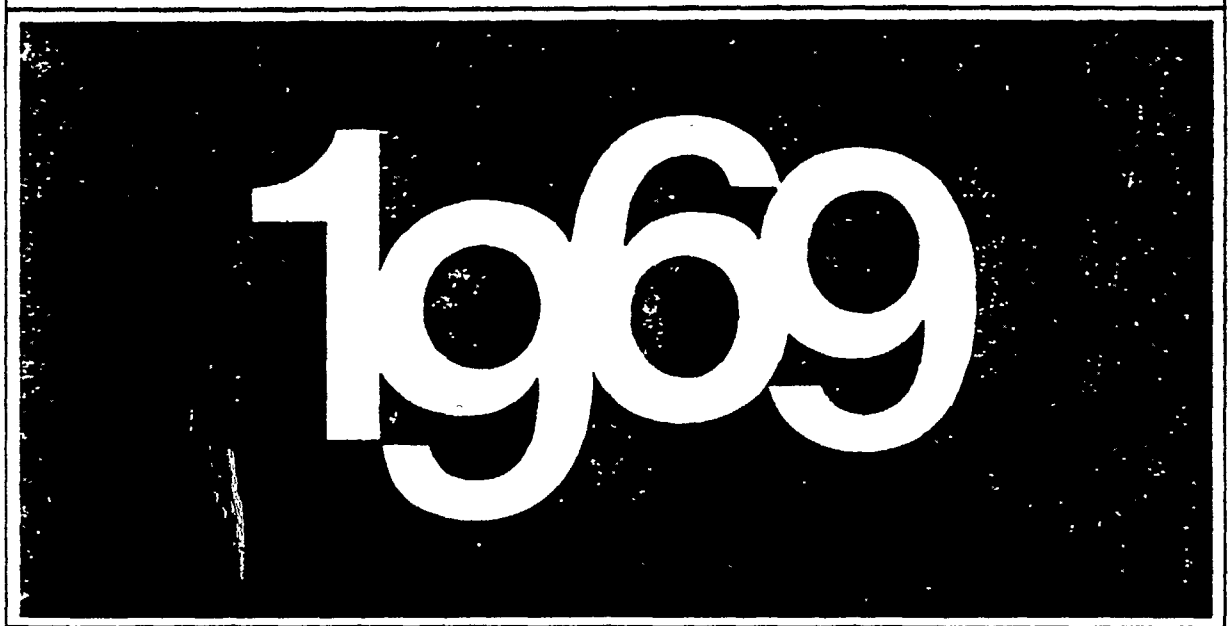
PLAINTIFF'S
EXHIBIT
BEA-8
PENCAD-Bayonne,N.J

Built-up Roofing

Manual for Architects • Engineers • Contractors



KOPPERS

Architectural and
Construction Materials

KOPPERS

Architectural and Construction Materials

Coal Tar Pitch built-up roofing

Koppers coal tar pitch built-up roofing systems consist of layers of Koppers Old Style Pitch and Koppers approved tarred felt, surfaced with a heavy top pouring of Koppers Old Style Pitch into which is embedded an aggregate.

Koppers' coal tar pitch built-up roofing systems are used whenever a roof is exposed to water and/or corrosion and on all level or low sloped roofs where long, maintenance free service is required. Particularly recommended for:

All 'dead' level roofs
All water cooled roofs
Low sloped roofs with retarded drainage
Low sloped roofs with occasional water ponding
(Note: coal tar pitch roofs are especially suitable to withstand the water attack around drainage areas on roofs that are pitched to the drains.)
All buildings with level or low sloped roofs that are built for long service life

Coal tar pitch built-up roofing provides one of the most durable roofing membranes known. The advantages are found in the inherent superior characteristics of coal tar pitch for this purpose. This is the time proven roofing system for level and low sloped roofs.

Coal tar pitch has a natural resistance to water, air and water vapor penetration. A tight molecular structure enables coal tar pitch to permanently withstand water penetration and resist oxidation of the roof surface. Koppers water-cooled roof specifications take advantage of the unique water-resistant characteristics of coal tar pitch to give you long-term roofing performance.

Another unique feature of coal tar roofing is its self-healing ability. Alligatoring and hairline cracks common to most materials, eventually cause damage to the roofing membrane. Coal tar pitch has a property known as "cold-flow," which automatically corrects these conditions before serious damage takes place. This "cold-flow" feature heals small mechanical fractures at normal temperatures.

Time and statistics have proven that coal tar roofing pitch when applied in accordance with the following specifications results in the highest acceptable quality level of any built-up roofing system. Coal tar pitch is a nature-formed polynuclear large molecule compound. Coal tar roofing pitch is a selectively manufactured fraction which satisfies the basic requirements for long-term roofing service on level and low-sloped roofs.

When you specify a Koppers Coal Tar Roof, you are assuring your building owner-client of long-term roofing performance.

