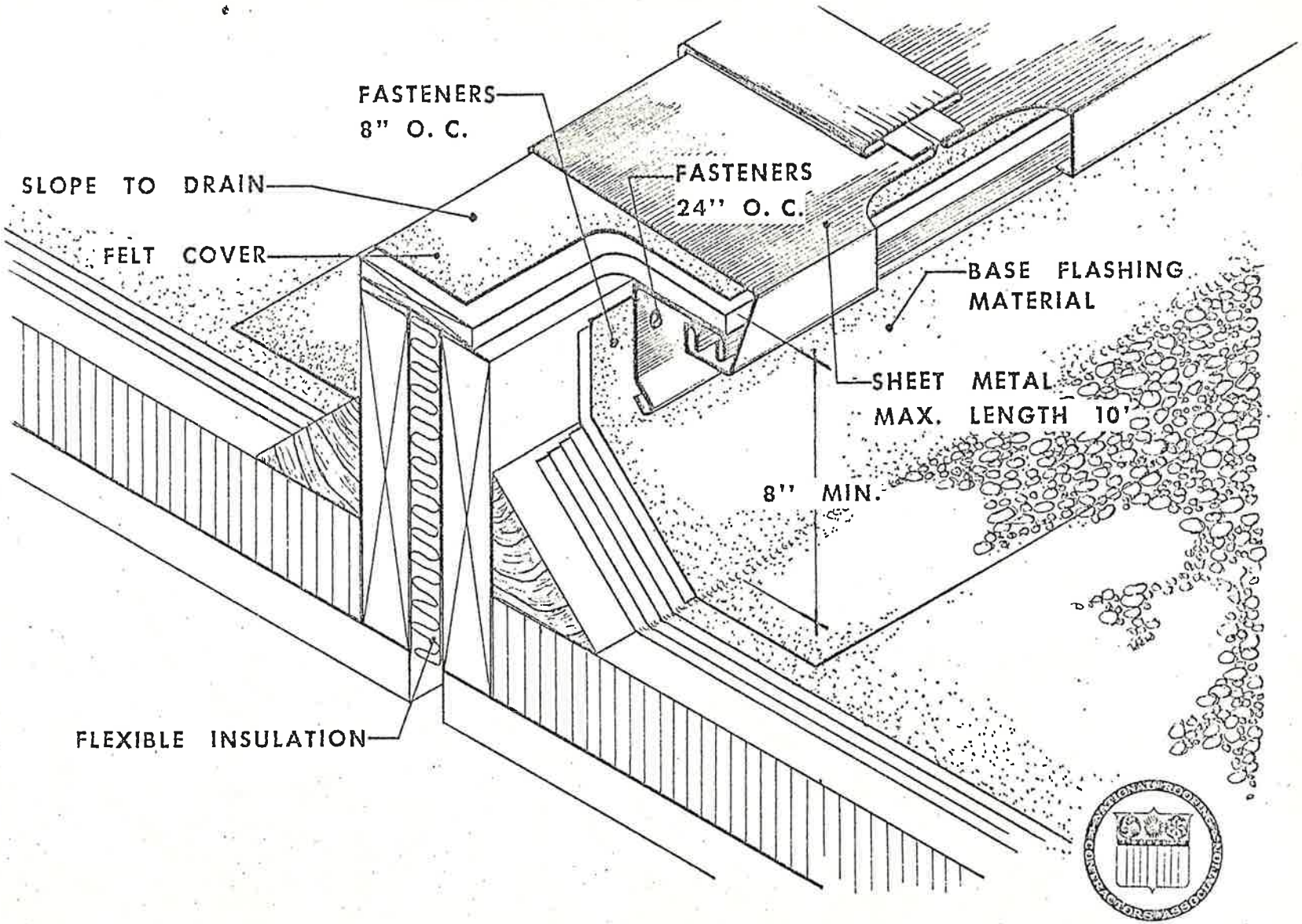
1969
P

BLUEPRINT READING & SPECIFICATIONS

NAME

DATE

EXPANSION JOINT



Like Detail C this detail allows for movement in both directions. This detail has proven successful with many contractors and is sometimes preferred over Detail C.

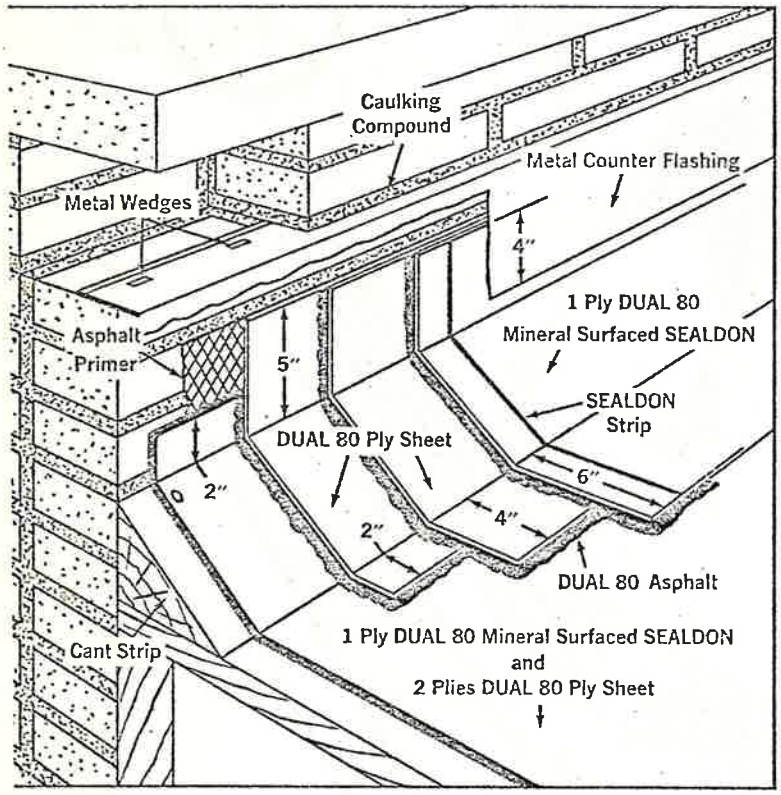
1969
Q

BLUEPRINT READING & SPECIFICATIONS

NAME _____ DATE _____

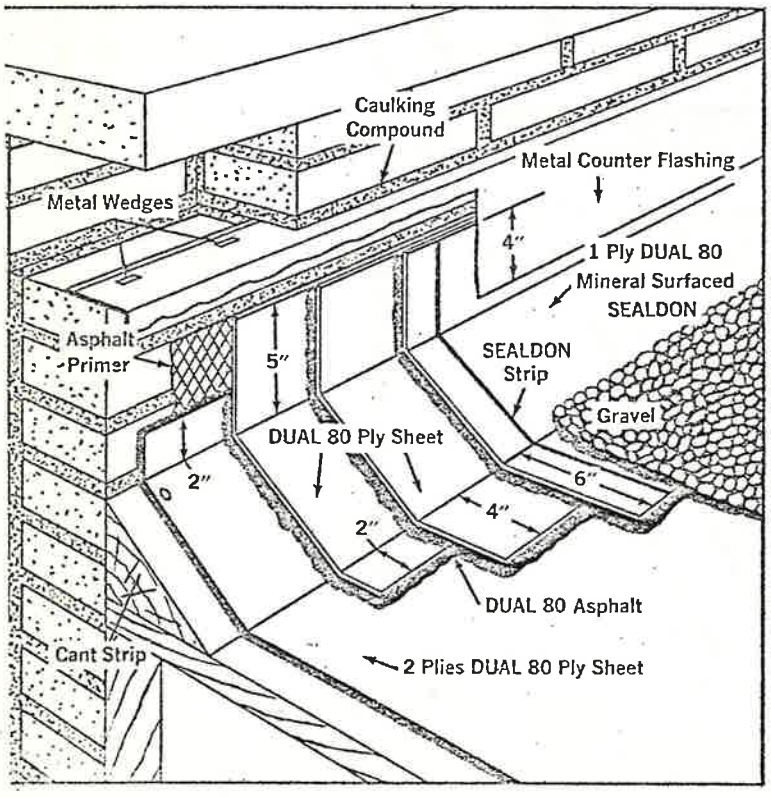
BLUEPRINT READING & SPECIFICATIONS

MINERAL SURFACED BASE FLASHING
METAL COUNTER FLASHING



MINERAL SURFACED

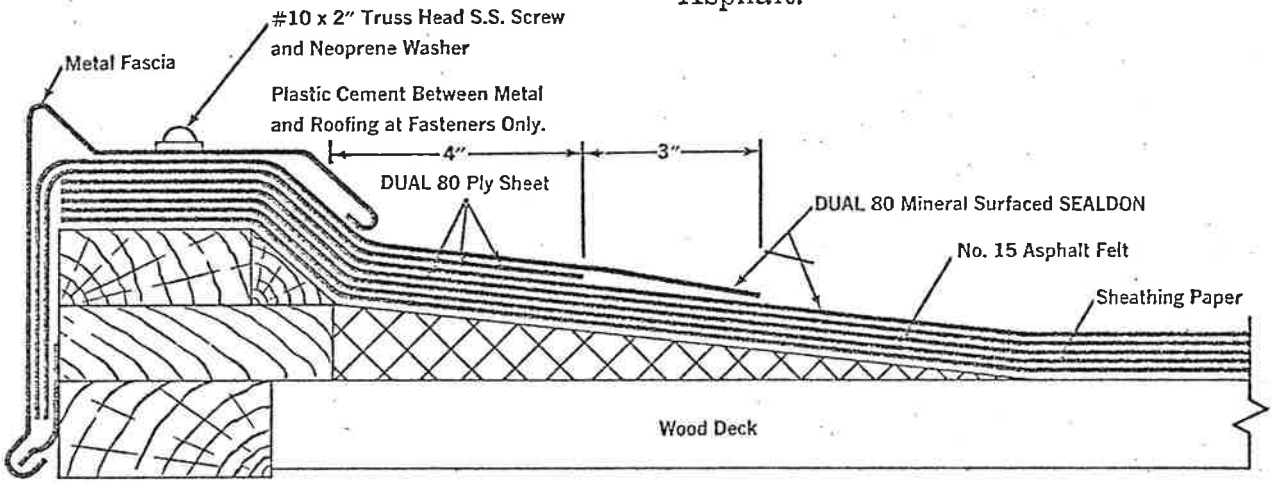
Solidly bond two plies of Dual 80 ply sheet and one ply of Dual 80 Mineral Surfaced Sealdon with Dual 80 asphalt. Extend these felts above the cant strip 5 inches and out on to the roof surface 2 inches 4 inches and 6 inches as indicated by the specification diagram. Nail along the top edge every 8 inches into the brick mortar joints, or other surfaces provided for nailing. Apply the Dual 80 Mineral Surfaced Seald with the Sealdon surface at right angles to the roof edge. Metal counter flashing shall be of 3 lb. sheet lead or 16 oz. copper, not less than 7½" wide with each edge returned upon itself at least ½ inch. The upper edge shall be entered at least 1½ inches into the mortar joints or other openings provided for the purpose, and be secured with metal wedges not more than 12 inches apart. The mortar joints shall be filled and pointed up with plastic cement or caulking compound. The lower edge shall extend at least 4" below the top edge of the flashing. Metal end joints shall be lapped not less than 4 inches and are not to be soldered.



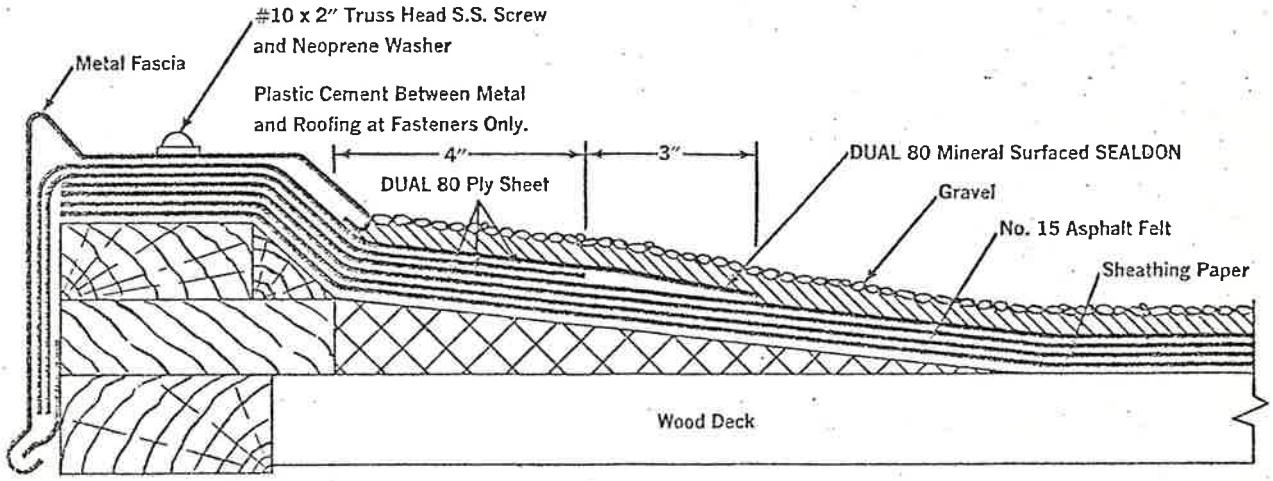
GRAVEL SURFACED

METAL FASCIA

Extend the two plies of Dual 80 ply sheet and a top ply of Dual 80 Mineral Surfaced Sealdon to the outer edge of the building. This is to be followed by the application of one additional ply of Dual 80 ply sheet extended down the outer face of the building (as permitted by the metal) and on to the roof surface 4 inches beyond the cant strip. To this apply one ply of Dual 80 Mineral Surfaced Sealdon extended down the outer face of the building (as permitted by the metal) and on to the roof surface 7 inches beyond the cant strip. Apply the Dual 80 Mineral Surfaced Sealdon with the Sealdon surface at right angles to the roof edge. Apply Metal Fascia as indicated by the specification diagram. All felts are to be solidly bonded together with a hot mopping of Dual 80 Asphalt.



MINERAL SURFACED



GRAVEL SURFACED

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

A. FELTS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify the various types of roofing felts.

REFERENCES:
1. Philip Carey Built-Up Roofing Specifications
2. Barrett Built-Up Roofing Specifications

RELATED INFORMATION:

		Types	Width	Size
A.	Organic Felts			
1.	15 lb. Rag Asphalt	Plain	36 in.	4 sq.
2.	15 lb. Rag Asphalt	Perforated	36 in.	4 sq.
3.	30 lb. Rag Asphalt	Plain	36 in.	2 sq.
4.	30 lb. Rag Asphalt	Perforated	36 in.	2 sq.
5.	30 lb. Double Coated	Plain	36 in.	2 sq.
6.	40 lb. Double Coated	Plain	36 in.	1¼-2 sq.
7.	15 lb. Tar	Plain	36 in.	4 sq.
8.	Red Rosin Paper	Plain	36 in.	10 sq.
9.	Roof Tred		½ in. x 36 in. x 72 in.	
			1 in. x 36 in. x 72 in.	
B.	Inorganic Felts			
1.	15 lb. Asphalt asbestos	Plain or perforated	36 in.	3-4 sq.
2.	35 lb. Asphalt Asbestos	Plain or perforated	36 in.	2 sq.
3.	30 lb. Asphalt Asbestos	Base Sheet Plain	36 in.	2 sq.
4.	45 lb. Asphalt Asbestos	Base Sheet Plain	36 in.	1 sq.
5.	55 lb. Asphalt Asbestos	Base Sheet Plain	36 in.	1 sq.
6.	15 lb. Tar Asbestos	Base Sheet Plain	36 in.	4 sq.
C.	Mineral Surface Roofing			
1.	85 lb. Asphalt Glass	Plain	36 in.	1 sq.
2.	90 lb. Asphalt Lastile	Plain	36 in.	1 sq.
3.	90 lb. Semi-Lastile	Plain	36 in.	½ sq.
D.	Smooth Roofing			
1.	65 lb. Mica Kote	Plain	36 in.	1 sq.
2.	50 lb. Surety	Plain	36 in.	1 sq.
3.	Woven Fabrics and Mats			
	a. Glass Fabrics		36 in. x 150 ft.	
	b. Cotton Fabrics		36 in. x 150 ft.	

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

c. Glass Mat	36 in. x 5½ sq.
d. Polyethylene (Barrett Chem Ply System)	or 1 sq. roll

Fiberglass Built-Up Roofing Systems

Rubber and Plastic Systems

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

B. AGGREGATES

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify the various types of aggregates.

REFERENCES:
1. Philip Carey Built-Up Roofing Specifications
2. Barrett Built-Up Roofing Specifications

RELATED INFORMATION:

Marble Chip:
1. 80% passing through 1/2 inch mesh.

Slag:
1. Shall be 1/2 inch in size. 100% passing through 3/4 inch mesh.

Gravel:
1. Shall be 3/8 inch in size. 100% passing through 1/2 inch mesh.

Limestone:
(All types of Aggregates must be clean and dry. No sand or loam is permitted.)

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

C. INSULATION

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify the various types of insulation.

REFERENCES:
1. Philip Carey Built-Up Roofing Specifications
2. Barrett Built-Up Roofing Specifications

RELATED INFORMATION:

Perlite:
1. Organic fibers and expanded volcanic rock.

Fiberglass -

Perlite - Asphalt Mix

Urethane
1. Foamed plastic

Fiberboard
1. Long strong wood fibers

Cork

Foamglass
1. Cellular Glass Board

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

D. VAPOR BARRIERS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify the various types of vapor barriers.

REFERENCES:
1. Philip Carey Built-Up Roofing Specifications
2. Barrett Built-Up Roofing Specifications

RELATED INFORMATION:

Kraft Paper
1. Sisalkraft

Plastic
1. Grefco Inc. and others

Asbestos Felt
1. 15 lb.

Felt
1. 15 lb.

Coated Base Sheet
1. 30 lb.

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

E. NAILS, CLIPS AND SCREWS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify the various types of nails and clips.

REFERENCES:
1. Philip Carety Built-Up Roofing Specifications
2. Barrett Built-Up Roofing Specifications.

RELATED INFORMATION:

Simplex nails

Regular roofing and through tin caps

Capped E & S nails

Tube-Lok nail

E. G. insuldeck nail

Clips

Sheathing Screws

Square cut nails

(Riv-nail E & S)

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

F. BITUMENS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify and discuss the various types of Bitumens.

REFERENCES:
1. Philip Carey Built-Up Roofing Specifications
2. Barrett Built-Up Roofing Specifications.

RELATED INFORMATION:

Asphalt (Special Asphalts as recommended by manufacturers)

1. Recommended Temperature Usage

	Softening Point	Application Temperature	Kettle Temp. Maximum
Special Steep	205-225°	350°	475°
Steep	180-200°	350°	475°
Flat	160-175°	350°	475°
Extra Low Melting Point	135-148°	300°	400°

Coal Tar Pitch (Special Coal Tar Pitches recommended by manufacturers)

1. Recommended Temperature Usage

	Softening Point	Application Temperature	Kettle Temp. Maximum
Tar	140-150°	300°	400°

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

G. ADHESIVES

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify and discuss the various types of adhesives.

REFERENCES:
1. Philip Carey Built-Up Roofing Specifications
2. Barrett Built-Up Roofing Specifications

RELATED INFORMATION:

Epoxy

Rubber and Plastics Compound

Asphalt Base

Asbestos and Plastic

Emulsion

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

H. HOT AND COLD COATINGS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify and discuss the various types of hot and cold coatings.

REFERENCES:
1. Philip Carey Built-Up Roofing Specifications
2. Barrett Built-Up Roofing Specifications

RELATED INFORMATION:

Hot Coatings
1. Asphalt
2. Pitch

Cold Coatings
1. Tar Base
   a. Non-fiberated
2. Asphalt Fiber Coating
3. Aluminum Non-fiberated
4. Aluminum Fiberated
5. Emulsion - Asphalt Base
6. Emulsion - Tar Base

BUILT-UP ROOFING MATERIALS - TEST

NAME _____ DATE _____

1. Name two organic rag felts that are perforated.

2. Name a polyethylene system of roofing.

3. 15 no. tar asbestos is what type of felt?

4. Name three types of aggregates used in roofing.

5. "Organic fibers and expanded volcanic rock" is a description of what type of insulation?

6. Name four types of vapor barriers.

7. What type of asphalt has a softening point of 180-200°?

8. Name four adhesives.

9. 30 no. double coated sheet is what type of felt?

10. Felts are classified in what four categories?

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

11. Name five general types of insulation.

12. Generally, an asphalt Kettle's maximum temperature is what degree?

13. Name six types of cold coatings.

14. How must aggregates appear when delivered?

15. Tell the amount of squares in the following rolls of felt.

    A. 15 lb. rag asphalt

    B. 15 lb. asphalt asbestos

    C. 65 lb. Mica Kote

16. What is Urethane Insulation made of?

17. Name two types of felt.

18. What is the recommended application temperature of coal tar pitch?

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

19. Name five types of fasteners for securing roof insulation and roof felt.

20. Name two kinds of hot coatings.

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

I. FLASHINGS AND EXPANSION JOINTS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to identify, discuss and explain the various types of materials utilized in flashings, counter flashings and expansion joints as related to the principles of design and practical application in the roofing industry.

REFERENCES: Manual of Built-Up Roof Systems, McGraw-Hill Book Company, Chapter 7. C. W. Griffin.

RELATED INFORMATION:

1. What are the five functional types of flashing classifications?

2. What are the four qualities that flashing materials must possess?

3. What should be the prime consideration in selecting material to be used for flashing?

4. Why is metal a superior material for utilization as counter flashings?

5. Metal is generally unsuitable as base flashing, however, metal base flashings should be used in conjunction with what part of a roof system?

6. What fabric flashings materials offer greater strength per ply, than do felted flashings?

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

7. Hot-mopping is advantageous due to speed, convenience and economy, name a disadvantage of hot-mopping.

8. Fabric and organic felt flashings must be surfaced with what material?

9. List seven types of metals commonly utilized in counter flashing.

10. Where should expansion joints be provided in a roof?

11. The flashing seal of expansion joint must allow for what types of movement?

12. Name four different types of non-metallic materials utilized for counter flashings.

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

J. FASTENERS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to differentiate between the various materials, appliances and methods used to anchor roofing materials to the roof system.

REFERENCES: Manual of Built-Up Roof Systems, McGraw-Hill Book Company, Chapters 1, 3, and 9. C. W. Griffin.

RELATED INFORMATION:

1. What is the best general method of anchoring built-up roofing materials?

2. When are mechanical anchoring fasteners required on hot-mopped decks?

3. Why do roofing nails have large diameter heads and/or caps?

4. When designing a roof, three basic methods of anchorage are possible. Name them.

5. Why are cold applied adhesives used in the application of insulation or vapor barriers on Class I steel decks?

6. What are the two basic types of methods used to anchor the roof system to the structural deck?

7. What type of anchoring method provides the highest shear strength and resistance to wind uplift?

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

8. Name one disadvantage of solid mopping as an anchoring method on deck surfaces which are subject to shrinkage cracking.

9. List the advantages of strip or spot mopping as opposed to solid mopping.

10. What is best anchoring method for poured gypsum decks?

11. What is the minimum gage metal utilized for roofing nail caps?

12. Name two types of cold adhesives, and give the advantages of using cold adhesives as opposed to hot-mopped bitumens.

13. Name the two types of Factory Mutal approved mechanical fasteners for use with Class I steel deck assemblies.

14. What is the manufacturers' recommended pull-out strength for nails and other mechanical fasteners?

15. On deck surfaces which are subject to shrinkage or cracking, why is spot or strip mopping preferable to solid mopping?

16. On poured gypsum decks, which are subject to shrinkage and high moisture absorption, what anchorage method is the best?

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

K. ROOF DECKS

OBJECTIVE OF ASSIGNMENT: The apprentice will define and describe the materials used in the construction of roof decks.

The apprentice will be able to discuss all general specifications pertaining to roof decks.

REFERENCES: Johns-Manville Built-Up Roof Specifications; St. Louis Apprentice Manual; Manual of Built-Up Roof Systems - Griffin, National Gypsum Co. Bulletins nos. 3-589 and 3-4275.

RELATED INFORMATION:

1. What is the definition of a roof deck?

2. What three outstanding characteristics does a structural wood fiber decking system exhibit?

3. How are roof decks classified?

4. If the end joint of a plywood decking panel should fall off a joist during its application what steps should be taken to secure the unit?

5. What are the component parts of a gypsum roof deck?

6. Why are steel decks used in a greater quantity than other decking material?

BUILT-UP ROOFING MATERIALS

NAME _____ DATE _____

17. Why doesn't cold weather effect the application of a gypsum roof deck system?

18. How soon should roofing be applied after gypsum deck is poured?

BUILT-UP ROOFING METHODS

NAME _____ DATE _____

A. LOADING OF EQUIPMENT AND MATERIALS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain the proper methods of loading and unloading job equipment and materials from a practical, efficient and economic standpoint.

REFERENCES:

RELATED INFORMATION:

Usually the first job to which apprentice roofers are assigned is loading the truck preparatory to going on a roofing job. This is a more involved assignment than it may sound because the object is not just getting on the truck all the materials required, but also getting them on in the order in which they will be used and getting them arranged so their weight will be evenly distributed over all wheels of the truck. On the job the roofer should be able to lay his hands immediately on precisely the piece of equipment or material he needs.

You should also be aware that no workman should ride on the truck bed unless adequate seating is provided for his safety and comfort.

CHECKING THE TRUCK: Number one on the list of tasks involved in loading a roofing truck is checking the truck itself to be sure it is in good working order. Many a truck has been completely loaded and then found not to be operating. This is not only time consuming and costly but also very exasperating.

Therefore, before putting any equipment or materials on the truck, check it for oil, gas, lights, windshield wipers, tires, and the like.

Every truck should be equipped with a fire extinguisher, preferably of a powder type, and a first aid kit. Both should be checked to be sure they are filled and ready for use.

A number of roofing contractors maintain different trucks for different types of jobs. In these cases, the trucks used for composition shingle jobs do not carry mops and buckets and the ones used for hot jobs generally do not carry roof brackets and planking.

Providing a specific truck for each type of job has definite advantages. Not only does it eliminate the need for transferring equipment from one truck to the other, but also it protects the materials and equipment. For example, a truck used for hot work may have

BUILT-UP ROOFING METHODS

NAME _____ DATE _____

If the truck is not equipped with racks to hold such tools and equipment as mops, brooms and shovels, they should be put upright in or between the rolls.

Next, the asphalt -- which is the first thing to be used, should be loaded. Place it from side to side against the 15 pound felt and equipment.