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	Slope of Deck	Bondable Classification Years	Type of Surface	No. of Plies	Basic Spec. No.	Page No.
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2. Flat Deck Old Style Pitch Roofing System						
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Metal-Insulated with Vapor Barrier	up to 2"	20	Roofing Aggregate	4	17 wi	9
	up to 2"	15	Roofing Aggregate	3	18 wi	9
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	up to 2"	15	Roofing Aggregate	4	2	16

NOTE: All elements in the roof structure affect roofing performance. Koppers built-up roofing specifications are based on the general type of deck to be used so that precautionary statements are readily available for reference. Specifications are designated by general deck type. If insulation board is used, the suffix wi is added to the base specification. If vapor barrier is used the suffix I is added. If the base sheet alternate is used, the suffix ba is used. For example, a 4 ply roof over poured concrete with insulation and vapor barrier is designated Koppers 5 wiv.

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Poured and Precast Concrete, and Metal with inslation	2"-3"	20	Gravel or Slag	4	800-A	18
	2"-3"	15	Gravel or Slag	3	3200-A	18
Mineral Surface						
Wood	3"-9"	15	Mineral	3	31-A	19
	3"-9"	10	Mineral	2	4-A	19
Poured Concrete or Poured Gypsum	3"-9"	15	Mineral	3	33-A	19
	3"-9"	10	Mineral	2	9-A	19
Precast Gypsum, Gypsum Metal Bound Plank, Precast Concrete	3"-9"	15	Mineral	3	34-A	19
	3"-9"	10	Mineral	2	35-A	19
Smooth Surface						
Wood, Poured or Precast	2"-6"	20	Smooth coated	4	3-A	*
Gypsum, Gypsum	2"-6"	15	Smooth coated	3	25-A	*
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6. Flashing Specifications						20-21
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For decks or insulations not covered in these specifications, consult your Koppers Representative.

preface

This manual contains recommended roofing specifications and procedures which are based on the many years of Koppers experience and generally accepted good roofing practice. They are intended to provide the architect, engineer, general contractor and roofer with the proper information to plan and construct the best built-up roof with the most time-proven materials available today.

The availability of a Koppers surety bond for roofing and flashing constructed according to the information contained in this manual under Koppers bond procedure, which customarily includes inspection by Koppers during application, and the publishing of these specifications and information shall not be construed as creating any warranty, expressed or implied, with regard to any roofing or flashing for which a bond has not been issued.

This roofing manual supersedes all previous roofing manuals and literature published by Koppers.

1. GENERAL REQUIREMENTS

1.1 BUILT-UP ROOFING

1.1.1 Decks

The deck is the base over which the built-up roofing, or insulation and built-up roofing is applied. Where the term deck is used in this manual without reference to insulation, it shall designate the surface over which roofing is to be applied. All decks shall be clean, smooth, dry, rigid and free of debris. Any deck defect shall be corrected before application of roofing. All decks shall be installed in accordance with the deck manufacturer's specifications and shall be in compliance with Koppers General Requirements.

In approving any deck as satisfactory to receive a Koppers roof, only the deck surface is accepted. It is the responsibility of the building designer and the deck manufacturer to provide for expansion and contraction in a manner that will provide a stable base for the roofing; for support of maximum anticipated loads; secure attachments vertically and laterally, and the selection of the deck material and construction details including their ability to contain bitumens. Koppers will not assume responsibility for deck defects, the affect of deck defects on Koppers roofs, or bitumen seepage.

The placing of conduits, bolt heads, etc., above the roof deck and below the roofing membrane is not recommended.

All projections or openings in the deck should be completed prior to the application of the roofing.

Optimum adhesion to the deck is necessary for good roof performance. Where Koppers Old Style Pitch or steep asphalt is used for adhesion, questionable decks may be tested for dryness and adhesion by pouring one pint of the bitumen, heated to application temperature, over a representative area or areas of the deck. The deck is not satisfactory if the bitumen foams or bubbles, or upon cooling to ambient temperature may be stripped clean of the deck.

1.1.2 Lightweight Aggregate Insulating Decks

Koppers will only accept lightweight aggregate insulating decks which are designed to permit the fill to vent water vapor or to dry from the underside. Koppers will not accept lightweight aggregate decks over poured concrete substrates, vapor barriers, unvented metals, or any type of base which will not permit the fill to vent or dry. It is necessary to prevent a water vapor pressure built-up under the built-up roof. Occasional, or spot vents through the roofing as the only venting method are not satisfactory substitutes for underside or continuous vented systems.

1.1.3 Old Style* Pitch

Koppers Old Style* coal tar roofing pitch is carefully manufactured to standards which have been regularly improved over many years. Koppers Old Style Pitch is manufactured to exceed the minimum requirements of the following specifications:

Federal Specification RP381 Type I
ASTM D-450 Type A
Underwriters' Laboratories, Inc.

1.1.4 Koppers No. 15 Tarred Felt

Koppers approved tarred felt is manufactured to meet the following specifications:

Federal Specification HH-R-595 Type I Class 1
ASTM D-227
Underwriters' Laboratories, Inc.

1.1.5 Application of Roofing

All roofing is to be built-up in place with alternate moppings of bitumen and layers of felt over the proper substrate and preliminary work as described or specified in this book under the several sub-heads for various types of deck construction and slope. Application is to be made by experienced workmen in the manner described. The finished roof is to consist of the number of plies of felt and moppings of bitumen plus top pouring as specified herein. Applicable portions of Koppers precautions for "Food Establishments" apply.

1.1.6 Application of Bitumen

Recommended Weights (for estimating purposes only)

	Average Interply	Top Coating
Old Style Pitch	25 lbs.	75 lbs.
Steep Asphalt	23 lbs.	60 lbs.

Average interply weights are based on long years of experience in good roofing practice, and take into account a reasonable variation in distribution as well as a variation in the amount absorbed in different substrates, and the type of specification. Moppings of bitumen between felts shall be continuous. Felt shall not touch felt. The top pouring of Old Style Pitch is most important, and must be thorough; and must be uniformly covered with specification aggregate embedded in the pitch while hot.

Recommended Temperature Limitations:

	Heated Temperature Maximum	Application Temperature Minimum
Old Style Pitch	400°F	300°F (Recommended 375°F)
Steep Asphalt	475°F	350°F

If heat is desired during a holding period at the jobsite while material is not being drawn off and replenished as under normal usage, kettle temperature should be reduced and not permitted to exceed 350°F for Old Style Pitch or 425°F for steep asphalt. The kettle should be full. These temperatures are applicable to job conditions and do not apply to holding or storage in kettles in excess of 4 hours. If bitumen is not to be used for periods over 4 hours kettle should be shut off.

Prolonged storage in small containers, such as roofing kettles, at temperatures exceeding those detailed above may result in changes in softening point, ductility, and other characteristics which can adversely affect the performance and life of the bitumen.

Old Style Pitch may be contained in 1000 gallon or greater capacity heated and automatically controlled closed vessel tankers at 375°F for periods, not exceeding 96 hours.

1.1.7 Cold Weather Application

When roofing is applied at temperatures below 45°F special precautions must be taken to insure the satisfactory performance of the finished roof. Before applying roofing the effects of moisture, that is all traces of ice, snow, surface water, etc., must be removed from the deck. Any moisture present at the time the roofing is applied may result in poor adhesion of the materials to the deck and blistering of the roofing felt. Moisture content of materials under the roofing must be as close to dry equilibrium water content as possible.

Hot applied bitumens tend to congeal rapidly in cold weather, even when the deck is dry, so extra care must be taken to set insulation or roofing in as quickly as possible.

Do not heat bitumens above the maximum temperature limit listed above to compensate for rapid chilling. Insulated containers, along with carefully timed material handling methods, must be employed. Whether hand mopping or mechanical distribution equipment is used, lapsed time before contact of felts or aggregate with hot bitumen must be kept to a minimum. In the case of hand mopping, mop no farther than 5 feet in front of felt roll and immediately roll in. Felts should be broomed or pressed in immediately.

After the membrane is completed, the top pouring and aggregate surfacing should be accomplished while there is still latent heat in the membrane.

1.1.8 Application of Felt

Plies of felt must be laid shingle fashion, not only because this method produces a stronger membrane, but because it also makes it possible to construct a roof of any desired number of plies in a single progressive operation. Where a water flow direction exists, felts should be applied so that the direction of flow is not against the laps. Broom or press all plies of felt into the hot pitch and lay without wrinkles, buckles or kinks, so that finished the roof is free of pockets or blisters. Each felt ply shall be completely covered with a uniform mopping of bitumen.

The number of plies are controlled by varying the widths of the edge laps. Three-ply roofing, for example, is achieved by lapping each ply approximately two thirds over the preceeding ply; for 4-plies, a lap of approximately three fourths the width is required. Koppers' No. 15 tarred felt is marked at the factory with lap lines for this purpose. Except as specifically provided for in Koppers specifications, application of felts in a method where two plies are laid over two plies, three plies over one ply, or any combination, other than all plies in shingle fashion, will not be permitted at anytime.

When beginning a membrane roofing installation, appropriate width starting strips of felt shall be used at the starting point to achieve the specification ply build-up at that point so that successive plies laid shingle fashion will produce the ply requirements. Overlap ends of all connecting plies of felt (end laps) not less than 10 inches. End stripping or taping of these laps is not permitted.

It is advisable on applications of felts on slopes from ½ inch to 1 inch per foot, felts be run with the slope, up and over the ridge of the roof (parallel to the slope line) and each sheet back or blind nailed along the end lap closest to the deck at the high point end of each roll.

Koppers requires that all felts be backnailed when the slope of the deck is one (1) inch per foot or more.

1.1.9 Application of the Old Style Pitch and Aggregate Surface

The final application of all Koppers Coal Tar Pitch Built-up roofs is the triple weight, extra heavy top pouring of Koppers Old Style* Pitch which provides the outstanding waterproofing and service life of the roof. Into the extra heavy top pouring of Old Style* Pitch, slag or gravel is imbedded. The slag or gravel acts as an armor coat against mechanical forces, such as hail and to deflect the intense radiation of the sun.

For best results, the top pouring of pitch with slag or gravel should be applied at the time of the application of the felts. A delay, particularly during inclement weather, can result in a considerably reduced service life of the roofing. If a delay is unavoidable due to construction scheduling, a glaze coating of Old Style* Pitch will provide temporary protection until the pouring of pitch and slag or gravel is applied. Ideally, the scheduling of construction shall be such that all roofing and flashing can be applied including slagging or gravelling in completely as daily application progresses.

The aggregate surfacing must be applied into the top pouring while hot so that a uniform layer will be embedded and adhered. The completed Koppers Old Style* Pitch and aggregate roof will have a uniform aggregate surface. Occasionally, on well applied roofs, small black globes known as "rasberries" or "blackberries" will temporarily form in the pitch and aggregate surface. These are not detrimental to the roof.