In most cases, the weight of the asphalt will hold the load in place. But if the load is very large, it should be secured with ropes.

Where ladder racks are not provided, ladders can be placed on top of the load or on the sidegate, but in either case, they must be tied to prevent them from falling off.

The last step in the loading process is hooking up the kettle. This connection is usually made with a ball trailer hitch or pin. Be sure the safety chain is connected every time you hookup the kettle going or coming from the job, and that the leg is raised before the kettle is moved. Remember, also, that the burner should not be in operation while in transit. Do not hand anything on the kettle. If a brake light connection is available, hook it up.

UNLOADING: Because competition demands efficient operation, the loading and unloading of trucks must be well organized, and materials and equipment must be handled as few times as possible. Therefore, before any material or equipment is unloaded, the best locations for the kettle and truck should be determined in advance.

The best location for the truck on most jobs is next to the building to be roofed, so that materials may be loaded from the truck to the roof, (eliminating unecessary carrying). The best location for the kettle is the safest place that is covenient to the job site. It should always be far enough away from building to avoid setting them on fire in case it should flash.

Although some contractors use fork lifts or life-bed trucks to get materials to the roof, many contractors use various types of hoists or conveyors for this procedure.

If the truck can be left near the building throughout the application of the roof, many roofers prefer to leave materials on the truck until they are needed. However, if the truck has to be moved, the asphalt should be unloaded immediately (for built-up roofs) and placed conveniently near the kettle. The fire extinguisher should also be kept handy. Other materials should be placed near the roof-loading device.

LOADING FOR RETURN: When the job has been completed and the truck is reloaded for return to the yard, trash should be separated. If the trash is stacked on top of left-over material and equipment, good materials or equipment may be thrown out with the

BUILT-UP ROOFING METHODS

NAME _____ DATE _____

B. SITE PREPARATION AND STOCK PILING

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to discuss what is necessary and required when inspecting the job site, prior to the application of the roofing componets.

REFERENCES: Manual of Built-Up Roof Systems, McGraw-Hill Book Company, Chapter 11. C.W. Griffin.

RELATED INFORMATION:

INTRODUCTION: Loading roofs takes skill and a knowledge of the roof structures. Unless careful consideration is given to loading properly and safely, damage to the roof and to interior finish may result.

When loading a roof, consideration must be given to the strength of the roof deck, condition of sheathing boards, weight distribution, accessibility of material for application and order in which materials will be needed.

CHECKING THE ROOF: A good workman will look over the roof deck before he loads any material on it, to determine if it will support the load. For example, cracked sheathing or sheathing with large knotholes may break under the weight of the material. Likewise, the overhand or eave should never have a load placed on it, and the roofer himself should exercise extreme care when walking or working on it. Among the things the roofer will look for is spacing of rafters, rafter supports and roof joists where metal decking is used in order to determine the parts that can carry weight. In cases where the rafter location is not easily determines, as in reroofing, the rafters can be located by tapping the roof until a solid pattern is found. Usually, rafters are placed every sixteen or twenty-four inches apart.

LOCATION FOR RECEIVING: A location that will be accessible to all sections of the roof should be selected to receive the material from the ground. The location nearest the edge and center of the roof (if accessible) would provide the shortest distance for distributing material to all parts of the roofs. However, the location selected should be clear of obstacles that may be a hinderance in transferring material, such as skylights, dormers, valleys, or high fire walls.

LOADING A PITCHED ROOF: The strongest part of a gable roof is in the ridge. The hips on a hip roof may also be used for loading. In addition, the support called a purlin that is usually placed midway between the ridge and outside wall at the eave may be

BUILT-UP ROOFING METHODS

NAME _____ DATE _____

QUESTIONS

1. How should rolls of felt be stored at the job site?

2. Why is it poor practice to store insulation and felts directly on the ground or newly poured concrete slabs?

3. Name at least four areas that must be considered when storing materials on a roof.

4. What area of the deck should never be used for storage?

5. In determining the location for material stockpiling on the ground, the primary consideration should be:

6. What parts of a pitched roof should never be utilized for material storage?

7. What is the strongest part of a barrel roof?

8. Why should materials never be dropped on a roof deck?

BUILT-UP ROOFING METHODS

NAME _____ DATE _____

C. TRANSPORTATION OF MATERIALS TO AND ON THE ROOF

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain the operation of the different types of equipment used to move material from a practical, efficient, and economic standpoint.

REFERENCES:

RELATED INFORMATION: Review of Chapter 5A and B will show pictures and descriptions of roofing equipment.

INTRODUCTION: New tools and equipment for use in applying roofs and roofing material are being introduced at a rapid pace. In most instances the use of these machines will result in reduced labor cost.

EQUIPMENT FOR HANDLING HOT STUFF: Kettles - Tankers - Pumps. Any one of these will be used depending on the size of the job. The proper use is covered in a later chapter.

Bucket. Many different kinds of buckets are used in the roofing industry. A general rule for safety in the use of buckets is to be sure that it is empty of water before using it because water in the bucket may cause hot to boil over.

Carts. Carts are used for various hauling jobs such as transporting rolls of felt and insulation and pails of hot stuff. Mop carts, some designed with removable trays to carry hot stuff, are in wide use on larger roof jobs today.

Highboys. The highboy is a drum mounted on a frame equipped with wheels so it can be moved around easily to deliver hot stuff where needed. It is used on large jobs where the hot stuff is pumped to the roof and into the drum.

Hoists and Conveyors. The selection of the hoists and conveyors for getting equipment and material to the roof will depend on the type and size of the job.

Felt Layers and Gravel Spreaders. Felt layers and gravel spreaders have been perfected to almost perfect application. There are different types and models in use today.

In addition to the above mentioned, there is also powered equipment to move material and equipment on the roof deck. Because of the additional hazards in the use of equipment, manual or powered, all safety rules must be followed.

BUILT-UP ROOFING METHODS

NAME _____ DATE _____

D. HEATING OF MATERIALS

OBJECTIVE OF ASSIGNMENT:

1. The apprentice will be able to discuss the proper and safe methods of preparing, operating and servicing of kettles and accessories.
2. The apprentice will be able to discuss safe and proper methods of transporting and applying heated bituminous materials to the roof area.

REFERENCES:

Manual of built-up roof systems, C.W. Griffin Manufacturers instructions manuals
Blackwell, Tremco maintenance report, National LP-Gas Association, Bulletin J.A.C. Manual - St. Louis, Vol.2, Lessons 13, 14, 15, 16
State of California manual - Book I, pgs. 101 to 120.
Garlock Equipment Co. Operating and Instruction Bulletin.
Aeriol Equipment Manual

RELATED INFORMATION:

1. What happens to bitumen when the products are subjected to overheating?

2. What is the proper and safe procedure for the lighting of a kerosene burner?

3. What are the main reasons for the overheating of bitumen - excluding poor judgement on the part of the kettleman?

4. What is the correct application temperature of coal - tar pitch?

BUILT-UP ROOFING METHODS

NAME _____ DATE _____

E. ROOF PREPARATION AND SPECIFICATION

1. INSPECTION OF DECK SURFACES

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to describe the proper sequence in inspecting the roof deck, before proceeding with the application of roofing material.

REFERENCES:

RELATED INFORMATION:

INTRODUCTION: The roof deck should be inspected by the roofing contractor or his crew supervisor to determine whether all preparatory construction work has been completed and what work, if any, remains to be done on the deck. If in making this inspection, unfinished or improper construction is discovered or flaws are found in the deck, all should be fixed before any roofing is done. Unless this procedure is followed, the roofing contractor may be faced at a later time with the problem of replacing or repairing a roof that should have been satisfactory and in all probability would have been satisfactory had the necessary steps been taken to have the roof ready for roofing.

In making an inspection of the roof of a new building, the roofing contractor or his representative should use the blueprint of the roof to determine (1) what pipes will extend through the deck and the locations of the pipes, (2) where ventilators will be located, (3) where drains will be located, (4) what chimneys or stacks have been installed, and (5) what surface structures, such as supports for electric signs, are required.

Pipes and Vents. Each pipe and vent extending through the roof should be examined to determine whether it is in place and properly installed, and the required pitch pocket or flashing is in place or available.

> Plumbing pipes. Plumbing pipes that extend above the roof level are black, pitch-coated iron soil pipes or galvanized pipes that are connected to the sewage system of the building.
>
> Conduits. Electrical conduits that penetrate the roof require pitch pocket or flashings wherever such penetration occurs. Although lead is sometimes used for this, the trend is toward the use of elastic flashing materials.

BUILT-UP ROOFING METHODS

NAME _____ DATE _____

Ventilation outlets. Ventilation outlets vary in size and sometimes terminate in a goose-neck, hood, or mobile unit. Pitch pockets or flashings are not always needed with them, because some have their own flanges or keep out water. However, when these flanges are used they must be secured to the roof in a water-tight manner.

Drains. Decks for flat roofs should always be leveled properly to insure the free drainage of water. In addition, the roofer must be sure that all drainage connections will permit the free flow of water, with all drain outlets set flush with the roof deck. On a flat roof, the overflow should be close to the outlet and about two inches higher than the lowest part of the roof. On an enclosed roof with a steep pitch, the overflow should be raised to compensate for the slope.

Chimneys and stacks. Chimneys are generally constructed of brick or stone, while stacks are made of metal or metal-jacketed products. In addition, it is usual for stacks to have weather caps attached. Both chimneys and stacks must be flashed.

Surface structures. Surface structures may include any of those items placed on a roof deck after the structure has been completed. They may include such things as legs to support a sign, the base for a flagpole, or an air conditioning unit. The roofer should make certain these items are properly installed on the deck prior to roofing around them.

Flashing and cant strips. Check to see that all required saddles, crickets, washbacks, and cant strips have been installed. Saddles, crickets, and washbacks are diverters placed on the high side of skylights, chimneys, and similar vertical structures to direct the flow of water away from the obstructions. Cant strips may be installed to protect the base flashing wherever a vertical rise occurs. If cant strips are of wood, they are applied before the roofer begins his work; if they are of fiberboard, they are part of the roofing application. Parapet walls are sometimes used around steep roofs, generally along the rake. This requires the use of step flashing and the procedure to be used in these cases will generally be found in the job specifications.

Wood or plywood decks. All sheathing boards should be dry, smooth, and free from large knotholes and cracks. If there are large knotholes or holes with loose knots, these should be covered with metal, nailed down before roofing material is applied. All sheathing boards should have a bearing and any curled edges must be nailed down securely if a good roof surface is to be attained. If thin plywood is used for decking, the joints must be blocked to avoid possible edge movement that will result in roof damage.

Concrete or gypsum decks. A concrete or gypsum deck must be smooth, firm, thoroughly cured, free from frost or the effects of freezing, properly leveled, and free from all debris prior to the installation of a roof. If the deck is found to be rough, any high spots, such as sharp ridges or other projections, must be removed and any low spots filled

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E. ROOF PREPARATION AND SPECIFICATION

2. PRIMING OF ROOF DECKS

OBJECTIVE OF ASSIGNMENT: The apprentice will explain the use of primer in the waterproofing and damp proofing of roof decks.

REFERENCES:

RELATED INFORMATION:

INTRODUCTION: Not all new roof waterproofing, damp proofing specifications require the deck to be primed. This information will be on the work sheet and specifications.

Priming of Roof Decks: The asphalt primer is a thin solution of asphalt and petroleum solvents. It serves as a primer coat under built-up roofing, waterproofing, damp proofing, and other asphalt cratings of concrete, sypsum, cinder block, brick, and metal. This material is generally brushed or rolled on with a roller mop. It can be applied with a small portable sprayer. It is marketed in one and five gallon cans and in 55 gallon drums.

QUESTIONS:

1. How do you find out if a deck has to be primed?

2. How is primer marketed?

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3. THE VAPOR BARRIER

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain the proper use and application of a vapor barrier.

REFERENCES:

RELATED INFORMATION:

INTRODUCTION: The use of a vapor barrier will be on the work sheet and in specifications.

The Vapor Barrier. The primary purpose of a vapor barrier is to prevent moisture in the building or roof deck from entering and damaging the insulation material. Vapor barriers are not really necessary under favorable climatic conditions, but their use is generally recommended between the roof deck and the insulation. Even under ideal conditions lightweight cement and gypsum decks require vapor barriers, however, because decks made of these materials usually contain a great deal of moisture.

The use of correct felt sealed with coal tar pitch or asphalt is standard practice in building a vapor barrier. Felt, by itself, is not a vapor barrier; it must be coated and sealed.

Some noncombustible rubber and plastic base materials are also used as vapor barriers. These materials are applied with a compatible adhesive. (Hot asphalt cannot be used because it will usually damage the material). The main difference between these rubber and plastic base materials and those made of asphalt is that they are noncombustible, while asphalt is highly combustible.

QUESTIONS:

1. How do you find out if a vapor barrier is to be applied?

2. What is the primary purpose of a vapor barrier?

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[illegible] - [illegible]

E. ROOF PREPARATION AND SPECIFICATION

[illegible]:

4. INSULATION APPLICATION

OBJECTIVE OF ASSIGNMENT: The apprentice will identify the various types of roof insulation, and explain their proper installation.

REFERENCES:

RELATED INFORMATION:

INTRODUCTION: Insulation "boards" used in connection with built-up roofing include materials of cork, cane fiber, wood fiber, expanded perlite glass filaments, cellular glass, and two foamed plastice--urethane and polystyrene.

INSULATION APPLICATION: The vegetable boards depend for their insulating value on the "still air" inprisoned between the fibers, as is also true of glass fiber board. Inorganic material such as cellular glass and plastic insulation depend upon cells of still air completely sealed from contact with adjoining cells.

In our previous discussion of "Air, Moisture and Heat," the need for insulation was demonstrated, but if insulation is used, and particularly with a built-up roof, it must be protected from vapor rising through the roof deck and condensing within the insulation or immediately below the roof covering to result later in pressure blisters.

It is true that condensation will not occur within cellular insulation, but condensation can and has occurred where vapor has been trapped between the joints. In one case where cellular insulation was used, the contractor feeling that he had no vapor problems covered a large roof deck with the insulation and had half of the deck waterproofed when it rained steadily for two days.

When the surface of the insulation had dried the second half of the roof was completed. A month later, under influence of summer heat, the roof became an interesting exhibit of the powers of imprisoned moisture vapor, one half being dead flat and the other half pockmarked with blisters.

Roof insulation must be kept dry and covered during delivery to the job site, and in storage on the job. Insulation must not be left uncovered on the roof overnight. Only enough insulation should be fastened to the deck that can be sealed in at the end of the

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To prevent infiltration of vapor from beneath, the roof deck should be covered with one, or preferably, two plies of felt, mopped over, in a continuous film with asphalt. While it is true that the bitumen provides the vapor sealing quality, it must be reinforced with felt, and since there is a possibility of an insecure lap or joint in one ply application, two plies makes good insurance.

Insulation is secured to flat roof decks by mopping the back side of the insulation. To resist the uplifting action of a decrease in air pressure immediately above the roof - when high winds cross the building, it is safer to supplement the mopping with metal fasteners, where steel decks are being covered. Nails are used in the case of wood or nailable cast in place of precast decks.

On steel decks, there are available several fasteners which are driven through the insulation into the flutes of the steel deck, but do not penetrate the deck. In addition there is a clip which penetrates the deck but seals the puncture by an automatic adjustment of the clip as it pierces the deck.

The point has been made that vapor seals are not required in climate zones where air temperatures seldom fall below 40° F. The need for insulation and for vapor seals under the insulation is not limited by climate, but by a combination of climate and occupancy. Climate has been known to change rather rapidly, but occupancy changes more often and with a new occupancy there often occurs a desire and need for a new interior climate.

Concrete decks, regardless of the location or occupancy use require a vapor seal to prevent the free moisture evaporation from the concrete from escaping into the insulation of the roofing plies.

The destruction by fire of a huge automobile plant resulted in a move away from insulation vapor seals, a distorted cautionary move which has proved to be expensive in fuel, air conditioning and other costs to owners of plants with uninsulated roofs.

Insulation Cut-Offs: Should cut-offs be used? The answer is "Yes" and "No". Let's explain this rather ambiguous answer, and ask ourselves another question. Why were cut-offs specified?

When fiber-board insulation was first applied to roof decks, contractors sealed the edges of all insulation at the end of each day's work. This is still a sensible precaution as the very factor which makes fibrous material resist the passage of heat, causes it to suck in moisture - and there's always moisture - laden air at night.

When cut-offs were specified by architects, roofing and insulation manufacturers, it was for another reason. Insulation depends for its resistance to the passage of heat to thousands of minute dead air cells - cells in which the imprisoned air does not move.

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When these cells become saturated with water, the insulation in fact ceases to be insulation with the loss of its resistance to the passage of heat.

As insulation was applied to greater areas, the risk of water damage to the insulation through roof leaks became greater and cut-offs were specified to separate the insulation into multiple areas so that, in the case of a roof leak, any damage would be isolated to the cut-off section surrounding or adjacent to the leak.

INSULATION APPLICATION: While water may descend upon insulation through a roof leak, it can also be drawn into the insulation in the form of vapor from below the roof deck. A vapor seal course was then specified to prevent the passage of heated, and therefore waterladen, air from below.

The most elusive of all forms of vapor is water vapor. It can enter a roof deck covering, presumably tight, from all directions - from behind flashings, through endjoint mortar spaces between parapet wall bricks, through minute spaces adjacent to vents and other roof projections. It can also leave by these entrances and many a blisterless roof owed that condition to such air-escape vents.

Air will pass through fibrous insulation and through the joints in non-fibrous insulation. If this excess air is imprisoned within the insulation it will thrust upwards, causing blisters and during a period of alternating cold and heat may condense and freeze.

The solution proposed for this condition is to provide side vents so that the excess air, instead of exerting pressure upwards will travel horizontally and exit through vents in parapet walls, behind flashings or at specially designed roof edging.

Obviously, if cut-offs are used to completely surround an area of insulation, the air cannot move horizontally and any movement of vapor will result in blisters on the surface of the roof covering.

Should cut-offs be used? We answered "Yes" and "No". Any roofing crew which does not seal the edges of insulation at the end of a day's work is asking for trouble. Where provision is made for edge venting, the cut-off can be applied so that it can be easily removed when work is resumed the following day, but where insulation runs from wall to wall, cut-offs can also be run from wall to wall without interfering with edge venting.

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E. ROOF PREPARATION AND SPECIFICATION

5. NAILING MOPPING SPECIFICATIONS

OBJECTIVE OF ASSIGNMENT: The apprentice will identify the various type of nails and discuss their uses in the application of roof materials.

REFERENCES: St. Louis Manual

RELATED INFORMATION:

INTRODUCTION: Controversy also enters into the subject of nailing. There is an element of risk in nailing to a gypsum deck which has not dried out but which has set. The question the roofing contractor has to answer is whether to use a nail whose individual holding power is higher than that of a competitive nail, in a freshly poured deck, but much lower once the deck has dried out and aged.

There are four types of nails available, the common wire nail, the galvanized roofing nail, the "screw-tite" square head nail and the "gypsum roof deck nail". The common wire type nail can be dismissed from consideration as its smooth surface eliminates it from consideration. The wire nail, however, has one advantage. It will rust. Cut nails with four-sided stems also rust and the greater surface area results in greater holding power.

There are few who have not broken a claw-hammer handle by attempting to withdraw a rusty nail from a plank, convincing proof to the holding power of the nail, the surface which oxidized and united with the material into which it was inserted to form an indissoluble bond.

The Screw-Tite nail does have the greatest holding power initially. The Gypsum Roof nail has a lower initial hold, but a greater long term holding power, increasing as the deck dries out.

Nails should penetrate the deck not less than 1 ½" and should have large 1" diameter head. The nailing specification is similar to that for nailable decks; two dry felts nailed to the deck and three piles mopped on top with a top pouring of 60 lbs. of bitumen and 400 lbs. of gravel.

Mopping of the felts should closely follow on the nailing to avoid the possibility of moisture from the deck infiltrating through the dry felts. The mopping of the other

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Sloping Decks: The previous description applies only to non-nailable decks where the slope is less than 3 inches to the foot. On steeper slopes, the roofing contractor may find his roof sliding off the deck into the street, unless provision has been made for anchoring the roof to the deck.

These anchors consist of wood battens embedded in the concrete. The battens should be secured at right angles to the felt application and spaced not more than 4 feet apart, preferably soaked in creosote or other wood preservative.

Booktile, and prestressed concrete slabs are applied similarly to poured concrete decks, differing only in the preparation of the deck surface. A one inch coating of portland cement mortar is applied over the entire deck previous to cementing the felts. Gypsum decks, precast or poured may be treated as wood decks or concrete decks.

Although slag and gravel can be used for inclines over 3 and less than 6 inches to the foot, where special precautions are taken the preferred medium is a mineral surface cap sheet.

Mineral cap sheets have a tendency to curl and should be unrolled 24 hours before the beginning of a job and stacked flat in piles. The weight of the material itself will level off the sheets. For the same reason, the material should never be applied in length greater than 20 feet. Sheets longer than this should be cut into suitable length before stacking.

Mineral surfaced sheets require greater care in application. Since the surface of the sheet is the final top surfacing, it can be easily marred in summer by walking over it with heavy, bitumen-soiled shoes, and in the winter, carelessness in dropping the roll can shatter the mineral surfacing. In summer or winter, the mopper must exercise greater care in mopping to insure that no excess bitumen spills or is mopped onto the mineral surfacing.

On saw-tooth roof slopes or similar steep slopes, the felts should be laid at right angles to the slope - the opposite from the application on a flat deck.

The sheets are nailed at the ridge, pulled tight at the base, nailed to the wood, nailed on the unsurfaced lap portions and mopped to the deck and to the flat portions at the foot of the slope.

Nailing the Felts: The flat roofing felt, incidentally should be carried up the sloping surface at least 24 inches. The sheets on the inclined surface, unless there is a special provision, should carry at least 12 inches over the ridge and be secured at this point with large headed roof nails.

On all such inclines and cap sheets, sheets should be mopped to decks with high melting point asphalt or steep roofing pitch.

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To prevent any possibility of lifting at side and end laps these portions of the sheet must be nailed and the upper sheet pressed firmly into the cementing agent at these portions. End laps should be at least 6 inches. End laps should be eliminated on steeply inclined surfaces, where possible.

Mineral Surfacing Specifications: Specifications differ greatly where mineral surfaced sheets are used. Any one of the following applications rate as 20 year bond:

3-plies of 15 lb. felt plus 1-ply mineral surface sheet
2-plies of 15 lb. felt, 1-ply of 55 lb. and 1-ply of mineral surface sheet
2-plies of 40 lb. felt and 1-ply of mineral surface sheet

The first consist of 3-plies of felt lapped two-thirds of their width, mopped solidly only between the laps, leaving one-third of each sheet unsecured with bitumen, but nailed to the deck or nailing strips.

The importance of nailing according to manufacturers' directions on steep inclines cannot be too strongly emphasized. Perfunctory nailing at these areas is extremely hazardous. A mineral surface sheet nailed and mopped to the under sheet completes the assembly.

An alternative method where half-surfaced sheets are used is to nail tow-plies of felt to the deck and follow with mineral sheet. Then an additional ply of 15 lb. felt is cemented to the surfaced portion of the succeeding mineral sheet making in effect a 5-ply assembly.

Smooth Surface Built-Up Roofs: Because of the construction of slag and gravel roofs, it is difficult to locate and repair leaks. In a well constructed slag or gravel roof, this disadvantage is offset by the fact that the roof will last for a score of years or more under normal conditions without requiring repairs.

The development, early in this century of heavy felts with a smooth, rubber-like, glossy surface found favor with property owners who favored them because they lent themselves to simple repairs. They also lend themselves to cold process application, which will be discussed in a separate class.

When hot mopping is used, the roofer may choose from a variety of weights of felts ranging from the standard specifications already described to a combination of 15 lb. felts and heavy base felts.

On all applications where there is considerable leeway in the selection of weights of felts, it should be remembered that the sum of the weights of felts for maximum 20 year bond should not be less than 60 lbs.

When a top surfacing of asphalt is specified, it is usual for the base sheet of felt to be a

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But take three piping hot, porous pancakes, liberally covered with syrup in between and on top of the layers, and a knife cut will show that the syrup has not only acted as an adhesive but has penetrated through the cakes, until it has become a solid unit.

With glass felts, the bitumen not only adheres to the different plies, but bleeds through them, and the success of the built-up roof roofing application depends upon this bleeding through. This permits all the asphalt between the plys and on the top to give life to the roof. If there is no bleed through, then the application becomes a laminating process, resulting invariably in the failure of the roofing.

Failures have occurred on glass felt jobs, not because the roofers were deliberately careless in workmanship, but because they were unaware of the need for greater viligance regarding material working temperatures in the application of glass felts, and the necessity for solid, continuous mopping of asphalt.

To cement two plies of felt together requires a bitumen hot enough to adhere to the surface area of the felts. To bleed through, the bitumen must have reached a temperature hot enough not only to adhere to the surface areas but also liquid enough to flow through the porous felt.

With asphalts or tarred felts, while not a good practice, it is possible to "skin" the job by applying a thin layer of bitumen. This is done by scrubbing it with a mop or by strip mopping. If the bitumen is hot enough it will adhere.

However, with glass felts "skinning" defeats the entire design of the application. Surveys have shown that on jobs, the moppers apply from 5 to 15 lbs. of bitumen less than the required 30 lbs.

To bleed through and to provide a continuous film, glass felt application requires a full 30 lbs. of asphalt. It requires a full mop delivering, with about a 6 foot stroke, an amount of bitumen which will form a wave at least an inch high in front of the roll of felt, and it requires the brooming of the felt close behind the roll so as to insure close contact.

If the broomers look behind and sees bitumen bleeding through the felt five feet behind, the mopper is doing a good job and the bitumen is at the right temperature. If there is no sign of bleeding through, the roofers might as well pick up the felt and start over again with the right quantity of materials at the right temperature and the correct application procedures.

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QUESTIONS:

1. What can happen if the mopping of felt doesn't follow closely the nailing of dry sheet?

2. What is the maximum recommended distance between expansion joints?

3. What is the oldest of all built up roof specifications?

4. Roofing manufacturers who issue bond guarantees rate these: maximum, medium, and minimum in relation to years are?

5. On steep or sloping decks what is used to anchor the roof to the deck?

6. How long ago was asbestos felt introduced?

7. Why aren't glass felts considered felts?

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ALPHA, LETTER – LESSON TITLE
E. ROOF PREPARATION AND SPECIFICATION

OBJECTIVE OF ASSIGNMENT:
6. BUILT - UP ROOF FLASHINGS

OBJECTIVE OF ASSIGNMENT: The apprentice will discuss the proper application of flashing according to specifications.

REFERENCES:

RELATED INFORMATION:

INTRODUCTION: Flashing is a term used to describe materials used to waterproof or seal the junction of horizontal and vertical surfaces and other intersecting planes.

Materials used for flashings include a variety of metals, bituminous felts, glass mats and plastics.

For built-up roofing, in theory, flashing materials should be flexible enough to hold themselves to irregular surfaces and contours. The materials should have a high degree of weather resistance. They should be of such character that they can be easily and swiftly applied. Since part of the flashing will be attached to the vertical surface, the flashing material and the adhesives used should be sag resistant.

While metals have qualities suitable for flashings of steep roofs, the flashing materials are invariably installed in short pieces with microscopic expansion and contraction movement, so their use in built-up roof application should be avoided.

Expansion and contraction of flashing metal used to seal the junction of roof deck and parapet wall is not microscopic, as the metal is usually installed in 10 ft. lengths. Where metal is specified, it is safer to use 5 or 6 ft. lengths, allowing at least 3 inches of lap for movement.

Lead is the only metal flexible enough to mold itself to irregular surfaces, but the material supplied for flashing is not sag resistant.

Metals should never be used for base flashing on built-up roofs. Where they are used for contour flashings, they require a reglet out into the wall. Because a masonary wall seldom hues to a straight line, the reglet should never be less than 2 inches. Reglets less than this result usually in a portion of the counter flashing being forced into the reglet

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Roof deck coverings always wear out faster than parapet wall flashings. This is true, despite the fact that for other reasons wall flashings are replaced more often than the roof deck.

If this is admitted, it must be concluded that a single ply, possessing weathering characteristics, is preferable to multiple plies cemented with an adhesive which in response to accumulated sun heat in summer will soften and slide to the foot of the wall. On all roof edges and terminations screeds must be provided to fasten metal edging and insulation.

It should be remembered also that the cementing medium is also the waterproofing agent and that the felt is applied as a reinforcement for the bitumen in the adhesion and incorporated in the felt.

The felt does its job if it is weather-resistant, sag resistant, and holds the waterproofing in a continuous film through which water cannot pass.

Roofing manufacturers have introduced sag-resistant bitumens for hot applications, but the sag-resistant qualities have often been destroyed by the overheating and allowing the sag-resistant additives to sink to the bottom of the kettle.

Cold adhesives, products of roofing manufacturers laboratories on the other hand, come to the job, with all of the sag-resistant characteristics required for vertical application. Very definitely, flashing felts, cemented with special cold bitumens, is the preferred medium for parapet wall flashing.

Flashing systems using glass fiber mats applied with cold cements have the advantage of extreme light weight, and when cemented to parapet walls are so closely united to the wall as to become an integral part. Used in one ply application they have been very successful.

Felts and glass mats bonded to metal foil are advantageous when used for base flashings and under other locations where a waterproofing course must travel through the wall.

Flashings of plastic materials are always applied in one ply formation. Their ability to mold to all types of irregular surfaces is their outstanding feature. In addition, plastic materials installed on two planes can be fused together at their base by heating the plastic and hand molding it.

Parapet Wall Flashing: According to the advertising of a roof manufacturer, "95 percent of all roof leaks occur at flashings". While the statement is a "guesstimate" most roofing contractors would agree as to its truth.

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ALPHA STEEL – LESSON TITLE

Rain impelled by winds strike parapet walls at all angles, even striking at an upward angle. Architects reconize that walls can become water soaked and provide "spandrel" flashings to catch the water and turn it outwards, through the wall flashing preforming the same function on parapet walls -- where such are designed. Not many parapets have the benefit of such designing, with the result that rainwater often enters the wall above the flashing, and moves inevitably into the interior.

There are two types of flashings, a single base flashing and a cap and base flashing. The single base flashing is always a bituminous flashing. The cap and base may be bituminous flashing or metal. Metal flashings have advantage over other types where metal has to be cut in small pieces, subject to little movement, such as step flashings. Where lengths are required to be set into raggles in parapet walls the movement of metal often results in opening avenues for water penetration, in addition to allowing water to get behind the base flashings.

Movement of parapet walls, always outwards indicates that the base flashings should not be fastened to the parapet wall. A cant strip must always be applied at the junction of all walls and roof decks, as it is almost impossible to make a sharp right angle bend with bituminous roofing.

To avoid fastening the base flashing to the wall an eight inch board should be inserted behind the cant strip, but not fastened to the wall, thus at some time later it won't be subject to cracking.

The base flashing can be nailed and cemented to the board, and its termination covered by a counter flashing fastened to the wall.

The following list includes the more popular methods of building parapet wall flashings.

Two or more plies of felt finished with and cemented to the wall with cold asphalt plastic cement.
A trowellable cement composed of asphalt asbestos fibers and petroleum solvent.
Two or more plies of felt.
A mineral surfaced counter flashing.
A metal base flashing.
A metal counter flashing.

A vinyl plastic flashing takes up wall movement without rupturing because of its considerable stretchability.

A base flashing as the name indicates, is a material applied to the base of a wall as protection for the junction of wall and deck. Unless flashing blocks are provided in the wall, the base flashing must in turn be protected by a cap or counter flashing of the same material as the base flashing or of metal.

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Common faults of parapets are soft brick or faulty concrete used in the construction, poor material, and faulty pointing of the brick joints.

Where counter flashing is ommitted, a neat job of applying base flashing requires striking a chalkline along the wall. In case of a 16 inch flashing felt, the line would be struck, 12 inches above the deck, allowing 4 inches to be cemented to the deck.

The wall is then primed to the line and allowed to dry, then the wall is mopped to near the line, the flashing felt is mopped to soften it and the felt stripped cemented to teh wall directly over the mopped wall portion. It is then pressed in place so as to leave no void blisters or wrinkles.

In absense of counter flashing a 4 inch strip of felt is cemented over the top of the base flashing, centered over the edge and covered with a heavy bodied flashing cement.

Where metal counter flashings are used, they should be applied in short lengths preferably 6 foot and lapped 3 inches but not soldered.

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E. ROOF PREPARATION AND SPECIFICATION

7. ROOF SURFACING:

OBJECTIVE OF ASSIGNMENT: The apprentice will differentiate between the different types of roofing materials used in roof surfacing, and describe each.

REFERENCES:

RELATED INFORMATION:

INTRODUCTION: Gravel is applied over bituminous roof coverings for one primary purpose to protect the bitumen, and the bitumen saturated felts from the destructive action of the sun's rays.

According to the U. S. Bureau of Standards, gravel or slag for roofing surfaces should be of such size that it will all be retained on a 1/8 in. screen, and all passed by a 3/4" sieve.

What this really means is that the gravel should not be so large that gaps will result between gravel units, allowing sun-rays to penetrate to the bitumen below them, or so small and light that a gust of wind will blow them off the roof.

In addition to the protection afforded by the gravel, on some types of roofs the weight is an advantage.

Gravel used for roofs should be angular in shape. Round or oval gravel has the disadvantage of failure to fit close enough together and leaving spaces for sun penetration. Sea gravel has this disadvantage too.

The gravel chosen should be resistant to penetration by the rays of the sun. Some granular material, especially when crushed to pea size is translucent and should be rejected.

The term gravel, is used here in a general sense and covers all granular material used on built up roofs. These include gravel, furnace slag, crushed joplin stone, crushed asbestos rock, crushed hard stone, marble chips, and dolomite.

Marble is a limestone. Some limestones are soft and disintegrate easily. Be sure that the chips purchased are of hard limestone, delivered preferably in bags to avoid the dust

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How Hot Can A Roof Get? Just how hot does a roof get? The physics department of a university inserted thermocouples in a roof and reported a roof surface temperature of 168 degrees with a surrounding air temperature of 92 degrees.

A research laboratory in Chicago using a bulb thermometer inserted in a black mastic roof coating, reported 153 degree temperature as contrasted with an air temperature of 90 degrees. A roofing contractor applying a roof on a Chicago factory sent his crew home when air temperature reached an all-time high of 104 degrees and the roof surface temperature zoomed to 180 degrees.

While the statistics on how hot a roof can get are somewhat sparse, there is no doubt that a roof does get plenty hot. Solar water heaters are quite common in Florida – taking the form of a glassed-in section of the roof over a network of water pipes. The temperature of this solar-heated water generally requires mixing with cold water for normal bathing.

Florida however, has no monopoly on sunshine. The Guide published annually by the American Society of Heating & Air-Conditioning Engineers reports that every state in the U.S.A. has had air temperatures of 100 degrees. Massachusetts Institute of Technology has several solar heated homes in Boston, and the University of Colorado has several units in Denver.

Professor Farrington Daniels, Chairman of the Department of Chemistry, University of Wisconsin, is of the opinion that it is much easier to harness the power of the sun than to split the atom. The sudden release of power from the detonation of the A or H-Bomb has an awesome, startling appeal to the imagination, but the potential energy of solar radiation is so much greater it is like comparing the energy produced by a mouse on a treadmill to the power of a multi-unit Diesel locomotive.

This endless solar energy from the sun is poured down on every nation of the world. Just recently the solar battery was put to use to supply the electric current to operate a rural telephone system at Americus, Georgia.

In theory, a solar battery on a house roof 30 feet x 36 feet will produce more electricity than is used by the average householder. It is reported that a modern flat roofed factory with 100,000 square feet of surface has solar energy poured down on it equivalent to 22,000 pounds of high grade coal every summer day.

Even popular journals are becoming cognizant of this source of energy. The Saturday Evening Post discussed the subject under the title "Big Power Plant In The Sky".

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consecutive years. Prior to coating with a white solution inside factory temperatures were 10 to 20 degrees hotter than summer air temperature. The white coating holds the inside temperatures to about the same or less than air temperatures.

The potential energy for solar radiation is astronomical in quantity. The many factory roofs are ready made for possible solar power plants. Until man's ingenuity devises a way to harness and use this energy it will be absorbed in the form of heat into the factory to increase the need and the cost of air conditioning or will be bounced back into the sky by reflective surfacing.

Plastic Gravel Surfacings: The radical design changes in roof contours in the 1950-60 decade influenced the development of gravel surfacings material secured to the roof with "binders"–liquid plastics with strong adhesive and weathering qualities.

Two types of surfacings have been developed, both using cold adhesives. One type is spread in a thick layer about 4 gallons to the square by brush or squeegee, directly over a flood coat of bitumen. The material is available in a wide variety of colors that closely match the gravel, marble chips or other mineral aggregate being used.

The mineral matter of a corresponding color is then immediately spread over the adhesive coating where it is permanently held fast. The roof surfacing resulting is adaptable to any slope or contour without danger of loss of the mineral matter.

Since the coating is the same color as the mineral matter, less of it is required generally 80 lbs. per square compared to 300-400 lbs. per square for coventionally surfaced roofs.

The coating contains asbestos fibers in addition to vinyl emulsion. The vinyl coatings are extremely flexible, enabling them to expand and contract with the movements of the felt subsurfacing. The application method is simple--dump the material on the roof covering, or pump to roof level and spread with a soft bristle warehouse broom. The crushed rock mineral matter is spread over it.

The second type is a combination of portland cement and vinyl resin. It is manufactured in a 2-package system, powder and liquid which must be mixed on the job site with cement-mixer type equipment. The cement type requires a prior application of fine gravel or "rice" coat before applying the compound.

Both types have proved to be very effective surfacing mediums, especially for the steep slope and odd shaped roofs. Further modifications of these products have been made so they can be sprayed as a top coating.

The surface spray coatings have wide application in the remodeling field. They are used to renew and insulate worn, eroded gravel roofs.

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Where this problem is encountered the following points should be kept in mind:

1. Whether or not insulation is specified, and inclusion of insulation between the deck and the mopped covering, will make it easier to remove the temporary roof covering.

2. The roof covering and the base flashing must not be fastened to the insulation, deck or walls.

3. The roof surface should be liberally weighted down with gravel, particularly around the walls. A counter-flashing should be installed over the base flashing.

Roofing--The Spray Way: It is little more than a hundred years since Samuel B. Warren started a roofing business in Cincinnati, Ohio, covering flat roofs with paper and pine tar.

A hundred years ago roofing paper was saturated laboriously by soaking it in pine tar and squeezing out the surplus through laundry rollers. Today the saturation of roofing felt is a mechanical process in which hand labor is almost completely eliminated.

Until recently there has been actually more hand labor connected with applying felts to roof decks than there was a century ago. In the interval roofs have been soaring higher and higher in height with the result that getting materials up onto roofs, even with the aid of hoists, has added still more labor to the the application of roofing felts. Two features contributed to the change--the development of cold process roofing and the invention of equipment which eliminated hand mopping or brushing.

The new roof spray equipment was developed during World War II for the spraying of army and navy installations. The equipment consists of an air compressor, pump, spray gun, hose reel, parapet roller, and two hose--one for conveying the spraying material and the other for air.

Use of the equipment eliminates the drudgery of hauling the roofing cement and coating material on to the roof. For jobs requiring only a spray coating to protect or arrest the weathering of a roof surface, incredible speed in spraying can be achieved--as much as 20 to 40 squares per hour, depending upon the type of roof. For roofs too far gone for coatings to be of any value, the time required to apply new built-up roof covering using the spray method for cementing between the plies of felt is cut by some 90 per cent.

In actual tests on roofs, one of which was 14 stories above the street, it took 45 seconds to cover one square of roof surface, using 3 gallons of roof coating. On a two-ply built-up roof, using heavier adhesive material it required but 1 minute 20 seconds to spray

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Should the pump still refuse to work properly remove the pump cylinder by unscrewing at the base of the pump and clean and examine the pump plunger. If the leather washers are worn, replace then with new washers. Also note the condition of the spring which operates the valve in the plunger and replace if broken, and remove any foreign matter which may prevent the valve from closing.

If the pump is working properly and the material hoseline has been checked and found okay, the trouble may be in the airline or the gun. The airline is checked in similar fashion to the material line, and if a plug is located, removed. Should the airline be okay then the trouble is in the gun, which can be taken apart and cleaned easily.

There is very little trouble encountered if equipment is cleaned daily. In the case of emulsions or fibrated materials it is wise to clean the pump only twice a day.

Built-Up Roofing The Spray Way: The procedures adopted in the application of built-up roofs using the spray process do not differ from other built-up roofs except in the method of cementing the various plies of felt together. On built-up roofing jobs, a 4 man crew is required–a groundman, hoseman, gunman and broomman.

On a typical two-ply built-up roof, as an illustration, the surface of the roof is cleaned by blowing or scraped to provide a surface free from dust and debris.

Two methods are in general use in laying roofing felt. In one method the felt is rolled into the adhesive. In the second method the felt is cut into 12 ft. strips and "flopped" over into a stretch of roof surface covered with adhesive. The second method may also include, particularly in roofs where the incline of the roof is over 2 inches to the foot, nailing one edge of the felt to the roof deck with large headed nails, or galvanized nails driven through large tin discs.

Under both systems application starts at the lowest point of the roof where an area of the surface, the width of the felt used and about 12 ft. long is sprayed with the adhesive. The felt is then rolled into the adhesive, or "flopped" over onto it, and in both cases aided in cementing by the action of a mechanic brooming the top felt surface.

Where the felt has to be nailed, a whole roof deck can be prepared for cementing by the spray process by cutting lengths of felt and arranging them on the roof for two ply construction by laying each layer so that it covers half of the width of the preceding layer, in each case running a row of nails along the top edge of the sheet.

To start cementing the sheets are all "flopped" back to expose the surface of the roof deck, and turned back on the roof as each portion of the roof is sprayed with the adhesive.

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UNIT SECTION – LESSON TITLE

which has a ball check valve at its lower end.

OBJECTIVE OF ASSIGNMENT

A plunger, moved up and down by the air motor, operates within this pipe and forces the material to be sprayed into the hose which connects the pump with the spray gun. The whole pump weighs approximately 60 lbs. and can be handled by one man. A simple bracket arrangement enables the pump to be clamped over the edge of an openhead drum in a vertical operating position. As has been already described, in operation, the air is supplied to the pump through an air inlet via a hose line from the compressor. An air outlet enables a hose to be attached to an air-drive agitator--a useful added piece of equipment to keep heavy fibrated materials in proper suspension.

The material hose is connected to the material outlet, completes the hooking up of the hoselines. An air pressure regulator controls the operation of the pump by regulating the air pressure admitted to the air motor, and is shown on an air pressure gauge above it.

The pump will develop 5½ times as much pressure on the material in the hose as is shown on the air gauge. In other words, if you have 100 lbs. of air on the pump, you develop 550 lbs. per square inch on the material in the line. Don't use too high atomizing air pressure. Consult the manufacturer of the material to be sprayed for the proper mixture of air and material. Don't on the other hand feed too little material into the gun.

A surge chamber is provided in the pump to smooth out the flow of material to the spray gun. At the bottom of this surge chamber is a material re-circulating cock which, when opened, provides a by-pass for material so that it can be recirculated back into the drum A shut off valve permits shutting off the pump while the compressor continues to operate. A special air valve fitting is used when clearing the line at the end of a job, or when shutting down for the night.

Spray Gun: The spray gun consists of two parallel light gauge metal pipes approximately 4½ feet long, equipped with cocks at the end opening up the air inlet valve.

While pumping fibrated roofing cement the pump should operate at approximately 16 strokes per minute. This can readily be determined by counting the pulsation of the material as it flows out of the handle and a spray head at the other end. The larger of the two pipes is the material line.

To keep the hose in good condition, a hose reel is an almost indispensable piece of equipment. The reel has a capacity of 200 feet of air hose and 200 feet of material hose. This is the minimum length of hose required. For convenience in handling, it is suggested that the air and material hoses be taped together at 18 inch intervals.

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must be used. This is advisable where reinforcing sheets are used in connection with corrugated roofing, or other type of roof covering where the shape of the units require the fabric reinforcing to be molded to the contours.

In case of corrugated roofing special rollers have been devised which enable the fabric to be rolled into close contact with the undulating surface.

With cement tile, molding by hand and brush is advisable. Brushing application requires a heavier bodied coating than that required for spraying. Brushes range from small 3-knot of felt-width pusher brooms.

Where a relatively thin uniform coating is desired the use of a squeegee is recommended. This is somewhat similar to the cold process spreader illustrated, but without the sideline shields.

Cold process material have the advantage that the composition of the material processed by the manufacturer cannot be changed on the job heating, but it can be changed by adding solvents and by failing to use the correct amount of materials. Solvents should not be used.

QUESTIONS:

1. What are the lower and upper measurements of roof gravel or slag?

2. What is the disadvantage of round or oval gravel?

3. What is the best color for sunray reflection?

4. What is the weight of roof covering in: a. gravel b. plastics?

5. What advantage is there in a spray type roof?

6. To eliminate problems in spray roofing what is necessary?

ROOFING REPAIRS

NAME _____ DATE _____

A. TYPES AND CAUSES OF LEAKS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to discuss the procedures involved in the location and repair of roof system failures.

REFERENCES: Manual of Built-up Roof Systems, C.W. Griffin, Chapter 1, McGraw-Hill Book Company.

RELATED INFORMATION:

INTRODUCTION: The topic, "Roofing Repairs", is planned to help you find answers to the following questions:

What are the most common conditions that lead to roof leaks?

What tools and equipment are generally needed for roof repair work?

What is the best method of locating a roof leak, and when is the best time to look?

What are the two main repair procedures for patching leaks, and when are they used?

Locating and repairing leaks is an important phase of the roofer's work. The man who possesses the skill and knowledge necessary to perform this work efficiently is often the man who enjoys full employment all year, instead of having to depend entirely on the uncertainties of the construction field. The roofer who has a good general knowledge of building construction has an advantage in this work.

Roof leaks may be repaired not only when it rains but anytime when other work is unavailable. The roofer who can be kept busy finding and repairing leaks can realize a substantial increase in his annual income. Roof repair can be considered a specialized field in the roofing trade, and nowhere is this more evident than in huge industrial complexes where there may be acres of roof areas to maintain.

A leaking roof may be caused by many things, but most leaks may be classified into three main types: obvious, difficult, and hidden. Almost any roofer can fix an obvious leak; that is, one where the location and cause of the leak is visible. A difficult leak may be one in which the cause is not at all obvious; one may see the water leaking inside the building, but the opening or fracture in the roof is not easy to find. The hidden leak is the worst and one that may challenge the skill, imagination, and ingenuity of the roofer.

ROOFING REPAIRS

NAME _____ DATE _____

Careless or poor work by other tradesmen in the installation of their work prior to application of the roof.

Inadequate inspection and correction of deck defects prior to the application of the roof.

Defective or poor quality roofing materials.

Rusted outlet boxes and flashings.

Wood shingles with cracks over cracks.

Capillary action where flashings are not high enough.

Blistering of the felts.

Inproper installation of sky lights.

Oxidation of the roof surface, weathering from the elements, or corrosive residue from manufacturing processes.

Extreme variations in temperature and humidity, causing severe expansion and contraction of the roof.

Poor patching.

Errors in original roof specifications or structural design.

Improperly installed gravel stops, edgings, and flashings.

Water from condensation on heating or cooling ducts and pipes. (These items often drip and appear to be leaking although they are not. The water, however, is just as damaging.)

ROOFING REPAIRS

NAME _____ DATE _____

B. TOOLS AND EQUIPMENT

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to list the tools and equipment normally carried on the "patch wagon" for making roofing repairs.

REFERENCES:

RELATED INFORMATION:

The roofer who is assigned to "chasing" leaks will find his work easier and more successful if his truck (sometimes called the "patch wagon") carries the right repair materials, tools, and equipment. Only a ladder may be needed to find a leak on one job, but it may require anything on the truck to find the repair. Sometimes temporary repairs are made during a rain, and permanent repairs will be made later when the roof is dry. It is a great saving to the contractor (and the customer) if the second trip can be avoided by making a permanent repair on the first call.

The Patch Wagon: The following is a suggested list of tools, materials fasteners, and equipment for a "patch wagon":

Ladder (two story type)
Spud bar
Shovel
Heavy broom
Hand cleaner
Rags
Wet patch and plastic
Fabric (Cotton or glass)
Mineral surface material (90 lb.)
Tin shingles
Nails (cement, 7/8 in. and 1-1/4 in.)
Hand line
Pencil and pad with clipboard (used to draw sketches necessary for locating leaks, and for writing information needed for reports on the back of job sheets)
Portable light

NOTE: Should the roofer notice upon arriving at the repair job site that the roof is in such bad condition that even temporary repairs are not possible, it is wise to measure the roof, make a working sketch, and outline the work that should be done. The contractor can use this information to estimate and sell a new roofing job. In this way, the roofer has not wasted his time on the job and, perhaps, has created a job for himself in the process.

The roofer should have the following tools and equipment with him on repair jobs:

Nail bag
Hatchet
Crowbar
Wirebrush
Small pointing trowel
Rain gear

ROOFING REPAIRS

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C. LOCATING LEAKS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to describe the various procedures used to locate leaks in the roof.

REFERENCES:

RELATED INFORMATION:

Roof conditions which indicate possible leaks can be recognized most any time by the experienced roofer, but the best time to locate a leak is during a rain. Sometimes during dry weather a leak may show up when water is turned on the roof by means of a garden hose, but this method is seldom successful. All too often, the point in the building at which the leak appears is far removed from the point on the roof at which the water has entered the roof material. As a consequence, a roofer must often trace the flow of water along pipes, rafters, beams, sheathing and metal decks until he arrives at the source. This is done best during a rain.

The following procedure is a good way of locating a leak point on a roof by using evidence found inside the building:

Step off inside the building, a distance from the leak point on a roof, by using the outside; for example, outside walk, skylight, chimneys, pipes, and the like.

Make a diagram of these findings, including anything that is easily identified from the roof.

On the roof, use the diagram to locate the area above the leak, and look for obvious signs of damage in and around that area. Mark the roof with keel in this area. You may immediately detect something which is obviously causing a leak, but this does not mean you should stop looking.

A roof leak is sometimes very deceiving and the roofer must look at every possibility. For example, sometimes the roof deck has been roofed more than once. One way to determine this is by making a cut in the roof in the form of a V, then lifting the roofing at the intersecting point. A previous roof may be found underneath. If only one built-up roof has been applied, then the chances are that the defect will be found in the immediate area above the inter point of leakage. If more than one roof has been applied, the roof defect may be far removed from this area. This is because the water, getting through the new roof, will travel underneath it and on top of the previous roof until it finds an opening into the building.

ROOFING REPAIRS

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D. REPAIR PROCEDURES

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain the various repair procedures used on various roof systems.

REFERENCES:

RELATED INFORMATION:

Although some roof repairs must be made during dry weather, others can be done during rain. Whether these repairs are temporary or permanent in nature, the procedure used is basically the same.

Patching Leaks in the Rain: The following procedure may be followed when patching a leaking roof during rain:

Clean away any rocks or dirt with a spud bar or wire brush in the vicinity of the leak. Prepare a smooth surface for the patch.

Using a wet patch, spread the material over the wet surface, working it in until a good bond is made over and around the spot where the leak has occured.

Place glass or saturated cotton fabric over the wet patch.

NOTE: This process may be done under water if necessary, but it will require more "working-in" to establish an adequate bond.

Repairs on a Dry Roof: The basic procedure to follow when repairing leaks on a dry roof is as follows:

Clean all dust and gravel away from the repair area.

Use hot asphalt in the same manner as on a reroofing job.

Prime all dry and dusty areas.

Cover any rough or irregular surfaces with membrane and cover this immediately with gravel or 90 lb. felt.

Apply mastic, plastic, or other flashing compound around pipes, flashing, and 3-ply roofing instead of wet patch.

ROOFING REPAIRS

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2. What is always the one inescapable fact when a leak occurs?

3. What is the best time to locate a leak?

4. When a temporary repair is made, what should be submitted to assist the roofer in the installation of the permanent repair?

5. What condition can be called a leak, but really is not?

STEEP ROOFING METHODS

NAME _____ DATE _____

A. SAFETY ON STEEP ROOFING

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to discuss the various safety precautions which must be used when working on steep roofs.

The apprentice will demonstrate his understanding of the elements of safety by his continued observance of sound safety habits while on the job site.

REFERENCES:

RELATED INFORMATION:

Working high off the ground is an essential part of the roofing trade. Any apprentice roofer who has a fear of height should choose another occupation. Even though "high work" seems to carry with it certain dangers, it need not be dangerous if all established safety rules are observed. A thorough study of this topic may help to avoid a serious injury at a later date.