1.1.10 The Aggregate

The aggregate to be used should meet ASTM Specification D1863-64. The basic requirements for this aggregate are as follows:

Sieve Size	Total Passing, Percent
¼"	100
½"	90-100
¾"	4-70
No. 4	0-15
No. 8	0-5
Dust, maximum, percent	0.5
Moisture, maximum, percent:	
crushed stone and gravel	0.5
crushed roofing slag	5.0
Unit Weight (loose), minimum lb. per cu. ft.	60

ASTM D1863-64 covers other properties, such as hardness and includes proper methods for sampling. If any doubt exists, the aggregate supplier should furnish a certified analysis and a certification that the product is produced to conform to ASTM D1863-64.

1.1.11 Koppers Steep Roofs

Koppers slag or gravel surfaced steep roofs for slopes from two (2) inches to three (3) inches per foot are constructed of asphalt saturated felts set in steep asphalt. A top coating of steep asphalt, into which either slag or gravel is embedded, completes this type construction.

Koppers mineral surfaced steep roofs for slopes from three (3) inches to nine (9) inches per foot are constructed of Koppers Asphalt Felts set in Koppers Steep Asphalt. The surface material is composed of Koppers Selvage Edge Mineral Surface roofing, a heavy asphalt saturated felt thirty-six (36) inches in width, of which nineteen (19) inches are bare and seventeen (17) inches of the top surface is covered with granules. This is embedded in Koppers steep asphalt with each sheet lapping the preceding sheet nineteen (19) inches, thereby presenting to the elements a continuous tough granule surface.

Koppers smooth surfaced steep roofs for slopes from two (2) inches to six (6) inches per foot are constructed of perforated asbestos felts thoroughly impregnated with specially refined asphalt firmly embedded in Koppers Steep Asphalt. Koppers Perforated Asphalt Saturated Asbestos Felts produce a long-lasting weather-resistant roof.

Note: For detailed specifications regarding *steep, smooth surfaced asbestos roofs*, consult Koppers.

1.1.12 Caulking and Taping

Whether the joints of various precast deck materials are grouted or not, the application of flashing cement and a felt strip approximately 6" wide will minimize the harmful effects on the roofing membrane of movement, moisture vapor transmission through an open joint, joints which are not level, and possible bitumen seepage. Refer to Page 12 for details of caulking and stripping.

1.1.13 Temporary Roofing

Temporary roofing applied for various reasons shall not be con-

sidered a part of the permanent built-up roofing. Consult your Koppers representative for recommended specifications over various type decks for temporary roof construction.

1.2 INSULATION

1.2.1 Board Type Insulations

These insulations come in varying thicknesses and sizes. The provisions or manner of attachment which follows in the various specifications are suggestions only. Should the manner of attachment as suggested, conflict with that specified by the individual insulation manufacture, the insulation manufacturers specifications shall be followed, and in addition, shall be in compliance with Koppers General Requirements.

The roofing insulation must be kept dry at all times. It must be of a type approved by Koppers for use with a Koppers built-up roof. It should only be applied over a deck complying with all of the General Requirements. Work must be scheduled to prevent damage from other trades and equipment. Roofing equipment must be of a type which will not damage the insulation used. Broken or damaged insulation sheets can only be used when the undamaged portion is cut out for application areas where fill-in pieces are required.

If the deck slope is one (1) inch per foot or more the insulation must be able to retain nails, or wood nailers must be installed perpendicular to the slope at each course of insulation. Provision for wood nailers in this fashion will provide both a surface for anchoring of roofing felts which shall be laid perpendicular to the wood nailers as well as an insulation stop. Spacing of nailers must be such that the insulation fits snugly with the nailers but must not be force fitted.

No more insulation shall be laid at any one time than can be protected by pitch and felt in case of sudden weather changes. Edges of insulation shall be brought closely together and shall not be forced into place. Where insulation joins vertical surfaces the insulation shall be cut in a neat manner allowing at least one-half (½) inch clearance.

When more than one (1) layer of insulation is used, joints in each layer shall not coincide. All layers shall be parallel to preceding layers.

1.2.2 Vapor Barrier

Vapor barriers are normally used where the heat flow direction and-or humidity within the building, during any climate or occupancy cycle, might cause the dew point or condensation to occur under the built-up roofing within the insulation chamber. It is important that the vapor barrier, when installed, provide a continuous seal, including ventilators, skylights, peripheral walls, and other terminations from the source of the water vapor. Ventilation provisions of the insulation chamber, when a vapor barrier is used, are dictated by the heat flow cycle and climatology of the building. Generally a building with a preponderant heat flow-up cycle should have an insulation chamber ventilated to the exterior. A building with a preponderant heat flow down cycle in a humid area, should not be ventilated to the exterior if the dew point can be reached above the deck and in the insulation chamber.

The vapor barrier systems described in these specifications are for information only and are not to be construed as part of the built-up roofing. The proper design and specification of such vapor barrier, thus becomes the sole responsibility of the building owner or his designer. Any subsequent failures, due to either the installation or lack of such installation will not be Koppers responsibility. This will also apply if it appears desirable to install such vapor barrier to the underside of the entire roofing assembly.