It is never advisable for any person, even though he may be used to high work, to work on a roof or scaffold when he is not feeling well. There may also be occasions when emotional strain makes it advisable to stay on the ground. In any event, steep roofs should never be climbed on unless the correct equipment is available and the roofer has the knowledge and training to use such equipment effectively. Even with correct safety equipment in use on the job, the roofer should remember at all times a cardinal rule for all high work: "Keep your mind on the job - don't let it wander off to other problems!"

Roof Pitch: A roof with a pitch over 8" in 12" is considered steep for walking upon, but it is not considered unsafe so long as the surface provides sufficient traction against the roofer's shoes to prevent slipping. Even roofs with less pitch may be considered dangerous if the roof is wet or covered with dust, moss or any other substances that may act as a lubricant to overcome friction.

Wearing shoes with leather soles and heels on a roof constructed of dry wooden shingles is an extremely hazardous practice and should not even be attempted on roofs with a pitch as low as 3" in 12". Gripper-type rubber soled tennis shoes are most satisfactory when shingling a steep roof, but proper roofer's shoes for each purpose should be worn at all other times.

When a roofer walks on a steep roof, he should always place the entire surface of his foot down upon the roof and stand erect (Fig. 1). If the roofer leans forward toward the peak of the roof, the weight of his body is thrust downward, and the heels of his shoes

STEEP ROOFING METHODS

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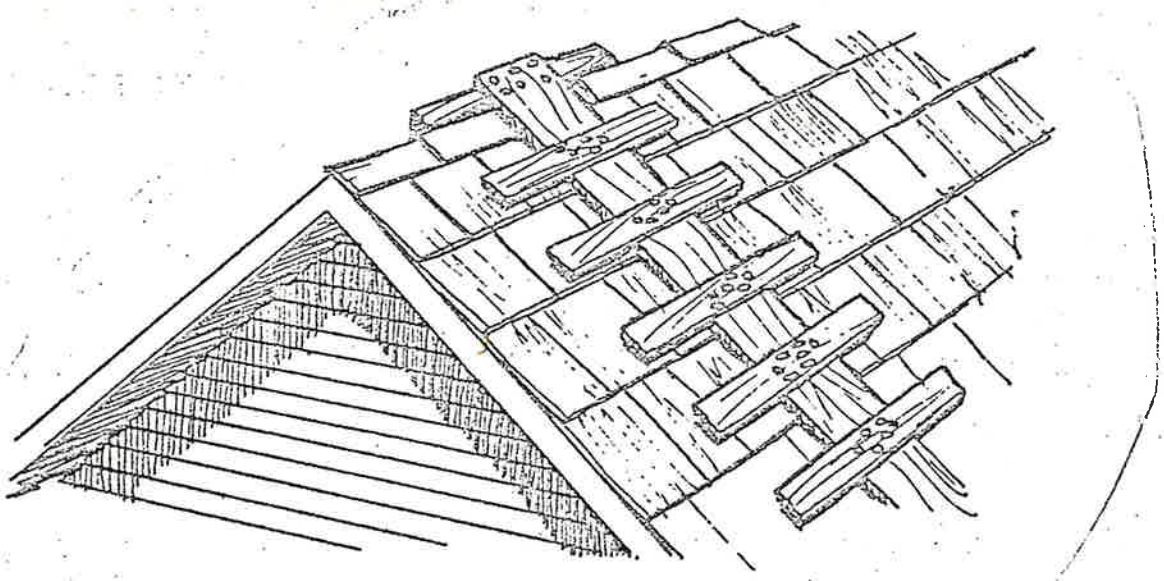

Fig. 3 - Construction of a typical chicken ladder

Roof and Ladder Jacks: When shingling on a steep roof, a roofer nails the first two courses in place while standing on a plank supported by two ladder jacks. The roofer next nails jacks (sometimes called roof brackets) not more than 10 feet apart and in such position that they do not interfere with the next course of shingles. Planks are placed upon the roof jacks to become the "platform" from which the roofer will work. (Caution: Care must be taken to see that the planks are of the right size and of such quality that they will support the load they will be required to carry.)

The roofer shingles up as far as he conveniently do so, then nails on another set of jacks. (Fig. 4) This process continues until the roofer has reached the ridge. When the job is completed, the roof jacks should be removed, starting from the top of the roof and working down. The jacks can be removed with a slight push upwards and sideways. It is only necessary to leave enough jacks and planks in place to provide access to the roof until the job has received its final inspection.

NOTE: Roof jacks should be secured to the roof with nails no smaller than 16 penny. Nails must be driven into a solid base, such as a rafter.

Scaffolding for Roofing: It is sometimes necessary to install scaffolding when working on spires or other roof surfaces too steep to accomodate roof jacks. Scaffolding is also used when siding is installed. Such scaffolding is usually erected by the general contractor on new jobs, or it may be done by a scaffolding company on repair and recover work.

STEEP ROOFING METHODS

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3. Walking on a wet glazed surface

4. Walking without due caution on a cold glazed surface

5. Wearing shoes not proper for the job

SAFETY NOTE: When "glazing in, " always keep water in a clean bucket. If water is kept in a "hot" bucket, it is too easy to confuse this with a bucket actually containing hot asphalt. Because of this confusion, many a roofer has accidently put his hand into a bucket of hot asphalt when he thought it was a bucket of water.

Questions:

1. What is a good knot to use when fastening two ropes of equal diameter together?

2. At what pitch is a roof considered "steep" for walking?

3. What is the minimum size nail to use when nailing roof jacks?

4. When are Boatswains' chairs used?

5. What two conditions when working with asphalt cause one to slip?

STEEP ROOFING METHODS

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B. LOADING OF EQUIPMENT AND MATERIALS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain the proper methods of loading and unloading job equipment and materials from a practical, efficient and economic standpoint.

REFERENCES:

RELATED INFORMATION:

See Built-Up Roofing Methods, Part A - Loading of Equipment and Materials.

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C. SITE PREPARATION

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to discuss what is necessary and required when inspecting the job site, prior to the application of the roofing componets.

REFERENCES: Manual of Built-Up Roof Systems, McGraw-Hill Book Company, Chapter 11. C. W. Griffin.

RELATED INFORMATION:

See Built-Up Roofing Methods, Part B - Site Preparation and Stock Piling.

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D. APPLICATION

1. ASPHALT

OBJECTIVE OF ASSIGNMENT:

REFERENCES:

RELATED INFORMATION:

Asphalt Shingles: In 1906 in Grand Rapids, Michigan, four squares of individual rectangular shingles were cut from mineral - surfaced prepared roofing and nailed onto the roof of a barn. This was the beginning of the asphalt shingles which became the principle product of the asphalt roofing industry in future years.

A few years later the idea of cutting a strip across the sheet of prepared roofing, and cutting slots deep enough to form shingle tabs, was conceived.

This was known as a strip shingle or four-in-one shingle. As this method had less overlapping area, only requiring 240 square feet of material to cover 100 square feet of roof deck - whereas the individual required 300 square feet - the use of the strip shingles soom exceeded the individual method. The labor was also less in the four-in-one than in the individual.

However, shingles of both kinds were used for a great many years. Both of these shingles had loose tabs, the nailing being done through the covered area above the tabs. The tabs frequently blew up, and often blew off, being torn from the nailed-on portion.

Beginning in 1920, various methods of locking the tabs down were devised.

The desire for improved appearance resulted in larger exposed areas, which further stimulated the need for securing the butts.

This method to hold down the tabs went from mechanical means to interlocking shingles, and then to underlying cement to hold down the tabs, the cement being applied under the tab at the factory.

As the public became more color conscious, the demand for color increased in shingles. From two drab colors in the beginning, white to black with every color of the rainbow in between is now available in asphalt shingles.

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1. Dry Looper - A roll of dry felt is installed on the felt reel and is unwound onto the "dry looper." The looper acts as a reservoir of felt material that can be drawn upon by the machine as circumstances demand, eliminating stoppages, such as when a new roll must be put on the felt reel, or when imperfections in the felt must be cut out.

2. Saturation of Felt - Following the dry looper, the felt is subjected to a hot saturating process which has as its objectives the elimination of moisture and the filling of the felt fibers and intervening spaces as completely as possible with the asphalt saturant.

3. Wet Looper - At the completion of the saturating process an excess of saturant usually remains on the surface of the sheet. It is therefore held for a time on a wet looper so that the natural shrinkage of the asphalt, upon cooling, will cause the excess to be sucked or drawn into the felt, resulting in a very high degree of saturation.

4. Coater - After saturation, the sheet is carried to the "coater" where the coating asphalt is applied to both the top and bottom surfaces. The amount is regulated by the "coating rolls" which can be brought together to reduce the amount, and separated to increase it.

   It is at this point that the finished weight of the product is controlled by the machine operator. Long experience enables him to maintain uniform production by delicate adjustments of the control mechanism. Many roofing machines are equipped with automatic scales which weigh the sheets in the process of manufacture and warn the operator when the material is running over or under weight specifications.

5. Mineral Surfacing - When smooth roll roofing is being made, talc or mica is applied to both sides by spreading and pressing through a press roll.

   When mineral surfaced products are being prepared, granules of specified color or color combinations are added from a hopper and spread thickly on the hot coating asphalt and the back coated with talc or mica. The sheet is then run through a series of press and cooling rolls or drums. In order to insure proper embedment of the granules, the sheet is subjected to controlled pressure which forces the granules into the coating to the desired depth.

6. Texture - At this point some products are textured by being pressed by an embossing roll which forms a pattern in the surfaces of the sheet.

7. Finish, or Cooling Looper - The sheet is now ready to go into the finish looper. The primary function of this looper is to cool the sheet down to a point where

STEEP ROOFING METHODS

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1. Product name

2. Shipping weight per square

3. Number of packages (or rolls) required to cover a square

4. The over-all dimensions of one unit of the product in length and width

5. Number of individual units required to cover a square

6. Gives the side or lap end; the shortest distance in inches which horizontally adjacent elements of roofing overlap each other. (See Fig. 2 & 3)

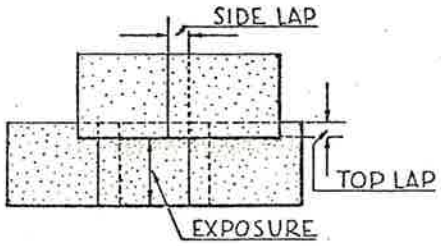

Fig. 2 - Dutch Lap

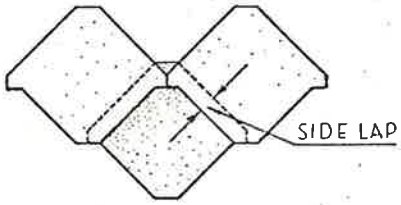

Fig. 3 - Individual Hex

7. Top lap is the shortest distance in inches from the lower edge of an overlapping shingle or sheet to the upper edge of the lapped unit in the first course below. (See Fig. 2 & 4)

8. Head lap is the shortest distance in inches from the lower edge of an overlapping shingle or sheet to the upper edge of the unit lapped in the second course below. (See Fig. 4)

Note - Cutouts, slits, slots or abutted vertical side edges are not considered in figuring laps or coverage.

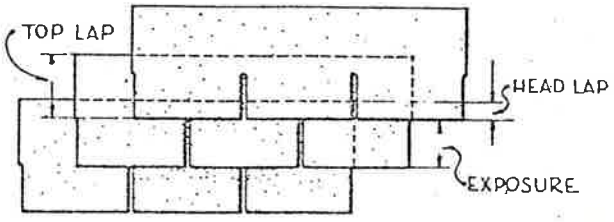

Fig. 4

STEEP ROOFING METHODS

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Any of the above specifications may be applied on a deck having a pitch steeper than the stated minimum.

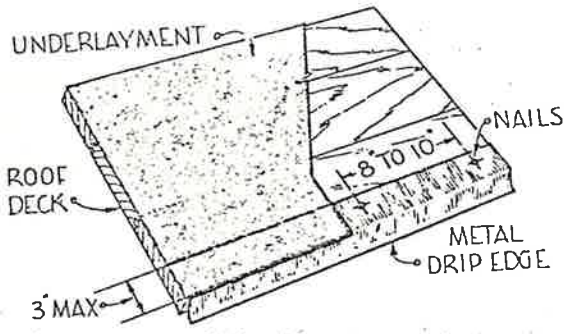

Fig. 6 - Application of metal drip at eaves directly on deck.

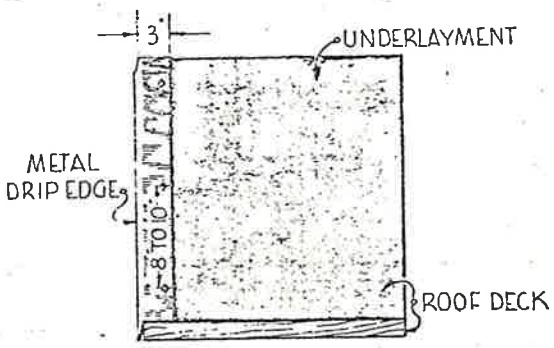

Fig. 7 - Application of metal drip at rakes over underlay.

Application of Strip Shingles:

1. General - Before starting to apply strip shingles, it is necessary that the deck be properly prepared; in the case of new construction that an underlayment be first applied; and in the case of reroofing, that the old surface be properly treated.

2. Application

   a. Metal Drip Edge - A metal drip edge, made of non-corrodible, non-staining metal, used along the eaves and rakes, applied directly on the wood deck at the eaves and over the underlay along the rakes as shown in Figs. 6 & 7. It is designed to allow water run-off to drip free of underlying construction. It should extend back from the edge of the deck not more than 3" and is secured with appropriate nails spaced 8" to 10" apart along its inner edge as shown.

   b. Underlayment - Before any shingles are applied, a layer of No. 15 asphalt saturated felt is applied over the entire deck.

   c. Chalk Lines - On small roofs, strip shingles may be laid from either rake, but on roofs 30 feet or longer, it is better to start them at the center and work both ways from a vertical line in order to insure more accurate vertical alignment and to provide for meeting and matching above any projection through the roof such as a dormer or chimney.

      Minor variations in the dimensions of asphalt shingles are unavoidable. Such divergence will seldom exceed ± ¼" in a 12" X 36" strip shingle in either length or width and usually will be no more than ± 1/8". In order to control the proper placement of shingles so that cutouts will be accurately aligned hor-

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order to insure a satisfactory color match at the spaces between tabs along the eaves.

f. First and Succeeding Courses - The first course is started with a full shingle while succeeding courses are started with full or cut strips depending upon the style of shingles being applied and the pattern desired. There are three major variations for square butt strip shingles.

1. Cutouts Break Joints on Thirds (Fig. 9) - When it is desired that cutouts break joints on thirds, the second course is started with a strip from which 4" has been cut, the third course with a shingle from which 8" has been cut, and the fourth course with a strip from which the entire first tab has been cut. This will cause the cutouts to break joints on thirds with the course below. Courses 5, 6 and 7 may repeat the process, or may continue by removing 1-1/3 tabs, 1-2/3 tabs and 2 tabs respectively from each first strip before applying it at the rake. The shingles are placed so that the lower edge of the butts align with the top of the cutouts of the underlying course.

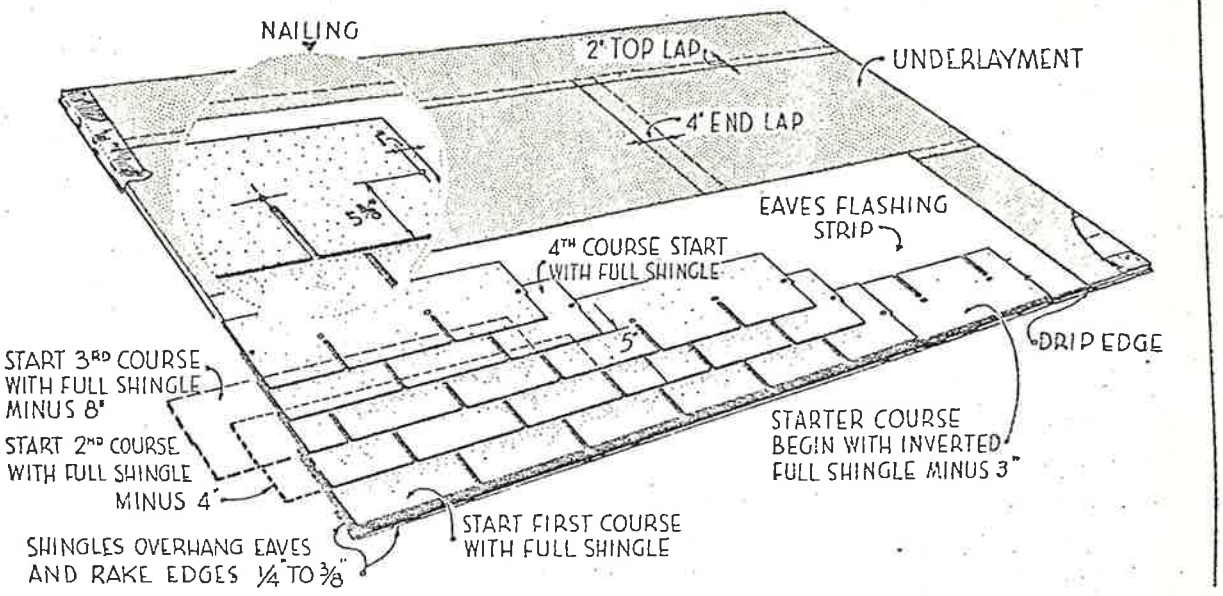

Fig. 9 - Three-tab square butt strips. Cutouts break joints on thirds.

2. Cutouts Break Joints on Halves (Fig. 10) - When it is desired that the cutouts break joints on halves the second course is started with a strip from which 6" has been cut from the first tab, the third with a strip the entire first tab has been removed, the fourth with one- half a strip. etc., thus causing the cutouts to be centered on the tabs of the course

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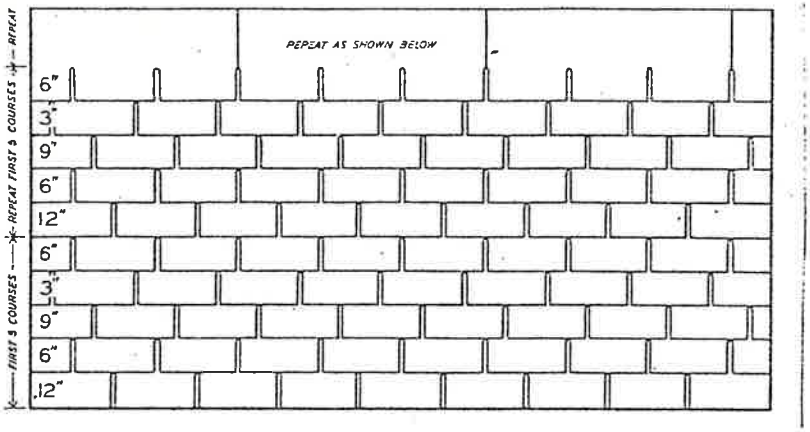

Fig. 11 - Random spacing of three-tab square butt strips.

Starting the first course with a full length strip, Fig. 11, indicates the length of the starting tab of each succeeding course in order to produce satisfactory random spacing.

4. Ribbon Courses - The use of a ribbon course every fifth course strengthens the horizontal roof lines and adds a distinctive massive appearance that many home owners find desirable.

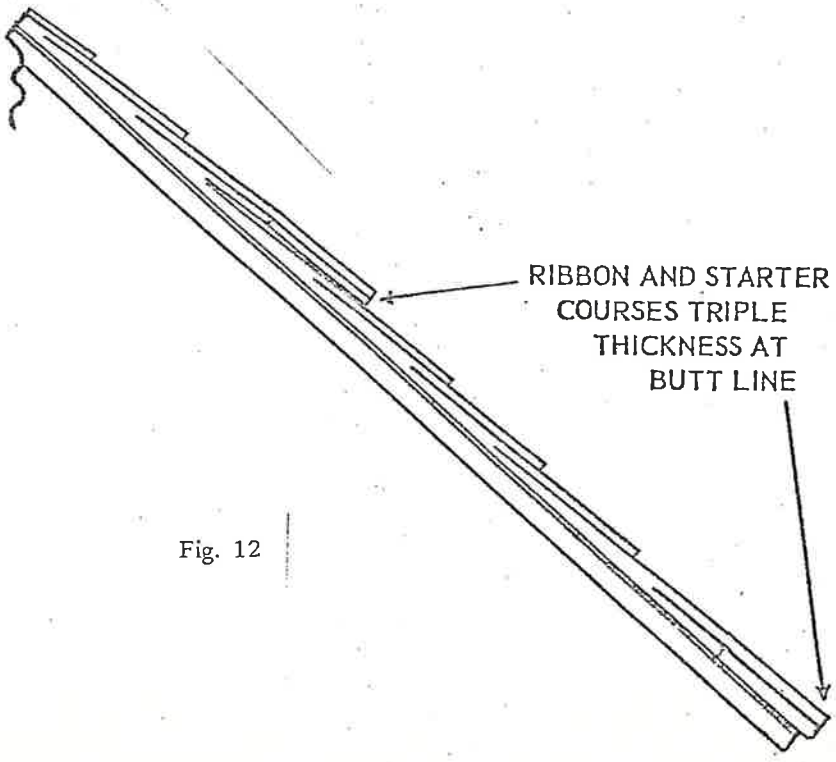

Fig. 12

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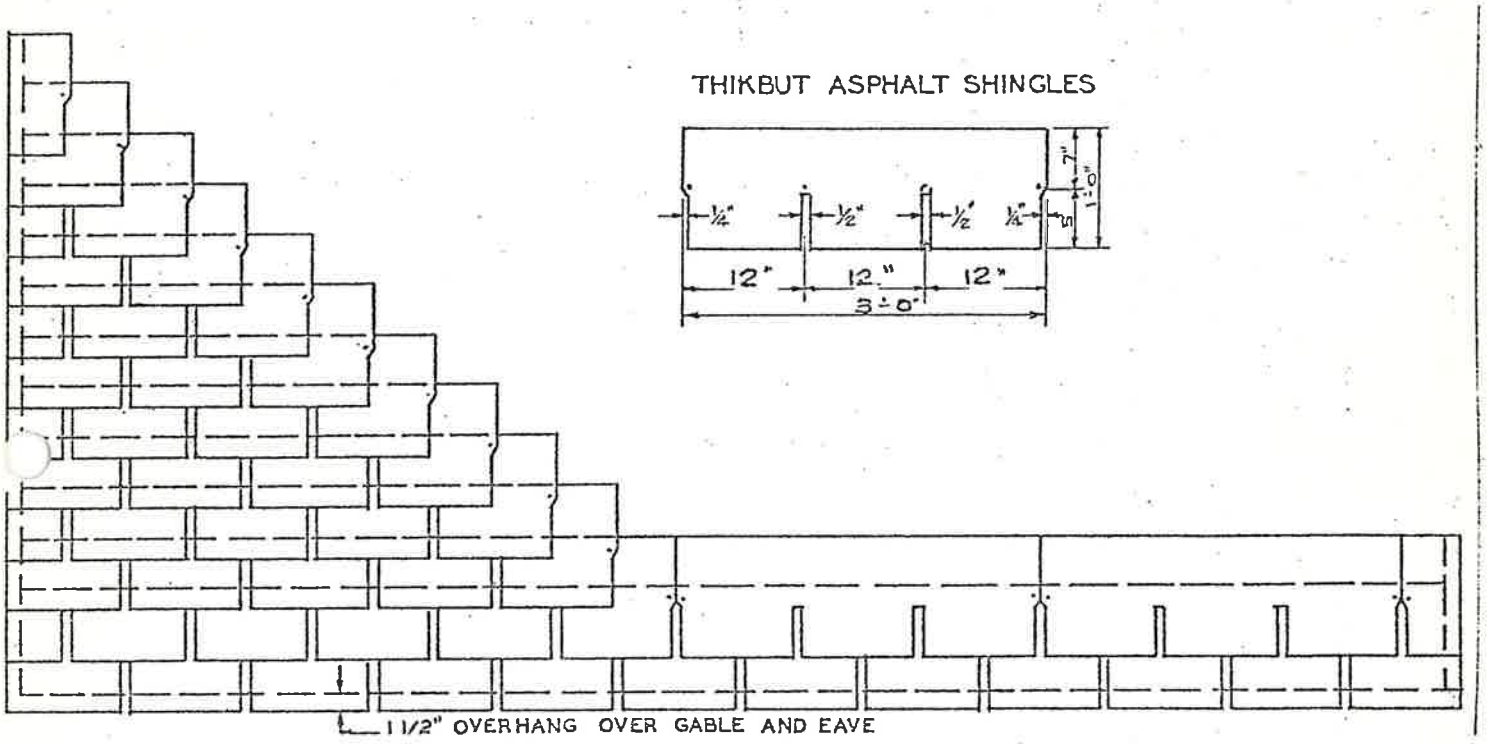

Fig. 14

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2. Windy Locations - In localities where strong winds are to be expected, "free" shingles tabs require additional security, which should preferably be provided by cementing. If the tabs are not to be cemented, greater anchorage of the shingles to the deck can be obtained by the use of 6 nails per strip. In this case, they should be placed 5/8" above the top of the cutouts and located horizontally as follows:

   One nail 1" back from each end of the strip.
   One nail 1-1/2" back from each side of the cutout centerline.

3. 4" Exposure - When shingles are applied with an exposure of 4", six nails are used, placed 1-1/2 back from each side of the cutout centerlines and from the ends of the strip, and located 4-5/8" above the exposed edge of the tabs.

4. Two and Three Tab Hex Strips - Both the two and three tab hex strip shingles require 4 nails per strip. They are located in a line 5-1/4" above the exposed butt edge and horizontally as follows:

   a. For Two-Tab Shingles (Fig. 17) -

      One nail 1" back from each end of the strip.
      One nail 3/4" back from each angle of the cutouts.

   b. For Three-Tab Shingles (Fig. 18) -

      One nail 1" back from each end.
      One nail centered above each cutout.

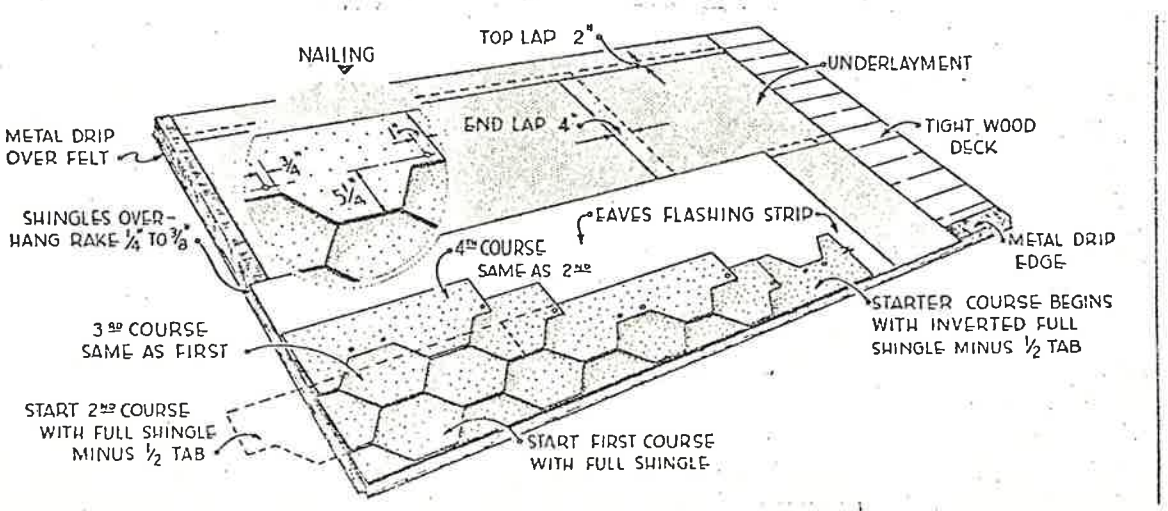

Fig. 17 - Application of two-tab hex strips.

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b. Beginning at the bottom of a hip or at one end of a ridge, apply the shingles over the hip or ridge exposing them 5".

c. Secure each shingle with one nail on each side, 5-1/2" back from the exposed end and 1" up from the edge.

Never use metal ridge roll with asphalt roofing products, as corrosion may discolor the roof.

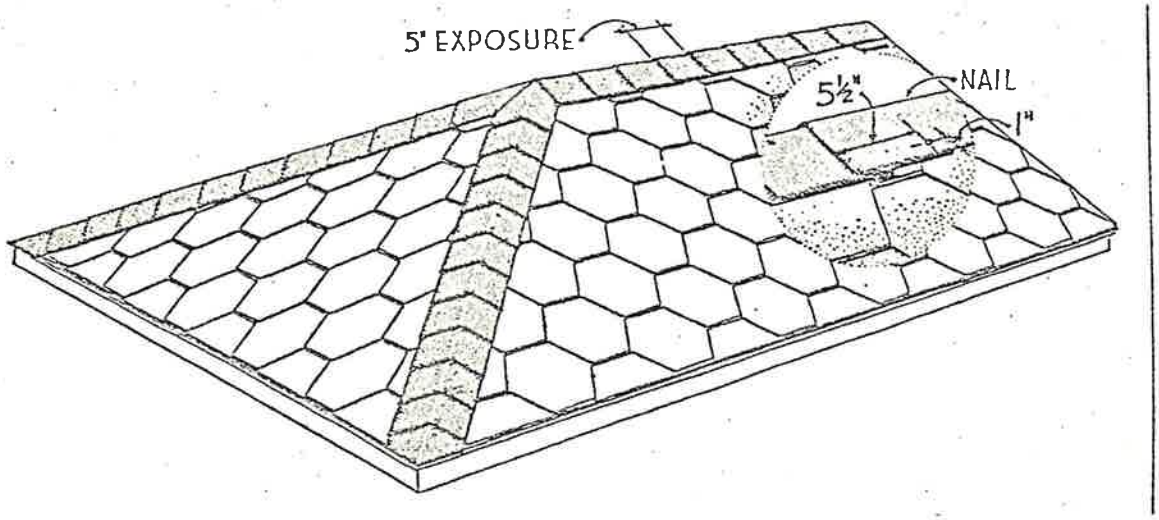

Fig. 19 - Hip and ridge shingles applied with hex tab strips.

Low Slope Application: Square-tab strip shingles are recommended for use on decks having a slope lower than 4" per foot but not less than 2" per foot when special application methods are used to compensate for the slower water run-off resulting from the lower

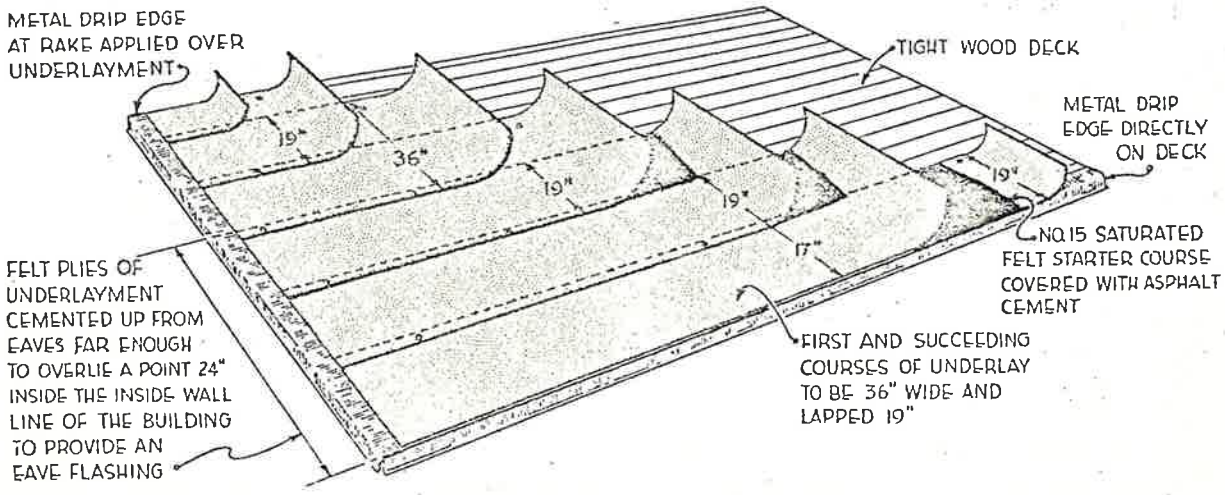

Fig. 20 - Application of No. 15 asphalt saturated felt underlay on a Low Slope Deck.

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(c) Application of Shingles: Fig. 22 shows how the shingles are applied over the underlayment. Any shingle arrangements as described for normal slope application may be used. The exposure is 5" and the number of nails required per strip is four.

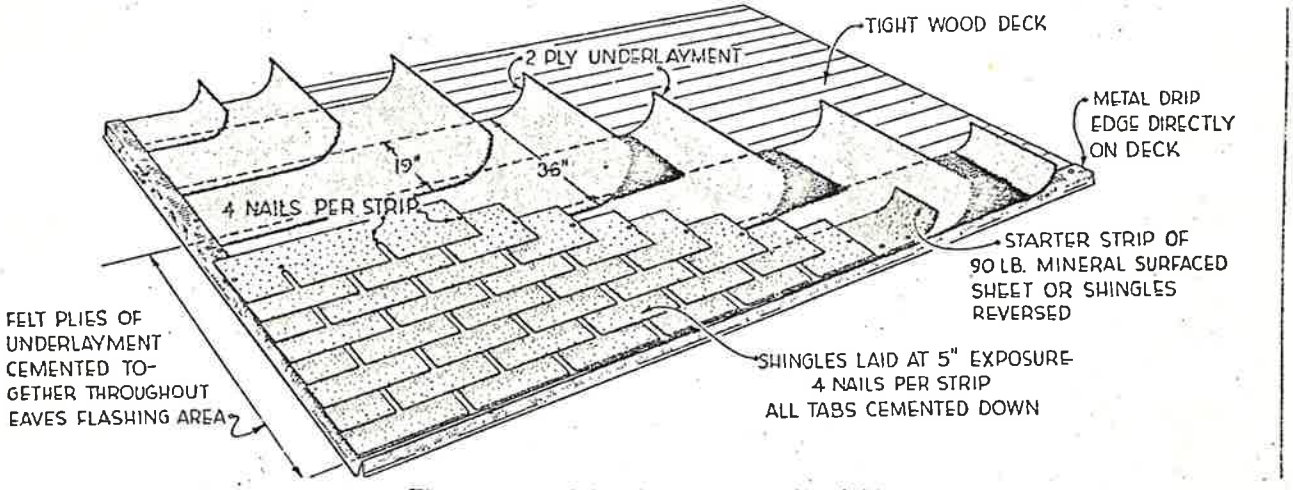

Fig. 22 - Application of shingles over double underlay.

Types of Flashing: See Fig. 21.

Flashings: Closed or Woven Valley

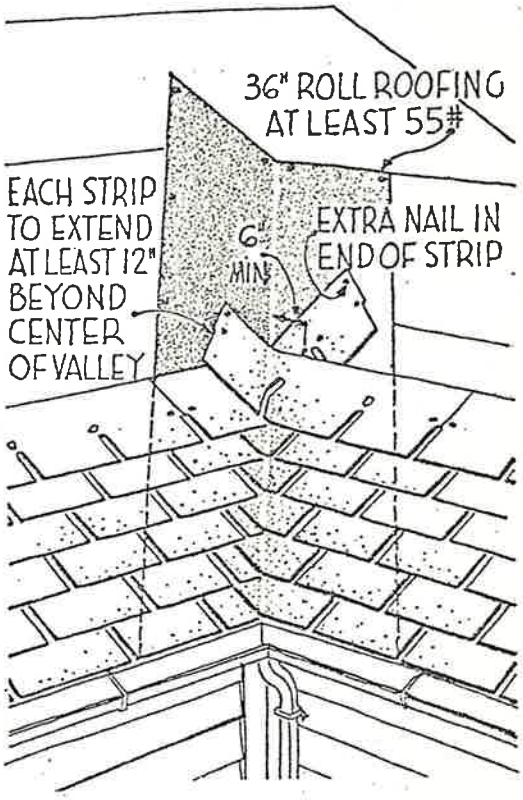

Fig. 24 - Closed or Woven Valley

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top corner as shown. As the metal is 7" wide, and the roof shingles are laid 5" to the weather, each element of flashing will lap the next by 2", as shown in Fig. 25.

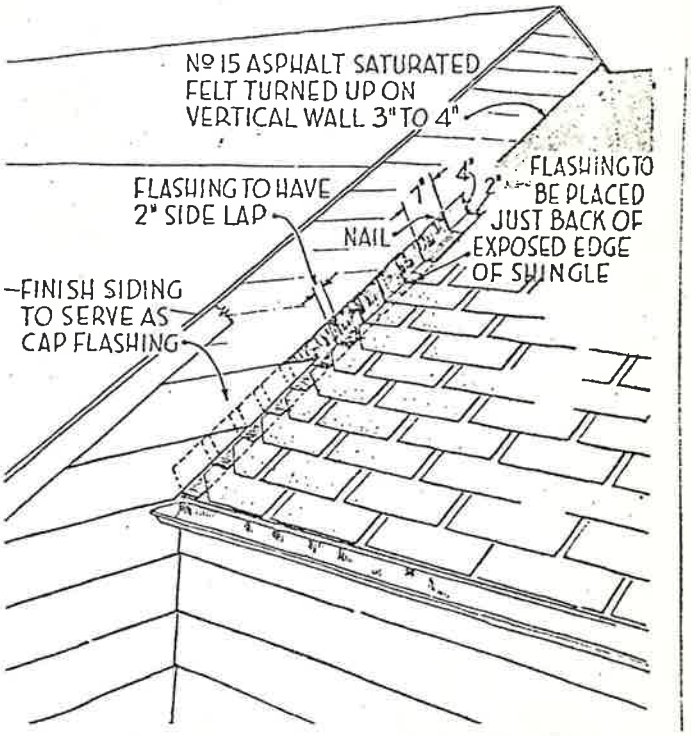

Fig. 25 - Use of metal flashing shingles to protect joint between sloping roof and vertical wall.

The finish siding is brought down over the flashing to serve as cap flashing, but is held far enough away from the shingles so that the ends of the boards may be readily painted to exclude dampness and prevent rot.

Chimneys: To avoid stresses and distortions due to uneven settling, the chimney is usually built on a separate foundation from which supports the structure, and is normally subject to some differential settling. Therefore, flashing at the point where the chimney projects through the roof calls for construction which will allow for such movement without damage to the water seal. It is necessary to use base flashings which are secured to the roof deck, and counter or cap flashings which are secured to the masonry.

Before any flashings are placed, shingles are applied over the roofing felt up to the front face of the chimney, and a cricket or saddle is constructed as shown in Fig. 26, between the back face of the chimney and the roof deck. The purpose of cricket is to prevent the accumulation of snow and ice and to deflect downflowing drainage water around the chimney. It is a very important element of the construction.

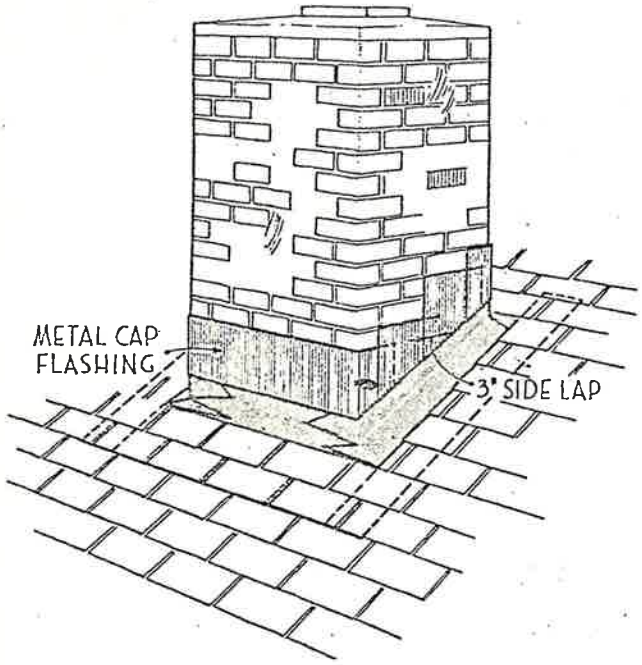

Fig. 27 - Metal cap flashing applied to cover base flashing.

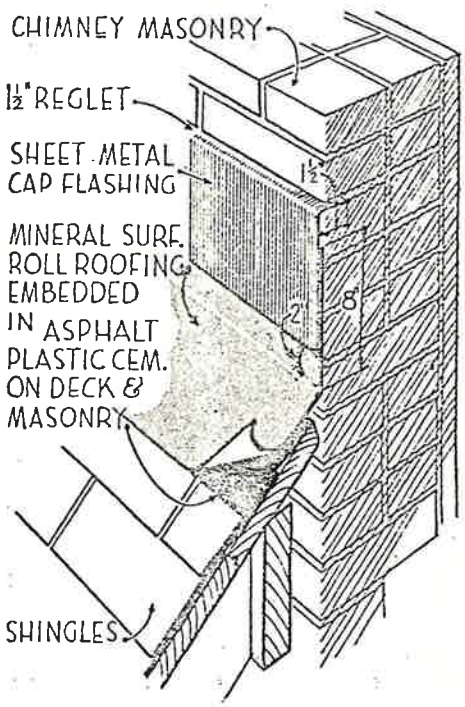

Fig. 28 - Method of securing cap flashing to the masonry.

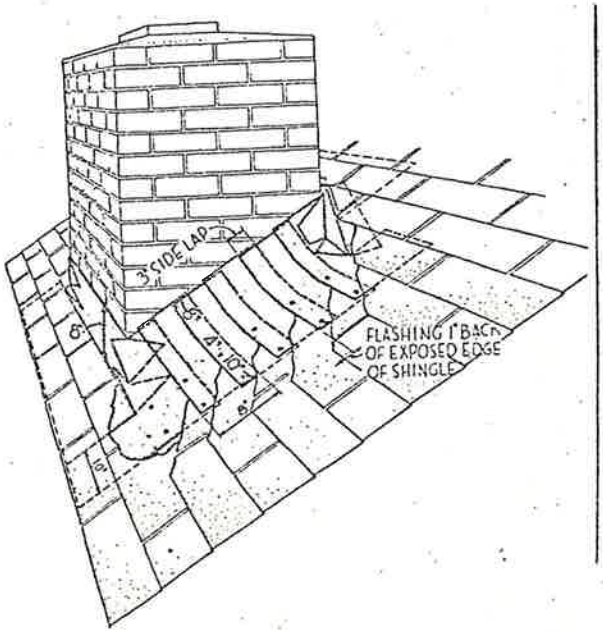

Fig. 29 - Alternate base flashing.

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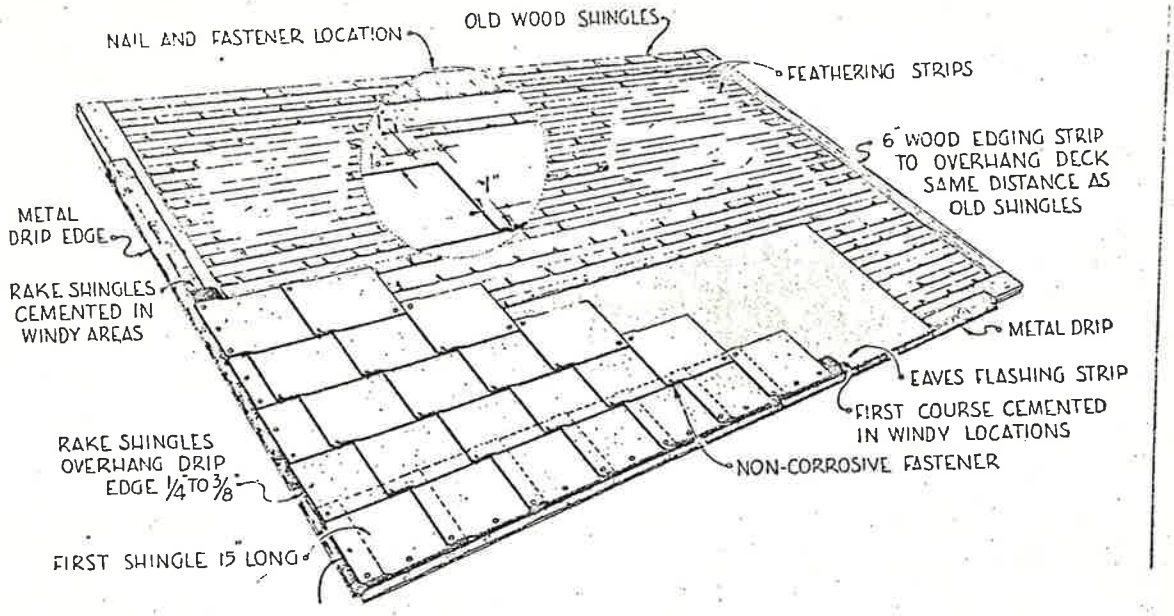

Fig. 31 - Application of Dutch Lap Shingle

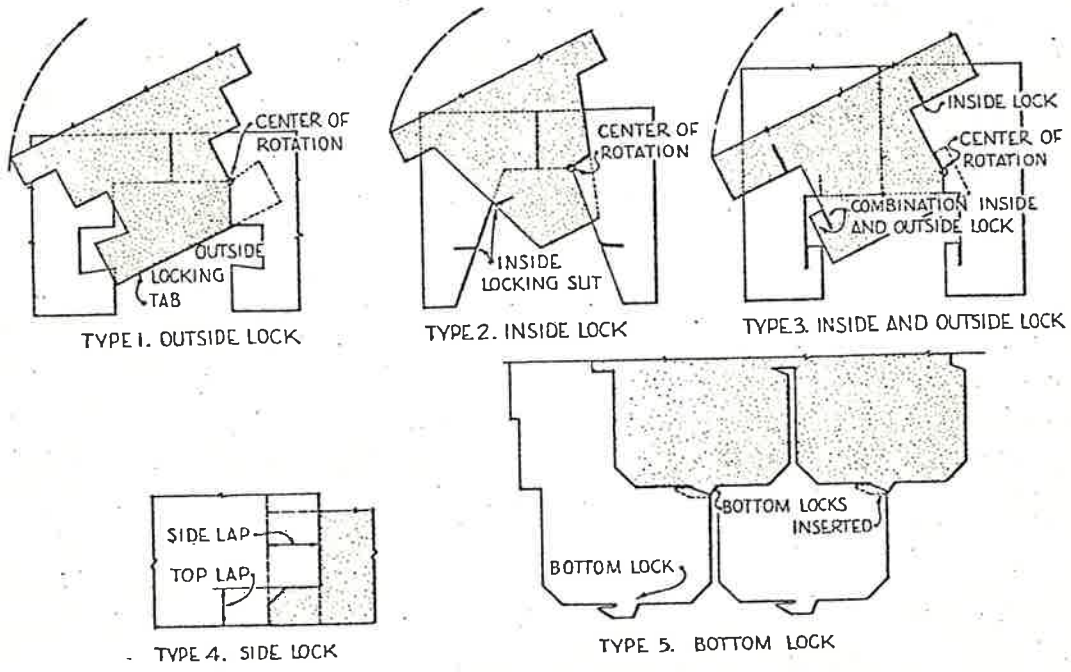

Fig. 32 - Methods of locking shingles of types 1-2-3-4-5. In each case the locking device only is shown here.

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covered in square feet, to divide this amount by 100 and then to add a certain percentage for waste and cutting. The percentage to add must be determined by each individual according to his own experience. A good general average is 10 percent. A simple roof, uncomplicated by dormers or other irregularities such as are illustrated in Fig. 37 will require less, while the complicated roofs will require more.

Estimating Area: The areas of simple surfaces, rectangular in shape or made up of rectangular elements, can be computed easily. The area of the shed roof, Fig. 33 is the product of the eave line and the rake line, A x B. The area of the simple gable roof., Fig. 33 equals the sum of the two rakes, B and C, multiplied by the eave line A. Likewise, the gambrel roof, Fig. 33, is estimated by multiplying the sum of the rake lines A, B, C & D by the eave line E.

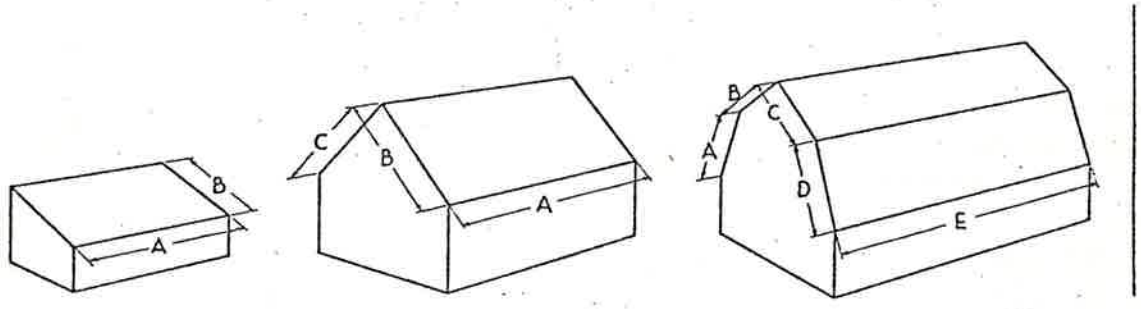

Fig. 33 - Simple Roof Types

But when ells and gables or dormers enter to problem as in Fig. 37 complications arise. The lengths of eaves, rakes, valleys and ridges can be easily obtained only from drawings or sketches. The simple methods described above cannot be followed without laboriously and perhaps dangerously climbing over the roof to measure the necessary distances directly.

The method described in the following pages has been worked out to enable the estimator to determine the areas to be roofed without climbing on the roof and without going through a long series of complicated computations. The method requires that:

1. The pitch of the roof be known or determined.

2. The horizontal area in square feet covered by the roof be computed.

Pitch: The span, rise and run of a simple gable roof are shown in Fig. 34. The pitch or slope of the roof is most often stated as the relation between the rise and the span. If the span is 24'0" and the rise is 8'0" the pitch will be 8/24 or 1/3. If the rise were

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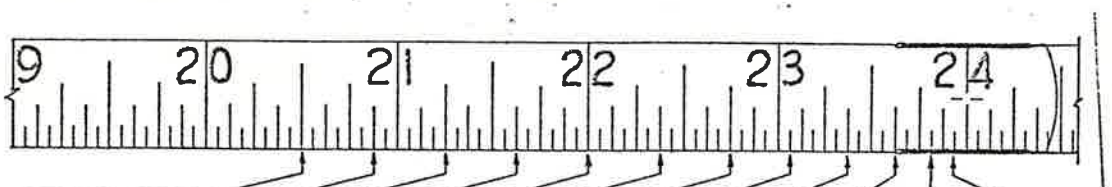

RULE READING	$20\frac{1}{2}$	$20\frac{7}{8}$	$21\frac{1}{4}$	$21\frac{5}{8}$	22	$22\frac{3}{8}$	$22\frac{3}{4}$	$23\frac{1}{16}$	$23\frac{3}{8}$	$23\frac{5}{8}$	$23\frac{13}{16}$	$23\frac{15}{16}$
PITCH FRACTIONS	$\frac{1}{2}$	$\frac{11}{24}$	$\frac{5}{12}$	$\frac{3}{8}$	$\frac{1}{3}$	$\frac{7}{24}$	$\frac{1}{4}$	$\frac{5}{24}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{24}$
RISE-INCHES PER FT.	12	11	10	9	8	7	6	5	4	3	2	1

Fig. 36 - Reading Point converted to pitch.

Horizontal Area: Fig. 37 shows a typical dwelling having a roof complicated by valleys, dormers and variable height ridges. The projection below the perspective shows the total ground area (horizontal surface) covered by the roof. All measurements needed to draw such a horizontal projection or roof plan, can be made from the ground or within the attic space of the house. No climbing on the roof is necessary.

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The horizontal area under the 9" slope roof will be:

	26 x 30 =	780 square feet
	19 x 30 =	570 square feet
	Total =	1350 square feet
Less	8 x 5 =	40 (triangular area under ell roof)
	4 x 4 =	16 (Chimney)
	=	1294 square feet

The area under the 6" rise roof will be:

20 x 30 =	600	square feet
8 x 5 =	+40	(triangular area projecting over the main house)
Total =	640	square feet

Duplications: Sometimes one element of a roof projects over another. Such duplicated areas should be added to the total horizontal area. If the eaves in Fig. 34 project only 4" there will be, (1) a duplication under the dormer eaves of 2 (5 x 1/3) or 3-1/3 sq. ft.; (2) a duplication of 2 (7 x 1/3) or 4-2/3 sq. ft. under the eaves of the main house where they overhang the rake of the Ell section; and (3) a duplication of 9-1/4 x 1/3 or 3-1/6 sq. ft. under the rake of the wide section of the main house where it overhung the rake of the small section in the rear. The total is 11-1/6 or 12 sq. ft.

Item (1) should be added to the area of the 6" pitch roof and Items (2) and (3) to the 9" pitch roof. The new totals will be 640 + 4 or 644 for the 6" pitch and 1294 + 8 or 1302 for the 9" pitch.

It now remains to convert horizontal areas to slope areas. This is done with the aid of the Conversion Table on the next page. Horizontal areas are given in the first column, while corresponding slope areas are given in columns 2 to 12.