1.2.3 Water Stops (Temporary Protection)

Water stops consisting of two (2) plies of tarred felt and moppings of Old Style Pitch for flat roofs or asphalt felt and asphalt for steep roofs extending onto the deck at least six (6) inches and four (4) inches on top of the insulation, shall be applied at the end of each day's work over exposed edges of insulation.

Water stops shall be continuous and tight.

This temporary protective measure *must* be removed cleanly when work is resumed.

1.2.4 Cut-offs (Permanent Installation)

Venting of roof insulation at walls, curbs, eaves, etc., is recommended for all but a few special roof structures. Therefore, cut-offs should not be installed at edges of insulation adjoining these areas for venting purposes.

Cut-offs may be installed, however, provided they are constructed to run in one direction continuously to vented edges and provided no section of the roofing is isolated or blocked from venting.

1.2.5 Lightweight Insulating Fills

Lightweight insulating fills must have sufficient cohesive strength to provide firm attachment of the roofing to the structural deck and framing in order to prevent wind uplift damage or a blow-off of the roofing. At the time of the application of the roofing, the insulating fill will have been dehydrated of all excess water used at the time of placement: Application over these types of fills varies according to the characteristics of the fill and the condition under which the roofing material is to be applied. Consult Koppers representative for roofing specifications over the type of insulating fill to be used.

In general, a lightweight insulating fill must be able to vent itself and thereby dry, otherwise serious effects to the roofing membrane will result. Koppers will not accept a vapor barrier beneath a lightweight fill nor a fill over a type of substrate that will not permit adequate venting from below such as poured concrete, unvented metal decks, etc. Koppers will not be responsible for failure of the insulating fill to remain integral or for disbonding of the roofing from the surface of the insulating fill.

Provisions should be made wherever possible to provide additional venting such as notched wood perimeter nailers, etc., in conjunction with the venting from the underside of the deck. If board type insulation is to be applied over a lightweight fill, a vapor barrier is necessary between the fill and the board insulation to prevent fill moisture from affecting the insulation and roofing.

1.2.6 Additional Information

When nailing of insulation or felts over insulation is required, selection of the type of insulation is critical.

For information concerning nailability of insulation, consult the insulation manufacturer or Koppers.

1.2.7 NOTE:

Insulations to comply with Underwriters' Laboratories, Inc., Class A, B or C roof coverings must be listed under Underwriters' Laboratories Guide No. 360 018 of their Building Materials List. For metal deck roofs, insulation must also be listed under their Guide No. 360 R 13.13.

1.3 OTHER REQUIREMENTS

1.3.1 Materials Protection

Roll roofing materials and insulation should be stored indoors if possible, otherwise it shall be protected by raised platforms and covered with suitable weatherproof protective coverings such as tarpaulins, plastic sheeting, etc.

1.3.2 Wood Nailing Strips

All non nailable decks require wood nailing strips at eaves, edges, walls, roof openings, etc. for proper securing of metal flanges. Nailers must be securely and firmly attached to the deck or through to its supporting members. Nailers shall extend not less than 1" beyond the apron or flange.

Roofing felts for all decks having a slope of one (1) inch per foot or more must be back nailed and therefore non-nailable

decks must be furnished with treated wood nailing strips. Wood nailers, installed on or in non-nailable decks for slopes one (1) inch per foot or more or when insulation is required of a non-nailable type, shall be run in the direction perpendicular to the direction in which the felts are to be laid.

Nailers should be treated to preserve their condition and hence their nail retentive power for the expected life of the roofing. Creosote or oil born preservatives may affect the roofing they contact and should not be used. Nailers should be pressure treated with a water born preservative such as Wolman salts or with penta applied in a liquified petroleum gas carrier such as the Cellon Process.

1.3.3 Walkways

Where periodic foot traffic patterns such as paths to or around equipment and other similar situations where the roofing may be subjected to anticipated unusual treatment, the roofing membrane should be protected. Walkway systems should never be placed directly on a slag or gravel surface. Areas of the roofing membrane which are to act as the bearing surface for a walkway should be given additional protection. Although there are a number of methods which can be employed, Koppers recommends one of the following:

1. **Treated Wooden Walkways.**
2. **Traffic Pads.**

Refer to page 25 of this manual.

If other methods are considered, consult your local Koppers representative.

1.3.4 Cold Storage & Freezer Buildings

Koppers will not bond its roofing over these structures if insulation, or insulation and vapor barrier is installed over the deck and unless there is an adequately ventilated air space between the deck and insulated refrigerated area.

The National Academy of Sciences — National Research Council have published a report pointing up the difficulties in maintaining refrigerated storage structures. This report is entitled "Refrigerated Storage Installations." Publication 759 1960). One important point brought out in this report is that a ventilated air space should be provided between the refrigeration insulation and the roof.

1.3.5 Attachment

Maximum adhesion or secure attachment of all components in the roofing assembly is necessary to satisfactory long-term performance of the roofing membrane. Secure attachment of the substrate is essential. Koppers will not be responsible for any damage caused by or the result of unsatisfactory attachment.

It is advisable that there be maximum adhesion or secure fastening of all components in the roofing system beginning with the structural frame base up through each component.

Attachment of the roofing membrane or insulation to the structural deck of standard commercial industrial and public buildings is normally accomplished by hot mopped bitumen. Cold adhesives or special fasteners may be used under certain conditions but require special consideration in relation to the materials they will be used with and careful application procedures must be followed to achieve required attachment of components.

1.3.6 Nails & Fasteners

All fastening devices must provide adequate retention in the deck structure. Nails must be driven through flat tin discs or be of an approved type fastener with an integral cap. Nail lengths and type of nails or fasteners depend on the deck material used and the thickness of same. (For insulation applications where nailing is required, nails must be of sufficient length to penetrate the insulation and provide the retention necessary.)

The following recommendations will serve as a guide for the installation of roofing for the decks as listed:

Metal Decks. For securing felts to insulation use soft nosed roofing nails ¾ inch longer than the thickness of the insulation, designed to clinch or hook on the underside of the insulation such as manufactured by Independent Nail Corporation or Simplex Tube-Lok nail or approved equal. Insulation must have sufficient nail retentive ability to meet general requirements for nailable decks.

Poured Gypsum and Poured Lightweight Aggregate Decks (When Not Thoroughly Dry). Use Simplex Gypsum Roof Deck Nail or Screw-Tite Squarehed Cap Nail or Capped E S Nail or square cut unfinished nails through flat tin discs.

Precast Nailable Lightweight Decks (Gypsum Plank and Dry Poured Gypsum). Use Simplex Tube-Lok Nail or square cut steel nail with head (Wheeling LaBelle or equal).

Preformed Composition Decks. Use Stronghold Annular Threaded Squarehed Cap Nail or Simplex Tube-Lok Nail or Capped E/S nail or approved equal. Deck density is particularly critical and must have required retentive ability.

Wood Decks. Use Simplex flat head roofing nail or Stronghold Annular Threaded Squarehed Cap Nail or barbed roofing nails through flat tin discs.

Plywood Decks. Use annular ring shanked nails through flat tin discs or Simplex Annular Threaded nails or equal. Refer to Douglas Fir Plywood Association Laboratory Bulletin 61-B dated March 20, 1961.)

Structural Wood Fiber Decks. For nailing applications use Simplex Tube-Lok Nail. Refer to page 14 of this manual.

NOTE: Nailing frequency is recommended in the individual application specifications which follow in this manual.

Should the manner of attachment as recommended above conflict with the specifications of the nail, insulation or deck manufacturer, these manufacturers' specifications should be followed.

Roofing over nailable decking where the underside of the deck is exposed shall be nailed on centers at one-half the spacing specified to provide additional protection against wind uplift.

For reference:
E. S Products, Inc., New Rochelle, N. Y.
Independent Nail Corp., Bridgewater, Mass.
Simplex Nail & Manufacturing Corp., Americus, Ga.
Wheeling Steel Corp., Wheeling, W. Va.

Nails for use with insulation shall be of sufficient lengths to pass through the insulation and make a maximum penetration into the deck without protruding through it (except for metal decks).

If other varieties of fasteners such as clips or cleats are desired they shall be as recommended by the deck manufacturer.

Nails shall be galvanized and driven through minimum one (1) inch diameter sturdy gauge tin caps or shall be acceptable integral capped nails such as "Simplex" or equal.

Approved mechanical fasteners should be used for securing insulation to metal decks when required.

1.3.7 Base Sheet Alternate

As a substitute for the first ply of tarred felt apply one ply of Koppers coated base sheet in a solid mopping of steep asphalt directly over the approved type of board insulation described in the specifications to be roofed, lapping each sheet four (4) inches over preceding sheet. Mop entire surface with uniform coating of Old Style Pitch. When specifying this alternate to any board type of insulated surface use the designation bs, for example Koppers Old Style pitch roof 17 wibs.

1.3.8 Notice:

This roofing specification manual contains the latest and best available information as derived from Koppers long experience in the roofing industry. The design criteria and details contained herein have been compiled and are offered as a guide for consideration to assist the architect, owner and roofer in an attempt to provide the best roof possible for long, trouble-free service. Responsibility, however, for design of any roofing system, remains with the architect or engineer and building owner. The contents of this manual are subject to change at the discretion of Koppers Company as future developments and experience are achieved.

2.1 Water Cooled Roofs

Process Water or Retarded Drainage Ponding Conditions

SLOPE • Up to 1 in. per ft.

SURFACE • **Double Aggregate** (with double pour)

PROCEDURE

Select clauses as required. Optional clauses in italic.

Green copy denotes built-up roofing specification

Condition of Surface to Receive Roofing

Do not apply built-up roofing to concrete surfaces which are not reasonably smooth and free from projections and holes which might cause rupture of the membrane. Surfaces must be dry. Immediately before the application of the roofing, thoroughly clean the surface of dust and loose material.

Application of Built-up Roofing

1st. Mop deck completely with Old Style Pitch.

2nd. Spec. No. 23

Apply over the entire surface four (4) plies of Koppers Approved Tarred Felt, lapping plies twenty-seven and one-half (27½) inches. Mop solidly between each 27½ inch lap with Old Style Pitch so that in no place shall felt touch felt.

2nd. Spec. No. 24

Apply over the entire surface three (3) plies of Koppers Approved Tarred Felt, lapping plies twenty-four and two-thirds (24-2/3) inches. Mop solidly between each (24-2/3) inch lap with Old Style Pitch so that in no place shall felt touch felt.
All felt shall be turned up not less than four (4) inches at vertical surfaces.