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The total area under the 6" rise - 644 square feet

	Horizontal Area	Slope Area
Opposite	600	670.8
Opposite	40	44.6
Opposite	4	4.5
Total	644	719.9

The total area for both pitches will be 1,627.5 + 719.9 = 2,347.4 sq. ft.

To this should be added an appropriate percentage for waste, say 10%, which will bring the total area of roofing required to 2,582 sq. ft. or 26 squares.

One point in connection with this method should be particularly emphasized. The method is possible because of the fact that over any given horizontal area, at a given pitch, a roof will always contain the same number of square feet regardless of its design. Trial will show that a shed roof, a gable roof, or a hip roof with or without dormers, when placed over the same horizontal area with the same pitch, will each require exactly the same square footage of roofing.

Accessories: Quantities of starter strips, edging strip, ridge shingles, and valley strips all depend upon linear measurements along eaves, rake, ridge and valley. Eaves and ridge are horizontal. The rakes and valleys run on a slope. Quantities for the horizontal elements can easily be taken off the roof plan directly. The true length of rakes and valleys, however, must be taken from appropriate conversion tables.

Length of Rake: To determine the length of the rake of the roof, measure first the horizontal distance over which it extends. In the case under consideration (Fig. 34), the rake on the ends of the main house span distances of 26' and 19' respectively. Additional rake footage occurs also at the point where the higher roof section joins the lower. This amounts to 13 + 3-1/2. The total rake footage is therefore 26 + 19 + 13 + 3-1/2 = 61-1/2 ft.

By referring to Table I under the 9" rise column, it is found that, opposite the figures in Column 1, which reads "Horizontal Area in Square Feet or Length in Feet":

	Horizontal Run	Length of Rake
	60	75.0
	1	1.3
	.5	.6
Total	61.5	76.9 actual length of rake

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The run of the common rafter is 1/2 of the horizontal distance which the roof spans. When used to determine the length of a valley, the run of the common rafter should be taken at the lower end of the valley.

In Fig. 37 the portion of the ell roof which projects over the main roof has a span of 16' at the lower end of the valley, and therefore the common rafter at this point has a run of 8' - 0".

Since there are two valleys at this roof intersection the total run of the common rafter to be considered is 16' - 0". Refer now to the Hip and Valley Table. Opposite the figures in the column headed "Horizontal", find the lineal feet of valleys in the column under the pitch involved.

Since one of the intersecting roofs has a rise of 6" and the other a rise of 9" the length for each rise must be found and the average of the two taken. (This will give you a very close approximation of the true length of the valley.)

Thus --Horizontal	6" Rise	9" Rise
10	15	16.0
6	9	9.6
16	24	25.6
		24.0
		2 / 49.6
		24.8 length of valleys

Dormer Valleys: The run of the common rafter at the dormer is 2.5 feet. Entering the Hip and Valley Table it is found that:

Horizontal	6" Rise
2.0	3.00
.5	.75
2.5	3.75 length of valley

Two such valleys will total 7.5'.

The total length of valley will therefore be 24.8 + 7.5 = 32.3 feet.

These figures can be used to estimate the amount of flashing material that will be required.

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D. APPLICATION

4. TILE

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to properly apply tile roofing and flashing.

REFERENCES: Roofers International Apprentice Manual.

RELATED INFORMATION:

This topic, "Tile Types, Stacking, and Loading," is planned to help you find answers to the following questions:

How many types of roofing tile are there?

What is the main difference between plain tile and interlocking tile?

What are some of the standard tile tests?

Why are custom tile designs sometimes required, and when are they generally used?

What are the recommended procedures for stacking and loading tile?

Perhaps more roofs throughout the world are covered with tile than with any other type of roofing material. The universal availability of tile, its ease of fabrication, and its excellent durability in all climates probably accounts for its popularity. No one really knows where or when clay tile was originated. Although early tile was undoubtedly sun dried and, therefore, easily destroyed by weather, ample evidence exists that indicates tile in some form was used by the Greeks and Romans in ancient Europe and by the Japanese and Chinese in Asia.

Tile played a major role in roofing during early California history. Although missions were originally covered with straw roofs, these were soon replaced by tile roofs. The tile used was usually molded over an Indian's thigh or over a formed section of a log. Then the tile was allowed to dry out and was eventually fired a kiln.

Although roofing tile is no longer used extensively in this country, most roofers will be called upon from time to time to work on a tile roof.

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Tile Tests: A single flat or shingle tile laid 10 in. on center should be able to withstand a weight load of 175 to 200 lbs. (Cement tile will not have this strength, especially if made with vermiculite.)

A typical building code requirement may read: "In the immersion test, tile should absorb not more than 15 percent water in 48 hours." (Cement tile made with a lightweight aggregate such as vermiculite may have a higher absorption rate; consequently, such tile must be waterproofed with a repellant or treated with a vinyl or oil-based material.

Another test requirement might read:

> All curved, burned-clay roofing tile shall successfully meet the following test requirement: Each tile from a group of five tile selected at random from the field shall be laid with the crown (or convex) side up across two bearings 12 in. apart to make a clear span of 12 in. A concentrated load shall then be carefully applied at the crown at its center or mid-span. This load shall be increased slowly to the destruction of the test sample. In no case shall any individual tile fail or fracture under a test load which is less than 350 lbs., and the average destruction load for the five samples tested shall not fall below 400 lbs.

Tile used for roofs is generally unglazed, therefore only water resistant. Because of this, an underlayment (or undertile membrane) is used with tile. High-quality tile has a proportionally higher water resistance, and glazed tile is considered waterproof.

Tile Colors: Tile color is generally that of the natural baked color of the clay used in its manufacture. "Variegated" tile is sorted and stacked at the tile plant to give a pleasing variety and distribution of tones. Such tile is more costly, of course, but is often preferred by the architect or builder. The tone variation is obtained during the process by varying the baking time. Conversely, uniform colors are obtained by glazing the title prior to baking and then firing at 1800 F.

Custom Tile Designs: Tile may be custom-designed and manufactured for a special job; for example, a conical tower roof. In cases such as this, each tile is numbered according to its designated location on the roof; for example, going from wide tile at the eave of the roof to progressively narrower tile toward the ridge or peak.

In addition, a number of specially shaped pieces may be manufactured to serve specific functions. These may include ridge, hip, and valley tiles, which often are a different size or shape than the field tiles. These special tiles must be made to fit over the field tiles and can be made to fit the various angles found in ridges and hips.

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D. APPLICATION

5. TOOLS

OBJECTIVE OF ASSIGNMENT:

REFERENCES:

RELATED INFORMATION

INTRODUCTION: The tools a craftsman owns and uses in his trade tell a good deal about his attitude toward his trade and the quality of work he produces. If the tools are the correct ones, of good quality, and well cared for, the craftsman is probably one who takes pride in a job well done. If, on the other hand, his tools are of poor quality and poorly cared for, the craftsman is probably one who does a job, but that's about all he contributes to his trade. The apprentice should therefore begin to acquire the tools he will need and, once he has these tools, he should take proper care of them.

Even though practices vary throughout the country concerning the tools a journeyman is required to carry and those the employer must furnish, the workman should be familiar with all the tools he might be called upon to use. In this workbook, the tools most generally furnished by the journeyman are listed and described in this topic. The equipment usually supplied by the employer is discussed in the topic that follows.

Basic Tools: The roofer should first acquire the basic tools, then add the others as he finds use for them. His goal should be to have a complete kit of well-kept, quality tools.

The basic tools of the roofer include the following:

Tool bag.

Web belt and leather nail pouch that is approximately 8" square.

Hammer. A 16-oz. hammer with straight claw and steel shaft.

Utility knife, also known as a fiberboard knife.

Small 8" crescent wrench.

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Medium-size screw driver.

18" tin snips, also called combination snips.

Roofing hatchet. This hatchet differs from a regular wood hatchet in that the blade (which is generally longer and thinner than that of a wood hatchet) is sharpened at one vertical edge as well as at the horizontal edge. This hatchet is used in almost all roofing processes.

> Safety precaution: Be sure the head of the hatchet is secure on the handle. When you drive nails with it, keep your head clear of the blade. Never strike hard metals with the blade end, because it may chip. When the hatchet is not in use, keep the blade shielded.

Roofing knife. Also known as a grape pruner's knife, it is similar in appearance to a linoleum knife, but the blade of the grape pruner's knife is thinner, which makes it easier to pull through the material being cut.

Pointing trowel. A must for applying mastics around vents and for pointing up around three-course flashing. The experienced roofer frequently has three sizes of this kind of trowel in his tool kit. The small trowel is used for mastic, medium size for most tile work, and the larger one for laying large quantities of tile. The points of the trowels are generally rounded before the trowels are used. Trowels should be kept clean at all times and never stored until cleaned.

Putty knife.

Small can or similar container. This can be used for:

1. Extra shoe laces
2. Faucet handle
3. Assorted screws and bolts
4. Knife blades
5. Shingler's gauges. These are clamped or screwed on the hatchet to gauge the exposure of shingles.
6. Book matches

Proper clothing. Well chosen, proper clothing is the mark of the professional. The roofer needs high-top shoes, several work shirts and pants, a hard hat and leather gloves. (See safety rules, Topic A.)

STEEP ROOFING METHODS

NAME _____ DATE _____

General Tools: The following tools, commonly used in the building trades, are particularly important to the roofer:

Measuring tapes. Cloth tapes are generally preferred by roofers because they cannot be kinked, weigh less than metal tapes, and will follow the contours of a roof.

Rules. The roofer uses both zig-zag and push-pull types.

Hacksaw.

Handsaw. A 26" blade is commonly used.

Cold chisel.

Side-cutting or diagonal-cutting pliers. Used mostly for cutting tile ties and tie wires.

Levels. Metal levels in various lengths are commonly used. A line level is also used.

Chalk-line reel. Used to snap straight lines on decks, felts, and walls. A powdered chalk, available in several colors, is contained in the reel canister.

Framing square or steel square.

Wing dividers. Used in making layouts for roof tile.

Hand drill.

Other roofing tools: The following are the more specialized tools used by the roofer on his job:

Tile pincers. Also called nippers, these are used for cutting or nipping off chips of roofing tile.

Shingle and slate ripper. Used for pulling nails and for removing shingles of slate.

Tile pick. A pick designed for cutting tile which may also be used to make new holes for nails and drains.

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

A. INTRODUCTION

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to define waterproofing and dampproofing and explain the differences.

REFERENCES:

RELATED INFORMATION:

Waterproofing: Waterproofing is employed to prevent water under pressure from entering the building or to resist the rosive action of running water.

Membrane Waterproofing: Membrane Waterproofing provides a continuous blanket which seals the entire area of the surface protected. It consists of a strong and elastic fabric or felt membrane mopped on with coal-tar pitch. It is applied to the water side of the construction to be protected. The water pressure pushes the membrane against the walls and floors and thus tends to preserve the contact between the membrane and the construction.

Dampproofing: Dampproofing is intended to render the surface of a material impermeable to water intermittintly present in small quantities and not amounting to a head of water pressure. It is therefore evident that while waterproofing is also naturally and inherently dampproofing, dampproofing can not be waterproofing.

Dampproofing generally consists of a water-repellent surface coating applied by brush, spray or trowel. A good dampproofing will penetrate into and fill the pores of a surface, is sufficiently elastic to conform to expansion and contraction, and is insoluble in and unaffected by acids or alkalis that may come in contact with it either in the water it is intended to repel ot the surfaces to which it is applied.

Through-Wall Flashing: Through-wall flashing, employing tarred fabric cemented with a flashing cement, is designed to prevent the penetration of intermittently present water through a wall or similar construction by diverting the direction of flow. It is essentially the same as dampproofing in principle, but differs in that dampproofing is generally an all-over surface treatment, while flashing is restricted to a vulnerable point.

Why Coal Tar Materials Should Be Used: The function of waterproofing and dampproofing is to protect masonry or concrete from attacks by water. The most important property that must be possessed by any waterproofing or dampproofing material is ability to resist prolonged contact with water. It cannot be assumed that all materials used for this work are actually resistant to water. True water-resistance is obtained with coal tar pitches. This is proved by

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

B. MATERIALS

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to describe coal tar pitch and list reasons for its use in waterproofing.

The apprentice will be able to describe fabric, and explain when it is used.

The apprentice will be able to describe felts, and explain when it is used.

The apprentice will be able to describe a protection course, and explain when it is used.

REFERENCES:

RELATED INFORMATION:

Pitch: Coal Tar Waterproofing Pitch is manufactured by distilling blends of coal tars to the proper consistency for waterproofing work. It is resistant to attack by termites, is self-healing and self-sealing if slight breaks occur in the pitch and it possesses a ductility which permits it to conform to irregularities in waterproofed surfaces.

Fabric: Open-mesh cotton fabric is thoroughly saturated with coal tar pitch by being passed sucessively through hot melted pitch and hot squeeze rolls. In Waterproofing Fabric, the cotton weighs not less than four ounces per square yard before treatment and no less than eleven ounces after treatment.

The finished fabric is sufficiently porous to permit the moppings of hot waterproofing pitch to seep through during the application of the waterproofing and become frimly anchored in place.

When To Use Fabric: Fabric has greater strength than felt and is especially effective where vibration or deflection is encountered. It is particularly recommended under heavily-loaded columns, on machine isolation and on railroad track isolation in buildings as well as on bridges, roadways, tunnels, etc. It is also used on waterproofing where no protection course is to be used. In corners, angles and on irregular surfaces, it can be applied without entrapping air, thus making a firmer bond.

Felt: Dry rag felt is produced by the "felting" of fibers of vegetable and animal origin. The dry felt is passed through a hot bath of coal tar and hot squeeze rolls. Tar-saturated felt increases in weight not less than 140% during saturation. The felt most frequently used in waterproofing weighs fifteen pounds per 108 square feet.

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

C. MEMBRANE WATERPROOFING

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to describe how membrane waterproofing is achieved, and list the steps used.

REFERENCES:

RELATED INFORMATION:

Preparation of Surface: All surfaces which are to be waterproofed shall be reasonably smooth and free from projections or holes which might cause puncture of the membrane. The surface shall be dry so as to prevent the formation of steam when the hot pitch is applied and, immediately before the application of the waterproofing, the surface shall be thoroughly cleaned of dust and loose materials.

No waterproofing shall be applied in wet weather or when the air temperature is below 35° F. unless vertical surfaces are heated and dried by salamanders, and horizontal surfaces are heated for one to two hours with a two-inch layer of hot sand. After the concrete is warm and thoroughly dry, the sand shall be swept back as work progresses.

Plies of Membrane Required for Different Water Pressures:

Head of Water in feet	Felt, Fabric, or Combined Felt and Fabric	
	Plies Required	Pitch Mopping Required
1-3	2	3
3-6	3	4
6-9	4	5
9-12	5	6
12-18	6	7
18-25	7	8
25-35	10	11
35-50	11	12
50-75	13	14
75-100	14	15

Application:

1. Beginning at the low point of the surface, thoroughly mop a strip of concrete with Waterproofing Pitch. This mopping and all succeeding moppings on the concrete surface shall cover the concrete so that in no place shall gray spots be visible. Immediately following the first mopping, press the first strip of fabric into the hot pitch so that it is smoothly and firmly bonded to the concrete.

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

All wall angles, corners or any place where, in the opinion of the engineer or architect, the waterproofing course may be subject to unusual strain there shall be applied on the water pressure side not less than two (2) additional reinforcement plies of fabric and mopping of pitch.

Insulate all hot water and steam pipes which project through or are near the surfaces to be waterproofed so as to prevent injury to the waterproofing. Extra plies of fabric and other precautions should be taken to prevent water from getting between the waterproofing and the waterproofed surface at all points where the membrane is penetrated by drains, pipes, etc.

Plies of Tar Saturated Fabric or Approved Tarred Felt	Alternate Moppings of Waterproofing Pitch Required	Pounds of Pitch Required to Complete Each 100 sq. ft. of Waterproofing
2	3	105
3	4	140
4	5	175
5	6	210
6	7	245

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

D. WOOD FLOOR WATERPROOFING

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to describe how wood floor waterproofing is achieved and be able to list the steps involved.

REFERENCES:

RELATED INFORMATION:

Lay over the entire surface two (2) thicknesses of red rosin paper (weighing not less than five (5) pounds per one hundred (100) square feet), lapping each sheet nineteen (19) inches over the preceeding sheet. Nail to hold in place.

Lay one (1) Thickness Approved Tarred Felt with two (2) inch side laps and six (6) inch end laps and nail as required to hold in place.

Mop entire surface with Old Style Pitch and into the pitch lap one (1) ply of Approved Tarred Felt with side laps of two (2) inches and end laps of six (6) inches. All laps shall be mopped so that in no place does felt touch felt. The entire surface shall then be mopped with pitch and the floor plank shall be embedded in the hot pitch.

At corners and angles two additional plies of felt shall be installed, alternately mopped and run up the wall, etc., not less than three (3) inches above the level of the finished flooring, where they shall be fastened securely and protected. The finished flooring shall be nailed to the embedded plank immediately. Nails of suitable length shall be used to avoid penetrating through planks into the waterproofing.

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

E. POURED CONCRETE FLOOR WATERPROOFING

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to describe how poured concrete floor waterproofing is achieved, and be able to list the steps involved.

REFERENCES:

RELATED INFORMATION:

Poured Concrete Floor Waterproofing: Lay over the entire surface two (2) thicknesses of Approved Tarred Felt, lapping each sheet nineteen (19) inches over the preceeding sheet, mopping the full width of the lap with Old Style Pitch so that in no less than seventy (70) pounds of pitch shall be used for completing the waterproofing on each one hundred (100) square feet of surface.

At all corners and angles two additional plies of felt shall be installed and mopped similarly and these shall be carried up the walls, etc., not less than three (3) inches above the level of the finished flooring where they shall be fastened securely and protected. The finished flooring shall be installed immediately.

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

F. SPANDREL AND WALL WATERPROOFING

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to describe how spandrel and wall waterproofing is achieved, and be able to list the steps involved.

REFERENCES:

RELATED INFORMATION:

Spandrel and Wall Waterproofing: Every building of masonry construction should have adequate flashings built through the walls to impede the movement of spandrel beams, reinforcing steel, steel window and door frames against corrosion. Coating the interior surfaces of all exterior walls with Waterproofing Pitch or Dampproofing Paint produces a moisture-repellent film between the structural walls and furring.

In all places where spandrel waterproofing is detailed two (2) plies of Tarred Fabric set in two (2) trowel coating of Plastic Cement shall be constructed. All flashing shall terminate one-half (½) inch from wall exteriors.

The interior surfaces of all exterior walls shall be brushed or sprayed with Concrete Priming Oil, using one (1) gallon for each two hundred (200) square feet. Eight (8) to twenty-four (24) hours later the well primed surfaces shall be mopped with Waterproofing Pitch. Two (2) coatings using a total of thirty (30) pounds of pitch for each one hundred (100) square feet shall be applied, permitting the first coating to cool before applying the second.

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

G. DAMPPROOFING – PITCH METHOD

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to list the steps used in the Pitch Method for dampproofing and termite proofing.

REFERENCES:

RELATED INFORMATION:

Uses: For all brick or concrete foundations and abutments where backfill will be used.

Application: The surfaces should be free from all dirt. All cracks should be thoroughly wetted with water and then filled with Portland Cement Mortar.

1. Over the entire surface to be dampproofed, apply a uniform brush coat of Concrete Priming Oil. Approximately one (1) gallon should be used for each one hundred (100) square feet.

2. Apply a mopping of Waterproofing Pitch. Approximately twenty-five (25) pounds per one hundred (100) square feet shall be used and the pitch shall be heated to a temperature at which it is entirely liquid, but this temperature shall not exceed three hundred and seventy-five (375) degrees F.

3. A second mopping of Waterproofing Pitch shall then be applied over the entire surface of the first mopping. Approximately twenty-five (25) pounds per one hundred (100) square feet shall be used so that the entire amount of pitch applied shall amount to a total of approximately fifty (50) pounds per one hundred (100) square feet.

4. The permanent back-fill shall be tamped into place immediately after the last mopping is applied.

5. For additional protection against termites, coal tar pitch seals shall be provided at all places where floor slabs join foundations walls and between adjacent slabs. Seals shall be completely filled with Waterproofing Pitch. Also 20 ounces copper shields set in Plastic Cement shall be installed on top of all foundation walls.

NOTE: Use Membrane Waterproofing when a head of water is encountered.

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

H. DAMPPROOFING – COLD APPLICATION METHOD

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to explain when and under what circumstances the cold application method is used.

The apprentice will be able to list the steps to be followed when using the cold application method to dampproof dense concrete, porous concrete, and precast concrete.

REFERENCES:

RELATED INFORMATION:

These treatments are used particularly for dampproofing foundations, bridge abutments, basement and retaining walls, culverts, reservoirs, dams, sumps, pits, vats, tanks, and sewage disposal plants. On reinforced concrete these treatments also give added protection to the reinforcing steel.

Specifications for Dense Concrete: Where concrete is dense and smooth-surfaced, the application of two coats of Bitumastic No. 50 provides protection against moisture and the acids and alkalies formed to soil and cinder fill. Bitumastic No. 50 is applied cold, by brush or special spray equipment, bonds tightly and does not run or sag on vertical surfaces, even when applied as heavily as 1/16 inch in multiple coats.

Application:

1. Remove all dirt, dust grease, oil and laitance; if surfaces are steam cleaned or flushed with water, allow to dry thoroughly.

2. Apply one coat of Bitumastic No. 50 by brush or spray (alemite Versatal Pump or equivalent) over entire surface to be protected. Apply heavily at rate of no more than 40 to 50 sq. ft. per gallon.

3. Allow 24 hours drying time.

4. Apply a second coat of Bitumastic No. 50 at the rate of 40 to 50 sq. ft. per gallon.

5. Allow 48 hours minimum drying time before backfilling.

Specifications for Porous Concrete: Primer and Seal Coat are used. Primer penetrates the surface of the concrete making it water repellent. Seal Coat seals the surface, thus protecting it from erosion.

WATERPROOFING & DAMPPROOFING

NAME _____ DATE _____

I. DAMPPROOFING – SUB-FLOOR

OBJECTIVE OF ASSIGNMENT: The apprentice will be able to describe how tar is used in sub-floor dampproofing.

REFERENCES:

RELATED INFORMATION:

Uses: In basements where the ground is damp and it is desired to use a wood finish floor, an effective dampproofing is necessary.

Specifications: The earth should be leveled off to proper grade. If earth or cinder fill is used it should be puddled and rolled or tamped to thoroughly compact it. The sub-base may be either a cement-concrete slab installed in the usual way, or a slab of No. 2 Sub-Floor Tar Concrete. A cubic yard of crushed stone or gravel passing a 2¼ inch sieve but retained on a ¼ inch sieve is mixed with approximately 10 gallons of No. 2 Sub-Floor Tar which has been heated. This should be thoroughly rolled or tamped and brought to accurate grade.

The dampproofing course is placed over the slab. One cubic yard of clean torpedo sand is heated (210° to 250°F.) and mixed with 25 to 30 gallons of No. 1 Sub-Floor Tar at the same temperature. The mixture is spread evenly over the slab to a thickness of from 1¼ inches to 1½ inches and leveled with a straightedge.

Well dried or treated planks are laid on this soft mixture before it cools and bedded by hammering, so that the coating compacts to a thickness of 1 inch. If any plank is hammered below level, it is raised and more of the mixture applied beneath it. After the planks have been brought to proper level they are toenailed together.

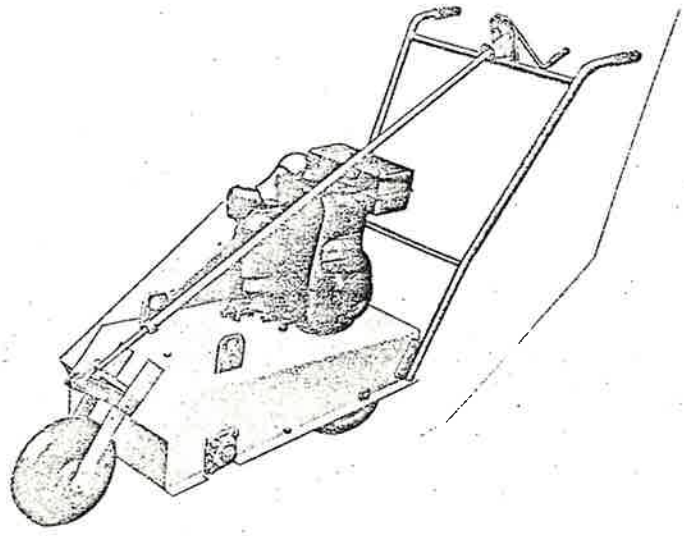
The sub-floor planks are preferably pressure-treated with coal tar creosote meeting the Grade 1 specifications of the American Wood Preservers' Association. In food factories, creameries, etc., where the odor of creosote might be objectionable, the planks should be treated with a suitable salt preservative such as a zinc chlorid or Wolman salts. Planks to be creosoted should be dried before treatment. When a salt preservative is used, the planks should be dried after treatment, whether or not they were dried before treatment.

The finished floor is then laid at right angles or diagonal to the planks in the usual manner.

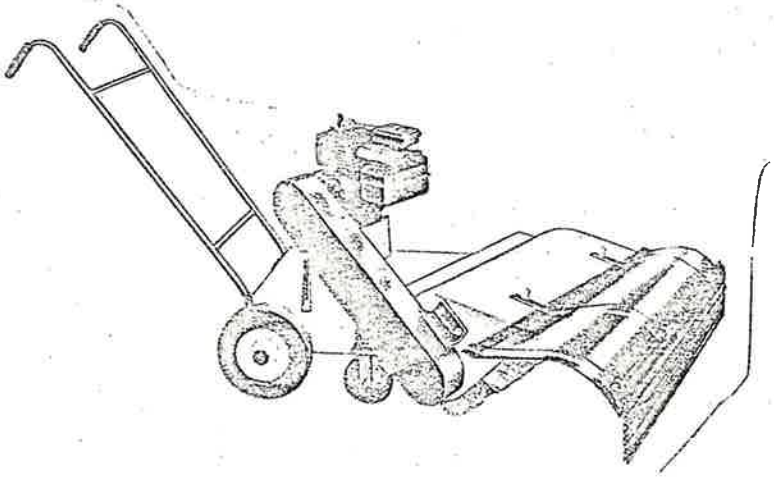
TOOLS AND EQUIPMENT

NAME _____ DATE _____

GRAVEL SCRATCHER AND CUTTER

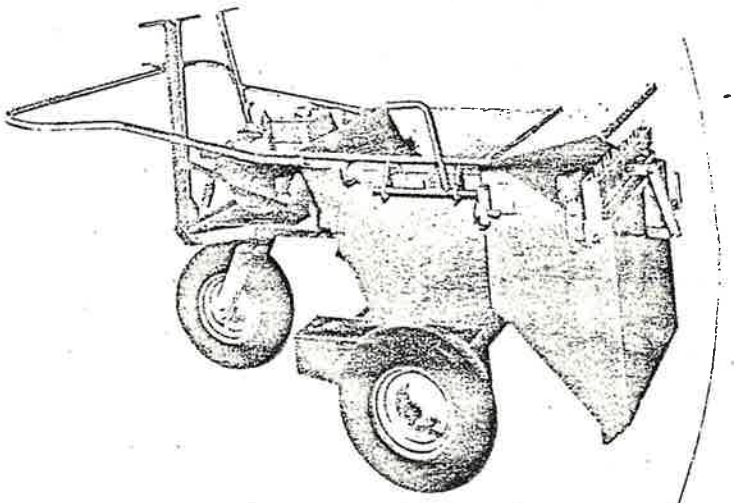


ROOF SWEEPER

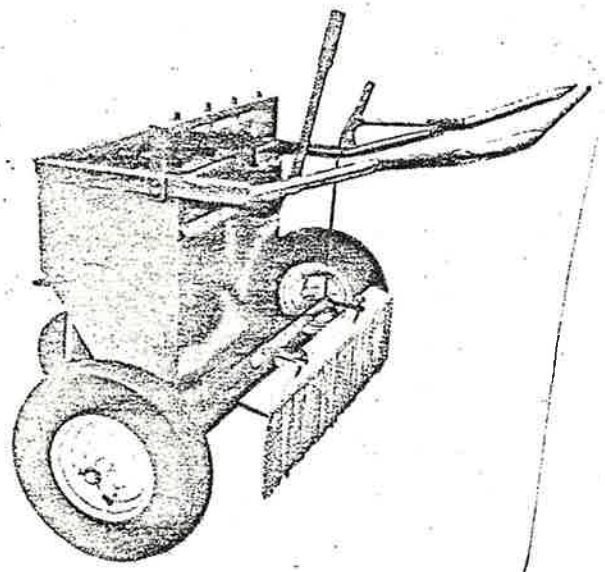


TOOLS AND EQUIPMENT

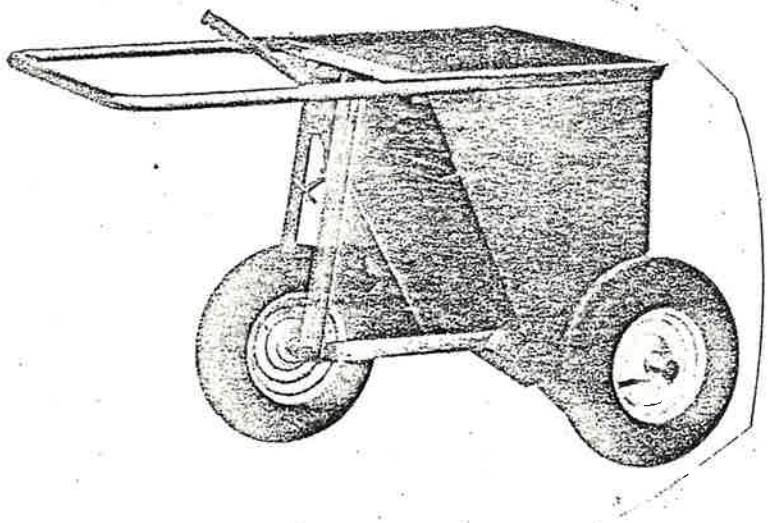
NAME _____ DATE _____



COMBINATION GRAVEL SPREADER AND DISPENSER



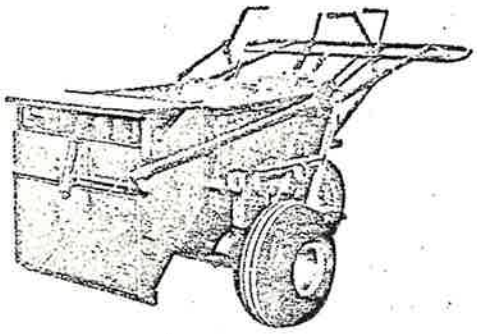
"HOT STUFF" DISPENSER



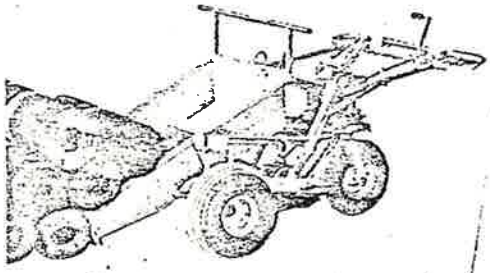
GRAVEL SPREADER

TOOLS AND EQUIPMENT

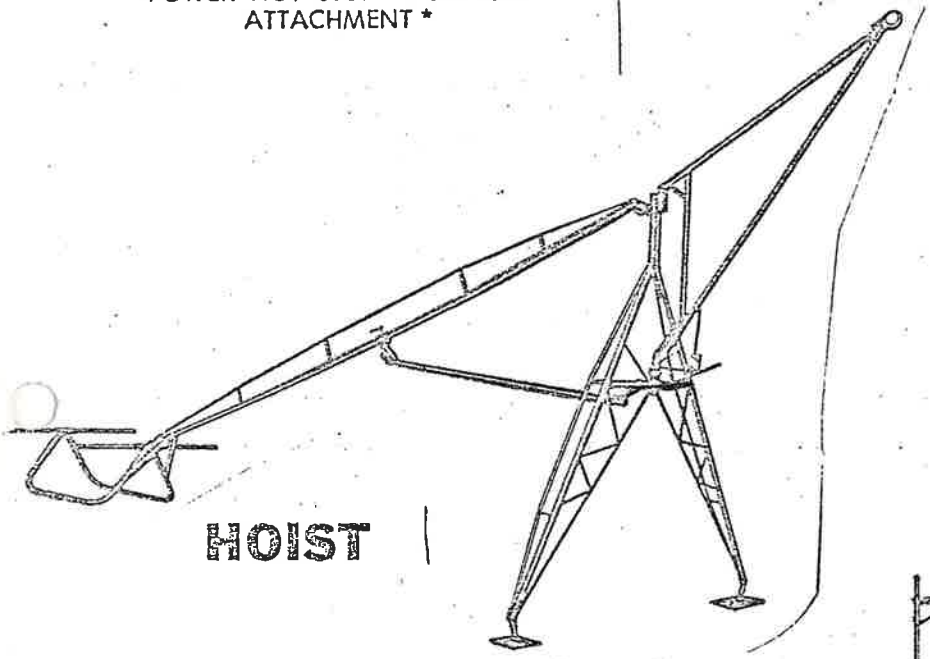
NAME _____ DATE _____



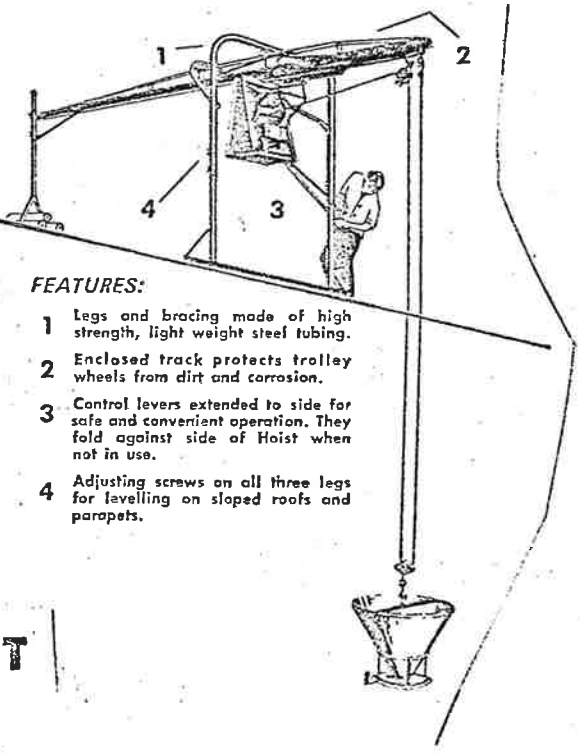
POWER HOT STUFF DISPENSER ATTACHMENT *



RUBBISH AND GRAVEL CARRIER . . DUMPS OVER PARAPET WALLS . . .



HOIST



FEATURES:

1. Legs and bracing made of high strength, light weight steel tubing.
2. Enclosed track protects trolley wheels from dirt and corrosion.
3. Control levers extended to side for safe and convenient operation. They fold against side of Hoist when not in use.
4. Adjusting screws on all three legs for levelling on sloped roofs and parapets.