3rd. Pour over the entire surface of the roofing membrane a uniform coating of Old Style Pitch into which, while hot, embed not less than four hundred (400) pounds of gravel or three hundred (300) pounds of slag for each one hundred (100) square feet.

4th. All loose gravel or slag shall be swept from surface and a second uniform pouring of approximately eighty-five (85) pounds of Old Style Pitch shall be applied over the gravel or slag, into which, while hot, shall be applied a second layer of three hundred (300) pounds of gravel or two hundred (200) pounds of slag for each 100 square feet. The entire surface shall then be thoroughly broomed free from all loose gravel or slag. It is advisable to roll the finished surface with a light roller so that aggregate is thoroughly embedded.

Note

a. At points where water pressure from the spray may be excessive, the roof surface should be protected with treated board platforms or other suitable construction to break the force of the water. These platforms should be laid on top of the roof surface and not fastened to the deck.
b. Insulation under a water cooled roof should be of a type which is rigid, dimensionally stable with high compressive strength and of a sealed cellular structure such as Foamglas.
c. At all points where roofing membrane meets a vertical surface, Koppers Flashing Specification No. 110, listed on page 21, must be applied.
d. Insulation and vapor barrier, if used, shall be applied according to Specifications 5, 7, 10, 11, 12 or 13 wi or wiv.
e. Specifications 23 and 24 may be applied over wood deck (P. 16) or metal decks (P. 8 and 9) for Process Water or Retarded Drainage Ponding only. Design live load must be 50 p.s.f. and deflection not greater than L/360 above the weight of water anticipated. Insulation joints must be taped. Vapor barriers must be two ply, solid mopped with steep asphalt over steel decks. Wood must be treated to prevent warping (1.3.2).

DEFINITIONS:

Water Cooled Roof: Water is contained on the roof at all times at a constant level by means of a drainage system and a water source. Water cooled roofs also include spray pond roofs where the roof is constantly sprayed with water but not necessarily kept at a constant level.

Process Water: Water from manufacturing process, cooling towers, etc., that from time to time deliver water across the roof for normal drainage.

Retarded Drainage Ponding: Drains are sized to deliver a controlled amount of water to the storm system and thus occasionally necessitates water ponding.

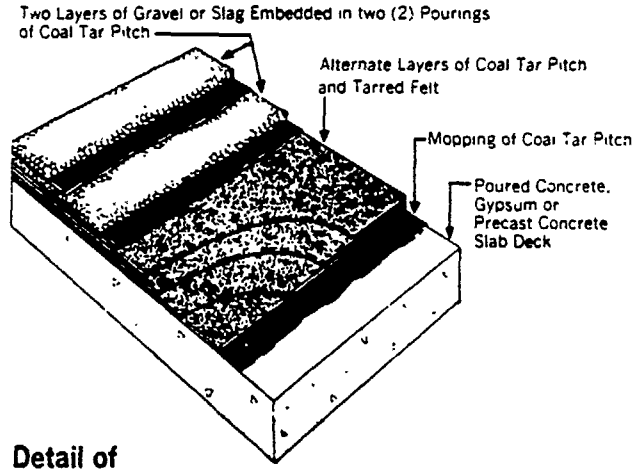
General Requirements on pages 3 through 6 and Detailed Specifications on pages 20 through 26 are a part of this specification and must be adhered to where applicable.

Spec. No. 23–4 ply–on deck
Spec. No. 24–3 ply–on deck

Spec. No. 23 wi–4 ply
Spec. No. 24 wi–3 ply
board type insulation

Spec. No. 23 wiv–4 ply
Spec. No. 24 wiv–3 ply
board type insulation with vapor barrier

NOTE: The base sheet alternate Section 1.3.7 shall not be used.



Detail of Specification No. 23

Koppers Water Cooled Roofs must be applied over Poured Concrete, Gypsum or Precast Concrete Decks. They must not be applied over Metal, Wood, Shredded Wood Fiber, or similar decks if they are designed for a water cooling system.

Water cooling of a built-up roof may be accomplished by either a spray or ponding system. Since BTU dissipation is directly related to evaporation, a light spray of water has proven to be the better method to accomplish cooling. If a quantity of water is permitted to pond so as to cover the slag or gravel completely, considerably less cooling results because of the lesser area exposed for evaporation. Over 90% of the heat ordinarily entering through the roof can be excluded by the use of the least quantity of water designed to continuously keep the roof surface damp.

Regardless of the cooling method used, it is mandatory that the system be closed down and the roof drained prior to cold weather. Neither the roofing nor the structure will withstand the expansion caused by ice formations.

The water cooled roof may be used alone or in conjunction with air conditioning equipment. When it is an adjunct of an air conditioning system, less refrigeration will be required for cooling within the building. Water required for air conditioning may be piped from the condenser to the roof for use in the roof cooling system. If water should be expensive or scarce, it should be noted that it is possible and practical to have it recycled from the roof to the air conditioning equipment with proper screening.