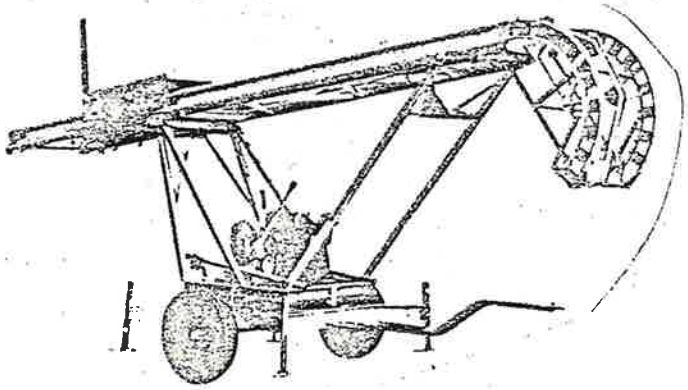
TROLLEY TRACK HOIST

TOOLS AND EQUIPMENT

NAME _____ DATE _____

TOP CURVED LAD-E-VATOR

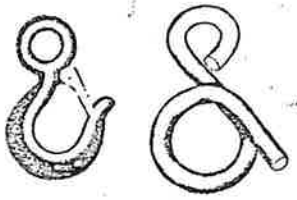
With Telescoping Booms



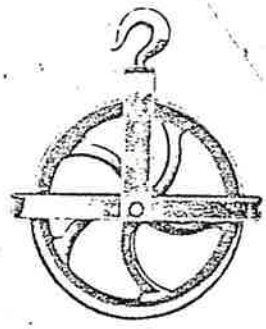
TOOLS AND EQUIPMENT

NAME _____ DATE _____

BUCKETS & HOOKS

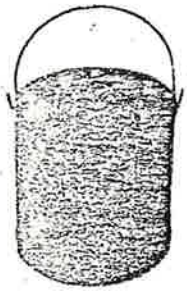


SAFETY BUCKET HOOKS



HOISTING WHEELS

BLACK IRON PAILS

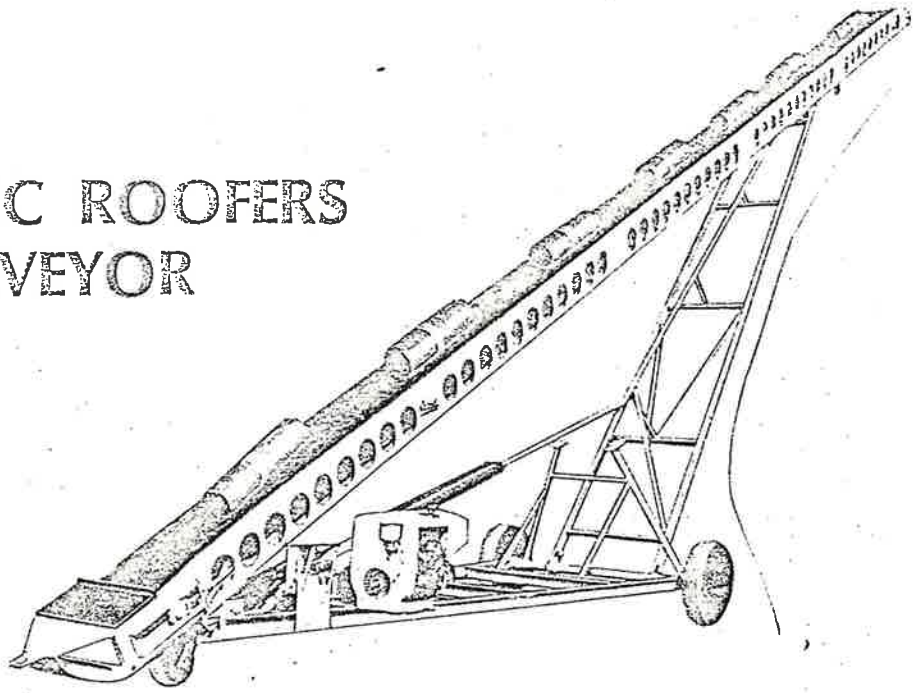


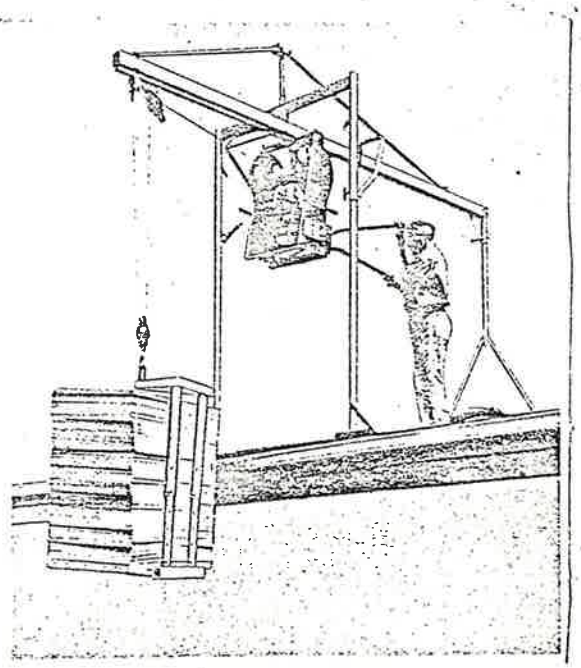
BUCKETS

TOOLS AND EQUIPMENT

NAME _____ DATE _____

HYDRAULIC ROOFERS CONVEYOR

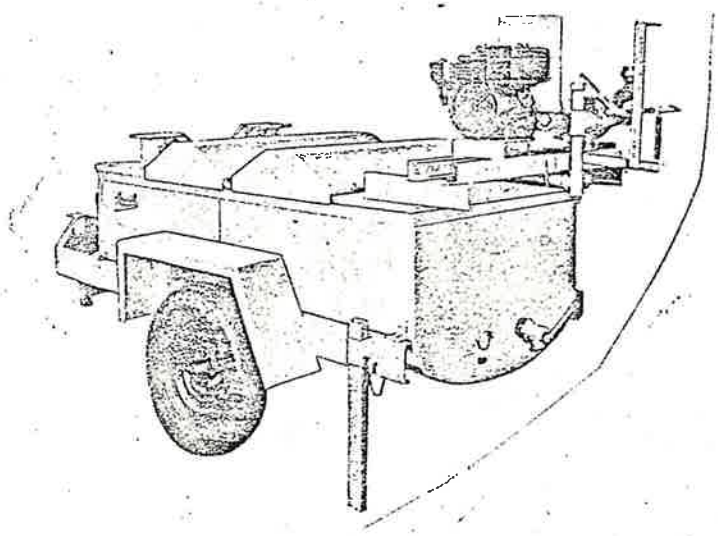




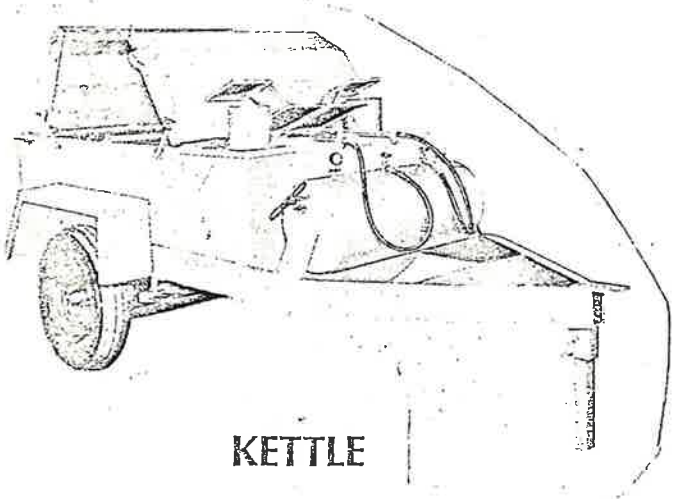
MONORAIL HOISTS

TOOLS AND EQUIPMENT

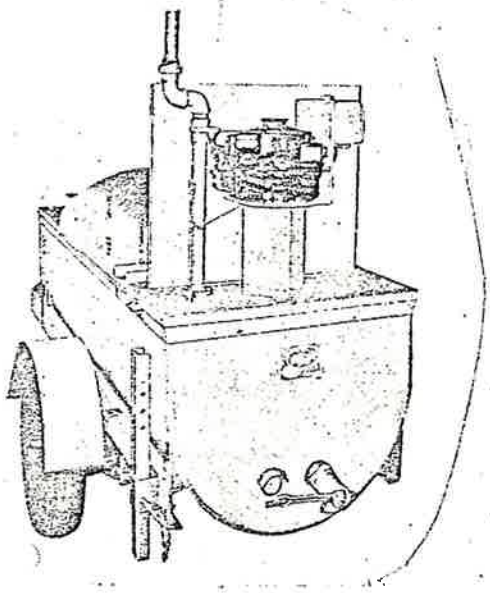
NAME _____ DATE _____



GEAR TYPE SINGLE LINE PUMP SYSTEM



KETTLE

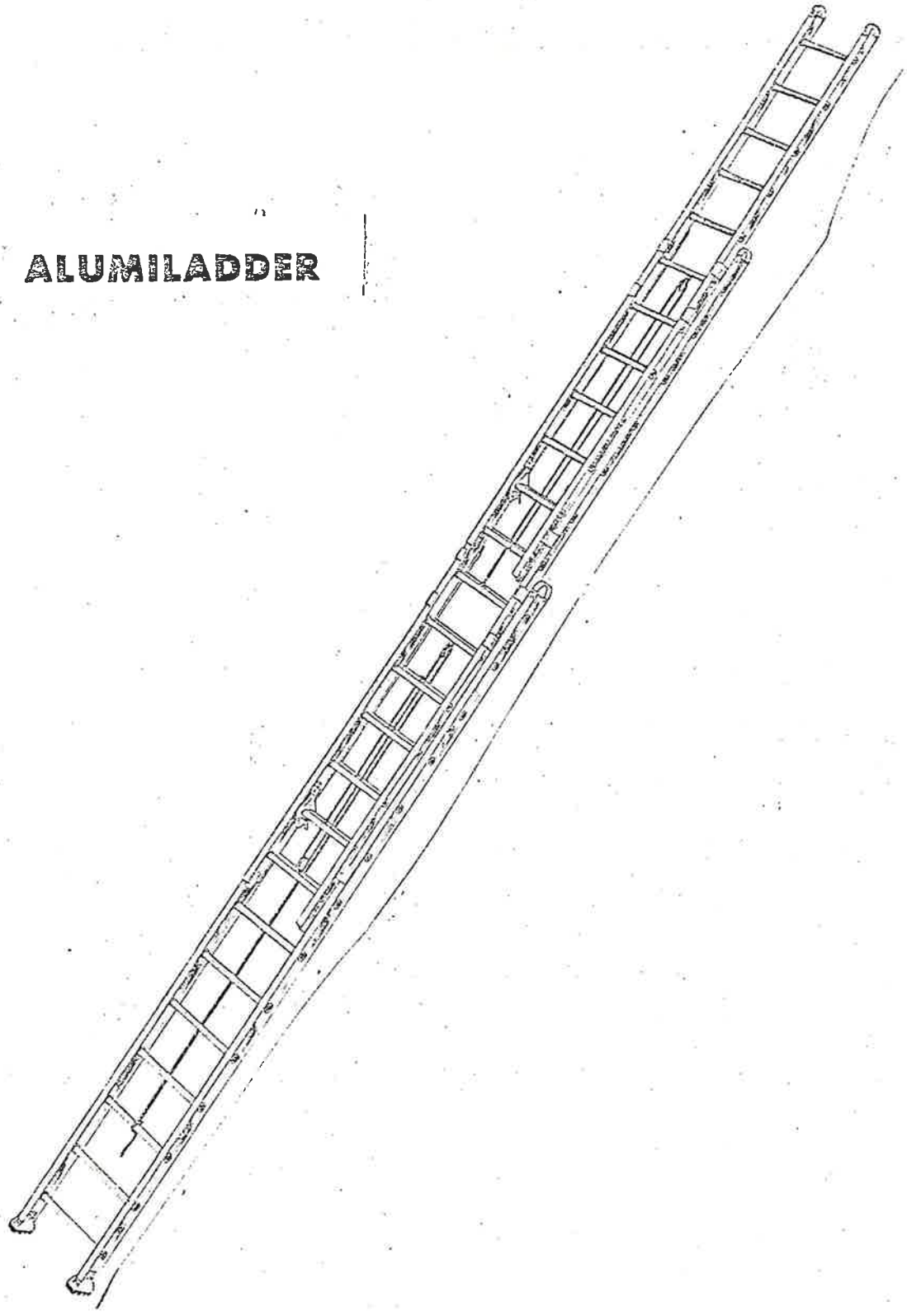


CENTRIFUGAL KETTLE PUMP

TOOLS AND EQUIPMENT

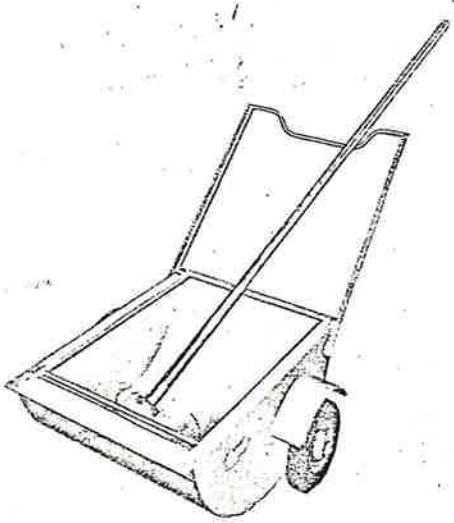
NAME _____ DATE _____

ALUMILADDER

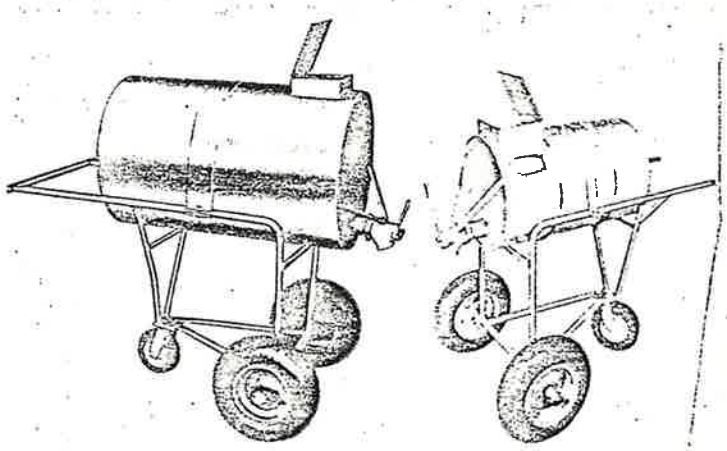


TOOLS AND EQUIPMENT

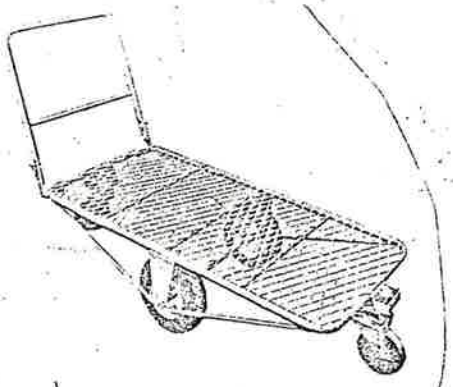
NAME _____ DATE _____



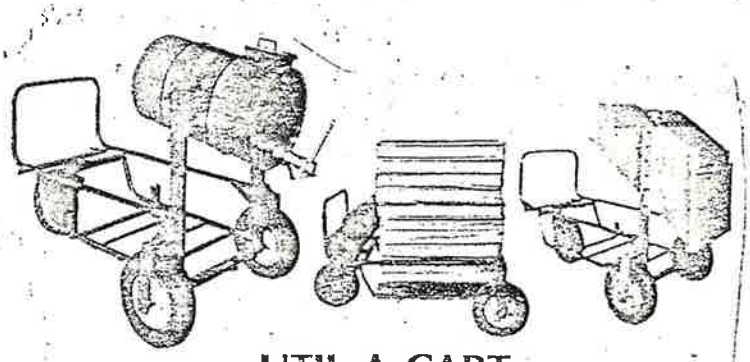
DELUXE MOP CART



DELUXE HOT LUGGERS



ROOFERS CART

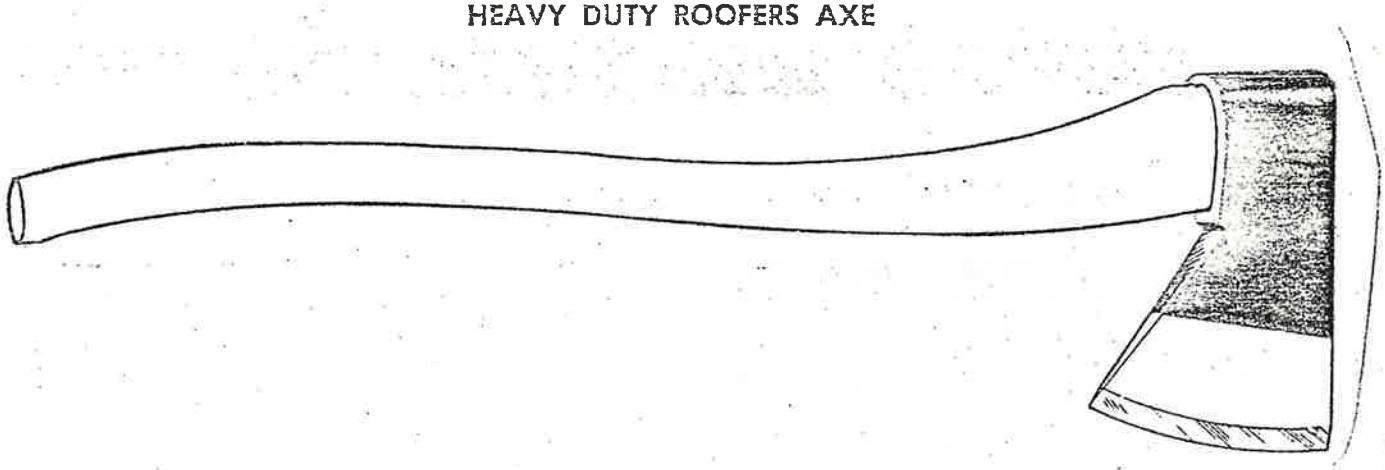


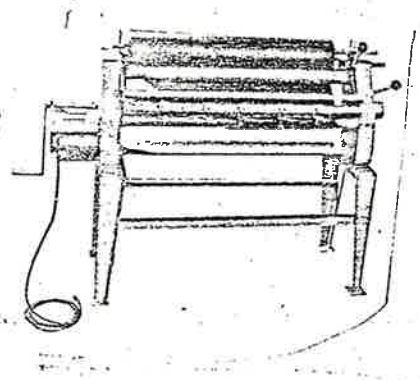
UTIL-A-CART

TOOLS AND EQUIPMENT

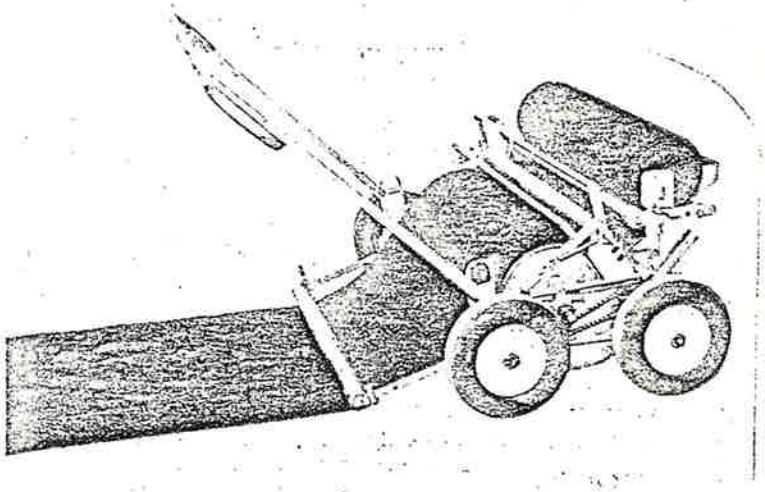
NAME _____ DATE _____

HEAVY DUTY ROOFERS AXE





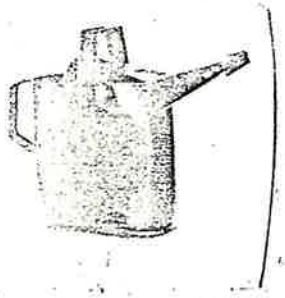
FELT SLITTER



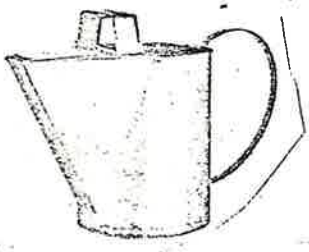
BASE SHEET APPLICATOR

TOOLS AND EQUIPMENT

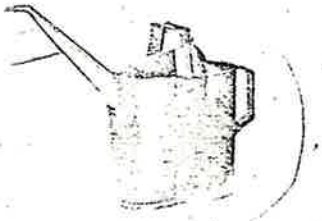
NAME _____ DATE _____



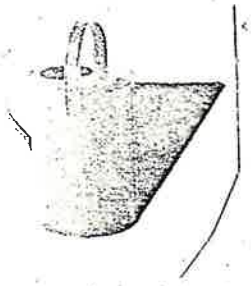
SHEET POURER



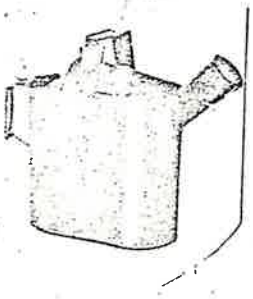
CHIP SPREADER



BRICK-JOINT FILLER

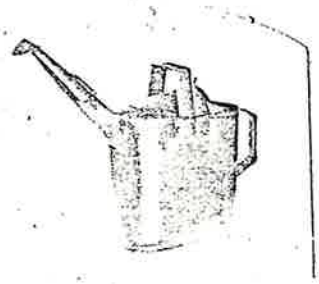


UTILITY POT

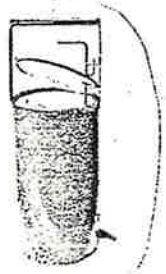


SPRINKLER POT

SPECIAL SHEET POURER



EMULSION SPREADER



INSULATED CRACKFILLER

GLOSSARY

Glossary of Roofing and Architectual Trade Terms

The definitions of terms included in this glossary are those that are pertinent to the roofing trade and are not necessarily those found in standard dictionaries. Some of the terms are colloquial in nature and are found with the meanings given only in the roofing trade.

A - Frame	A portable frame built in the shape of a letter "A" and used by roofers to hoist materials.
Alligatoring	Shrinkage cracking of the bituminous surface of built-up roofing, or the exposed surface of smooth-surfaced roofing, in which the loss of volatile oils under solar radiation produces a pattern of deep cracks with the scaly look of an alligator's hide. It occurs only in unsurfaced bitumen exposed to weather.
Angle	The figure formed by the meeting of the wall and roof, or the meeting of two walls.
Apex	The point, tip, or summit of anything; in roofing the highest point of any roof or structure.
Applications	The act of applying or putting on a roof.
Arch	A curved or pointed structural member, which is supported at the sides or ends; to "arch" means to cover with a curved structure or to form a bent top or covering.
Architect	One who plans or designs buildings.
Architecture	The art or science of building; the style of building.
Area	A flat surface or space having bounds.
Asbestos	A fibrous, non-combustible material.
Asphalt	A brownish black, natural bituminous mixture consisting mainly of hydrocarbons and used in applying roofing.
Asphalt Mastic	A mixture of asphaltic material, graded mineral aggregate, and fine mineral matter that can be poured when heated, but requires mechanical manipulation to form.

B.T.U.	British Thermal Unit. The heat energy required to cause one pound of water 1° F. in temperature.
Buckles	Roofing that has bent, crumpled or curled.
Building Code	Building rules and govermental regulations.
Built-Up Roofing	Roof formed by a number of layers of roofing mopped together with hot asphalt or pitch.
Burner	An apparatus that emits flame used to heat a kettle or to dry off roofs.
Butt	Short length of material; the unused or end portion of a roll of roofing.
Butler	To smooth on plastic with a trowel.
Butt Joint	Two pieces of roofing material fitted squarely against each other without overlapping.
Cable	A heavy rope or chain.
Canopy	An overhanging covering.
Cantilever	A beam that is held firmly at one end and that projects from its support.
Cant Strips	Triangular shaped material installed in the angles on a roof deck.
Canvas	A heavy, strong cloth used for roofing decks.
Capsheet	A finished roofing material, used as a covering for a roof.
Caulk	To make water tight by plugging with plastic.
Chalk Line	A heavy string or cord used for lining purposes.
Chicken Ladder	A lightweight ladder used to hang over the ridge on steep roofs.
Circumference	The perimeter of a circle; a line that bounds a circular plane surface.
Cleat	A strip of wood or metal fastened across other materials for additional strength; may be nailed against the wall for supporting an object.

Crowbar	A long, heavy steel bar, pointed or wedge shaped at the working end.
Cupola	A small, hemispherical dome structure above the roof.
Curb	A protective rim.
Cured	Completely dry; moisture free.
Cutback	Asphalt "cutback", or dissolved into its liquid form.
Cut Nails	Nails, rectangular in section, cut by machines from sheet metal.
Cut Off	A detail designed to precent lateral water infiltration into the insulation where it terminates at the end of the day's work. A felt strip is hot-mopped to the stepped contour of the deck, the insulation edge, and the horizontal insulation surface.
Damp Proof	The application of coating of hot or cold bitumens or the use of membranes to keep out dampness.
Dead Level	Absolutely horizontal, or absolutely level.
Debris	Accumulated rubbish, trash, and fragments of roofing.
Deck	The roof surface to be covered; a small platform used for walking.
Derrick	A framework, with a long beam, ropes, gear and pulleys, used for hoisting heavy weights.
Detail	One of the many minor parts into which a building may be divided.
Delamination	A built-up roofing membrane failure characterized by separation of the felt plies, sometimes resulting in wrinkling and cracking.
Dew Point	The temperature at which water vapor starts to condense in cooling air, with no change in atmospheric pressure or vapor content.
Diagonal	Crossing obliquely: running across from corner to corner.

Emulsion	An emulsified asphalt used in damp proofing and roof coating mixed with water. After drying, the asphalt remains.
End Lap	The material lapped at the point at which the ends of two pieces of roofing materials are joined.
Envelope	The continuous edge formed by folding an edge base felt over the plies above and securing it to the top felt or, if above-deck insulation is used, to the top surface of the insulation. The envelope thus prevents bitumen drippage through the exposed edge joints of the laminated, built-up roofing membrane and also prevents lateral water infiltration into the insulation.
Expansion Joint	A metal flashing installed on a roof to compensate for expansion and contraction.
Exposure	The portion of roofing exposed to the weather.
Fabric	Cotton or glass cloth saturated with asphalt.
Fallback	A reduction of bitumen softening point, sometimes caused by mixing asphalt with coal-tar pitch or overheating the bitumen.
Felt (dry)	A roofing material manufactured from cellulose fibers of rags, paper and wood.
Fiberboard	A tough substance that is separated into threads and spun or woven.
Fiber	Wood pulp moulded into a sheet used for insulation.
Firewall	A wall erected above the roof to block fires between two roofs also called a parapet wall.
Fishmouth	An opening formed by an edge wrinkle in a felt where it overlaps another felt in a built-up roofing membrane.
Flashing	Sheets of metal used to make water tight joints in roofs; also resilient materials installed by the roofer.
Flashing Cement	A trowelable, plastic mixture of bitumen and asbestos (or other inorganic) reinforcing fibers, and a solvent.

Hand Line	A rope used by hand to hoist light loads.
Hanger	A metal strap used to secure or hang gutter among the eaves.
Hatch	An opening in the roof; an access hole in the roof.
Header	Sheets of roofing laid around openings or paralleled with the wall or edges of the roof.
Hexagon	A figure with six sides.
Hexagonal Shingle	A composition shingle with six sides.
Hip Roof	A roof having sloping ends and four sloping sides. The line where adjacent sloping sides meet is called a hip.
Hoist	A hoisting machine; to pull up.
Holiday	A space or spot on the roof that is missed or un-mopped.
Horizontal	In the direction of or paralleled to the horizon.
"Hot", "Hot Stuff"	A term used for asphalt or tar after it has been heated.
Hypalon	A synthetic rubber (chemically chlorosulfonated polyethylene), often used in conjunction with neoprene in elastromeric roof coverings. (Hypalon is a registered trademark of E.I. du Pont de Nemours and Co.)
Imbricated	Overlapped in regular order, as is done with shingles.
Implement	An article of equipment such as an instrument or tool.
Impregnate	To cause to be filled or permeated with; to saturate.
Incline	A slope; a sloping surface.
Insulation	A material to prevent the passage of heat; also used to reduce fire hazard.
Inverted	In an opposite position or turned upside down.

Marquee	A covered roof extending out from a building.
Mastic	Thick adhesive mixture of bituminous preparations such as asphalt used for repairing roofs.
Membrane	An asphalt-impregnated fabric; a material for flashing.
Metal Edging	A metal trim used around the outside edges of a roof.
Mineral Granules	Natural or synthetic aggregate ranging in size from 500 microns to 1/4 in. diameter, used to surface cap sheets, slate sheets, and shingles.
Mission Tile	A curved tapering tile unit.
Monitor	A small tower arising from the roof of a factory or other buildings, with windows or louvers or both.
Mop Yarn	A material of cotton or glass used to make roofing mops.
Mopping	An application of bitumen applied hot with a mop or mechanical applicator to the substrate or to the felts of a built-up roofing membrane. Solid Mopping: A continuous mopping surface with no unmopped areas. Spot Mopping: A mopping pattern in which the hot bitumen is applied in roughly circular areas, generally about 19 in. in diameter, with a grid of unmopped, perpendicular bands. Strip Mopping: A mopping pattern in which the the hot bitumen is applied in parallel bands, generally 8 in. wide with 4 in. unmopped spaces. Sprinkle Mopping: A random pattern of heated bitumen beads hurled onto the substrate from a broom or mop.
Mortar	A mixture of sand and lime, or cement and water.
Moulding	A cornice or projecting decorative member used on any part of a building.
Mud	A colloquial term used for mortar.
Muslin	Asphalt impregnated fabric.

Pitch	The slope of a roof, indicated by the relation of the rise to the span; also a coal tar roofing material.
Pitch Pan	A metal pan filled with pitch or mastic set in hot pitch to waterproof around sign supports, or angle irons and plumbing pipes.
Plans	Drawing showing the proportion and relations of parts of a building.
Plaster Bond	Dampproofing material to be sprayed or brushed on masonry and basement walls before plastering.
Plastic Cement	Waterproofing material, composed of coal tar, asbestos fibers, etc.
Plate	A horizontal timber laid on a wall to receive a framework.
Plumb	True as indicated by a plumb line; upright, vertical or perpendicular.
Ply	Layers of thicknesses of roofing material; for example, four-ply roofing consists of four layers of roofing mopped together.
Ply Stick	Stick used in application of roofing felts to obtain proper lap and exposure.
Portal	An entrance way, especially one that is grand and imposing.
Porte-Cochere	A carport that is attached to a building.
Portico	An open space with roof upheld by columns often attached to a building.
Pot	Roofing kettle.
Precast	Cast beforehand, as precast gypsum roof slabs.
Primer	A thin asphalt base sprayed or brushed on roof before applying asphalt.
Protective Curtain	Heavy, smooth capsheet, nailed at top edge and left hanging loose, on exterior basement walls to protect waterproofing membrane when back-filling.

Rolling rod	A pipe or rod used to hold a roll of roofing.
Roll Rfg.	Coated felts, either smooth or mineral-surfaced.
Roofing	Roofs collectively; materials for roofs; the act of covering a roof.
Roofer	The roofing subcontractor.
Rot	Decay that attacks wood. The two major types are dry rot and wet rot.
Run	The horizontal distance that a rafter, a step, a brace.
Rung	A cross strip, as a chair or ladder.
Rust	A reddish matter formed on iron or steel, due to dampness.
Saddle	A water diverter located behind a chimney. (Sometimes referred to as a cricket.)
Saddle boards	Ridge boards; two boards, one lapped over the edge of the other to form the finish at the ridge.
Sag	To bend or cause to bend downward, especially in the middle of the roof.
Salamander	A white top asbestos roll roofing; usually called white top.
Saturate	To soak thoroughly.
Saturated felt	A felt that has been impregnated with bitumen of low softening point - 100 to 160° F.
Saw tooth roof	A roof built in the shape of saw teeth; the vertical position is well supplied with sash to admit light.
Scab	A cleat nailed over a joint, etc.
Scaffold	A temporary elevated structure for the support of workmen, materials, etc., during the construction of a building.
Scar	An indentation or mark made on roofing.

Slip Sheet	A light sheet of paper applied over roof sheathing to prevent the roofing from bonding to sheathing, may be called dry sheet.
Slit	To make a long incision; to cut lengthwise into strips.
Slippage	Relative lateral movement of adjacent felt plies in a built-up membrance. It occurs mainly in sloped roofing membranes, sometimes exposing the lower plies, or even the base sheet, to the weather.
Slope	See "pitch" above.
Smooth Surface Roof	A built-up roofing membrane surfaced with a layer of hot-mopped asphalt or cold-applied asphalt-clay emulsion or asphalt cutback, or sometimes with an unmopped inorganic felt.
Soffit	The under side of a beam, lintel, archway, cornice or stair.
Softening Point	An index bitumen fluidity. Asphalt softening point is measured by the "Ring-and-Ball" test (ASTM D2398). Coal-tar pitch's softening point is measured by the "Cube-in-Water" test (ASTM D61).
Solder	Equal parts of tin are used to join or patch metal.
Span	A space or distance between supports; in roof framing, the width of the frame between the outside edges of the building.
Solid Mopping Split	See Mopping.
Specifications	Written information augmenting plans for a building.
Spigot	A turning plug or faucet for drawing asphalt from the kettle.
Spire	A tapering or pyramidal roof of a tower; a pinnacle, a steeple.
Splice	To unite in such a way as to form one continuance, to join two ropes or parts of a rope by intertwining the strands.

Tar	A by-product of coal; may be referred to as coal tar.
Tedlar	Polyvinyl fluoride, used as a film surfacing in elastomeric membranes. (Tedlar is a registered trademark of E. I. du Pont de Nemours & Co.)
Template	A pattern or guide of wood or metal used for shaping or marking work.
Terra Cotta	A species of hard pottery used for building tile, etc.
Thatch-On	A type of interlocking shingle; a method of laying a shingle.
Thermal Shock	The stress-producing phenomenon resulting from sudden temperature changes in a roof membrane, when, for example, a rain shower follows brilliant sunshine.
Thick Butts	Same as square butt shingles.
Tile	A thin piece of baked clay used for covering roofs.
Tile Picks	A sharp pointed hammer used to pick holes in tile units.
Tile Strip	Wood strips used for nailing tile on top of roofing.
Tile Tye	A heavy braided wire, or flat metal strip, used in securing tile to the roof.
Tin Caps	A tin flat disc, used to nail through, giving greater holding area to the nail head. Used in windy areas.
Tin Snips	Cutters used for cutting light metal.
Toe Board	A protective board placed on a sloping roof to prevent workmen from slipping or falling.
Toenail	A nail driven obliquely to hold the foot of a stud or brace, also to draw boards into place.
Trowel	A flat, bladed instrument having an offset handle that is paralleled with the blade.
Truss	A braced framework over long spans such as found on large roof or bridge construction, also to brace or support by a truss.

Vermiculite	An aggregate used in lightweight insulating concrete, formed by heating and consequent expansion of mica rock.
Wall Insulating	Applying various materials to walls for the purpose of separating non-conductors from conductors.
Wash Back	Pyramid like structure on a roof provided to direct water to a drain.
Waterproof	Making impervious to water by use of membranes; also the material used in the process.
Water Table	A strong course moulding to throw off water.
Waveline	Line on edge of asbestos cement shingles.
Weeper	A small opening or hole at the base of a skylight to permit the escape of water or moisture collected inside the skylight.
Whetstone	A stone for sharpening cutting tools.
Winches	Hoists used for hauling or hoisting materials to the top of the roof.
Z Bar	Metal flashing especially used on walls where roof, plaster or wood siding meet.
Zone	A division of a certain political subdivision into districts that may have different building regulations.

MATH SYMBOLS & FORMULAS

SYMBOLS:

The use of the various mathematical symbols must be understood before the apprentice can complete many of the required jobs.

Mathematical signs:

+ means to add, thus 2 + 2 = 4
= means equals
– means to subtract, thus 2 – 2 = 0
x means to multiply, thus 2 x 4 = 8
/ or ÷ means to divide, thus 4/2 or 4 ÷ 2 = 2

Letter Symbols:

a = Altitude
A = Area
b = Base
C = Circumference
d = Diameter
h = Height
l = Length
p = Perimeter
R or r = Radius
S = Side
W = Width
π = Pi, a Greek Letter = 3.1416

Grouping Symbols:

When we must treat a group of numbers as a whole number, we use special grouping symbols to avoid confusion, such as:

() Parentheses (3+2) x (4+7) = 55

{ } Braces {(3+2) x (4+7)} + 5 = 60

[ ] Brackets [{(3+2) x (4+7)} + 5] – (2+7) = 51

FORMULAS:

A formula is a mathematical rule expressed by means of signs, letters, and symbols. Some common mathematical formulas are:

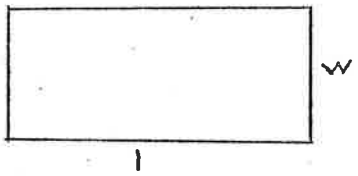
5. 

Area of a square.

Formula: $A = S^2$

A(Area) =(Equals) s(side)^2 (squared)
To square a number you multiply it by itself, thus $4^2 = 4 \times 4$, or 16

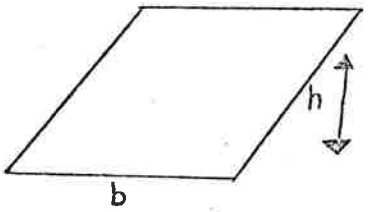
If you have a 2 inch square the area would be 2 x 2 or 4 square inches.

6. 

Area of a rectangle.

Formula: $A = lw$

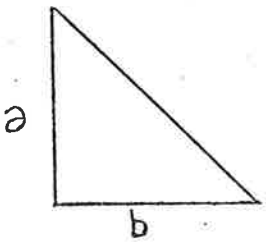
A(Area) =(Equals) l(length) x w(width)
Multiply the length by the width to find the area.

7. 

Area of a parallelogram.

Formula: $A = bh$

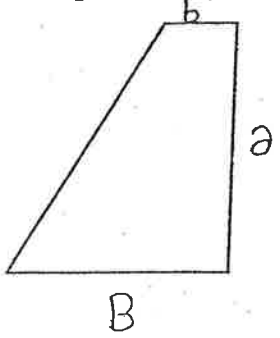
A(Area) =(Equals) b(Base) x h(Height)
Multiply the base by the height to find the area.

8. 

Area of a triangle.

Formula: $A = \frac{ab}{2}$

A(Area) =(Equals) a(altitude) x b(base) ÷ 2
Multiply the altitude by the base and divide the product by 2 to find the area.

9. 

Area of a trapezoid.

Formula: $A = \frac{(B + b)a}{2}$

itself, equals the given number. The square root of 4 is 2, because 2 x 2 = 4; the square root of 16 is 4, because 4 x 4 = 16.

5. The symbol $\sqrt{}$ indicates that the square root of a number is required. Example–

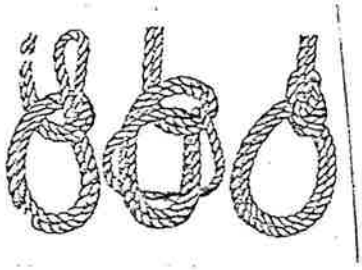
$$16 = \sqrt{4}$$

KNOTS

Hitches for Holding Needle Beams - Eye Splice, Running Bowline, Round Turn and Two Half Hitches.

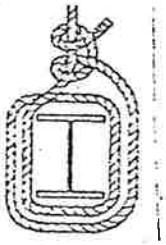
Bowline - One of the best known of all knots; used wherever a hitch is required that will not slip, jam, or fall.

Rolling or Taut Line Hitch - For holding tension in a line; a snubbing hitch.

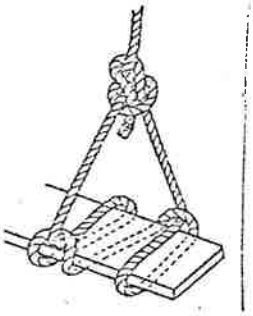


Bowline on the Bight - Used in emergencies to lift an injured man off a building or out of a hole. This is done by sitting in one loop and putting the other loop around the back and under the arms; also to tie bowline in middle of the line.

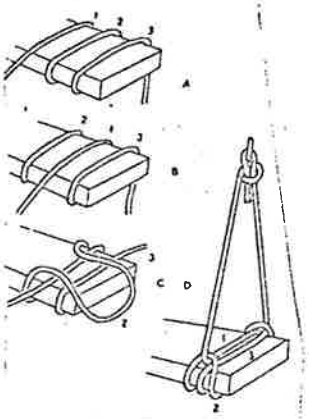
Timber Hitch - Useful for hoisting planks, timbers, and pipe; holds without slipping and does not jam. A half hitch is added to keep a plank or length of pipe on end while lifting.



Round Turn and Two Half Hitches - For fastening a scaffold line to a supporting beam.



Scaffold Hitch - For fastening single scaffold planks to hang level.



Self-Centering Bowline - For fastening single scaffold planks.

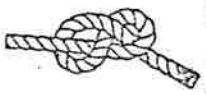
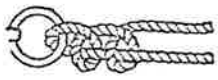
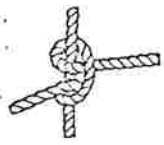


Figure 8 - Used in the end of a rope to prevent the strands from unlaying; also to prevent the end of a rope from slipping trhough a block or an eye.

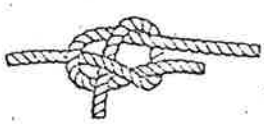


Two Half Hitches - Used to secure rope to column or posts; easily tied; does not jam; will stand heavy strain without slipping.



Clove Hitch - Also known as builder's hitch because of its wide use by construction workers in fastening rope to upright posts on staging to act as a rail or safety line.

Square Knot - Used to join two ropes or lines of the same size; holds firmly; easily untied.



Sheet Bend - Used to joint two lines of different or same sizes.

HAND SIGNALS

STOP SIGNALS

STOP

EMERGENCY STOP

TELESCOPING BOOMS

DOG EVERYTHING

SHORTEN BOOM

EXTEND BOOM

SLOW SIGNALS

MAKE MOVEMENTS SLOWLY

RAISE LOAD SLIGHTLY

LOWER LOAD SLOWLY

LOWER BOOM LIGHTLY

RAISE BOOM SLOWLY

CLAM BUCKET SIGNALS

OPEN

CLOSE

CRAWLER or TRACK SIGNALS

Travel Both Crawler Belts In Direction Indicated By Revolving Fists

RIGHT TURN

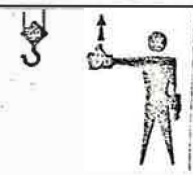
Lock The Crawler Belt on the Side Indicated By Raised Fist Travel Opposite Crawler Belt In Direction Indicated By Revolving Fist

LEFT TURN

HOIST LOAD

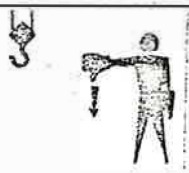
Arm Position 45°

LOWER LOAD



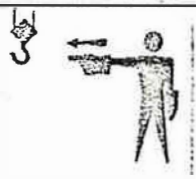
Arm Position 90°

BOOM UP



Arm Position 90°

BOOM DOWN



Arm Position 90°

SWING

SELECTING SINGLE or MULTIPLE REEVED LINE

RAISE THE BOOM AND RAISE THE LOAD

RAISE THE BOOM AND LOWER THE LOAD

MULTIPLE OR BIG LOAD LINE TAPPING HEAD BEFORE DIRECTION

Single Line Or Light Load, Wanted By Holding Elbow Before Signaling Directions

INSTRUCTIONS TO SIGNAL MEN:

1. Only one person to be signalman.
2. Make sure the operator can see you and acknowledges the signal given.
3. Signalman must watch the load - the operator is watching you.
4. Don't swing the load over the other workmen, warn them to keep out of the way.

WATCH FOR OVERHEAD LINES OR OTHER OBSTRUCTIONS