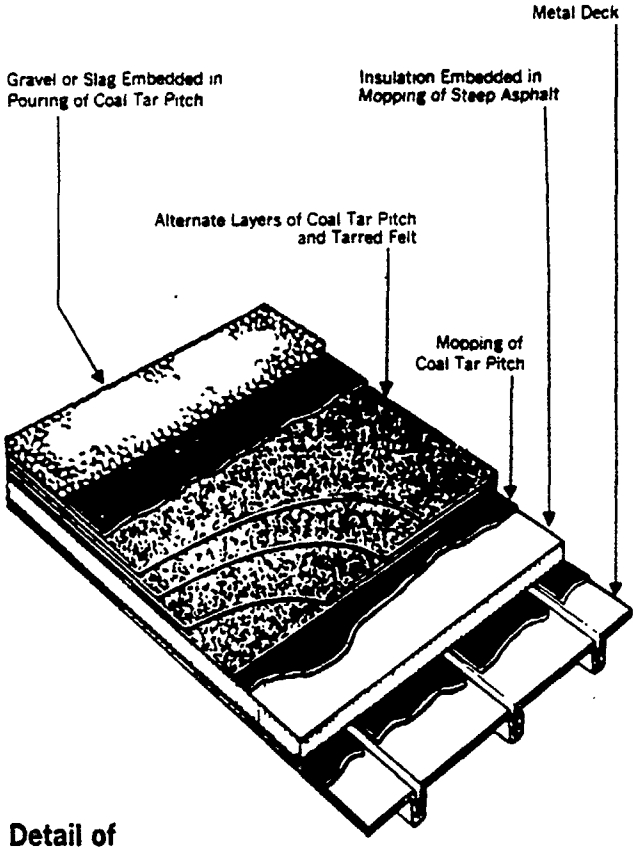
deck construction:

2.2 Metal Decks (Insulation Required)

SLOPE • Up to 2 in. per ft.
SURFACE • **Aggregate**

Spec. No. 17 wi–4 ply
Spec. No. 18 wi–3 ply
board type insulation

See Page 13 for lightweight insulating concrete—Section 2.7



Detail of Specification No. 17 wi

It is absolutely necessary to install insulation on a metal deck before the built-up roofing is applied.

A metal deck must be clean, smooth, and properly anchored to the steel purlins and all joints correctly lapped and fastened.

Type of metal deck, flute opening and various other factors determine the type and thickness of insulation required. Consult your Koppers representative for recommendations.

Metal roof decks shall be designed so that they will not have a deflection exceeding 1/240 of clear span under all types of roof traffic conditions including mechanical equipment used for roof application and weather conditions such as snow load.

Select clauses as required. Optional clauses in italic.

Green copy denotes built-up roofing specification

Condition of Surface to Receive Roofing

Metal roof decks shall be dry, clean and free from rust or oily substances. Immediately before the application of the insulation, thoroughly clean the surface of rust and loose material. Roof deck shall be properly graded to outlets.

Application of Insulation and Roofing Materials

1st a. Insulation shall be dry and of an approved type with the thickness dependent upon the width of the flute openings of the metal deck.

b. No more insulation shall be installed at any one time than can be protected by pitch and felt in case of sudden weather changes.

c. All abutting edges of insulation shall be fitted closely together but shall not be forced into place.

d. Install insulation in steep asphalt applied to deck at rate of 12 to 15 lbs. per 100 sq. ft. and place insulation while steep asphalt is still molten to provide good adhesion. See Attachment Section 1.3.5 Page 6.

e. If slope of deck is one (1) inch per foot or more, insulation must be able to retain nails and, in addition to being set in steep asphalt, insulation must be fastened to the metal deck with approved mechanical fasteners placed at all four (4) corners and the center of each sheet. If two layers of insulation are specified, top layer joints shall not coincide with joints of bottom layer. Fasteners shall be driven after the top layer of insulation is installed.

f. If U.L. and F.M. requirements are a factor for insurance rating, insulation must be listed and approved in accordance with their current data.

2nd. Mop a uniform coating of Old Style Pitch over the insulation preceding the application of roofing membrane.

3rd. Spec. No. 17 wi

Apply over the entire surface, four (4) plies of Koppers Approved Tarred Felt, lapping plies twenty-seven and one-half (27½) inches.

Mop solidly between each 27½ inch lap with Old Style Pitch so that in no place shall felt touch felt.

3rd. Spec. No. 18 wi

Apply over the entire surface, three (3) plies of Koppers Approved Tarred Felt, lapping plies twenty-four and two-thirds (24-2/3) inches.

Mop solidly between each 24-2/3 inch lap with Old Style Pitch so that in no place shall felt touch felt.

If slope of roof is one (1) inch per foot or more, each ply of felt shall be nailed along the back or upper edge on twenty-four (24) inch centers. If base sheet alternate is used, each ply of base sheet shall be nailed two (2) inches from the back or upper edge on twenty-four (24) inch centers.

4th. Pour over the entire surface of the roofing membrane a uniform coating of Old Style Pitch into which, while hot, embed not less than four hundred (400) pounds of gravel or three hundred (300) pounds of slag for each one hundred (100) square feet.

For base sheet alternate see Section 1.3.7 Page 6.

Membrane below the insulation and insulation including methods of application are not part of built-up roofing. Suggestions described in this section are offered to assist the designer in establishing their normal position and to indicate requirements for a suitable base for the built-up roofing. See Section 2.3 Page 9.

General Requirements on pages 3 through 6 and Detailed Specifications on pages 20 through 26 are a part of this specification and must be adhered to where applicable.

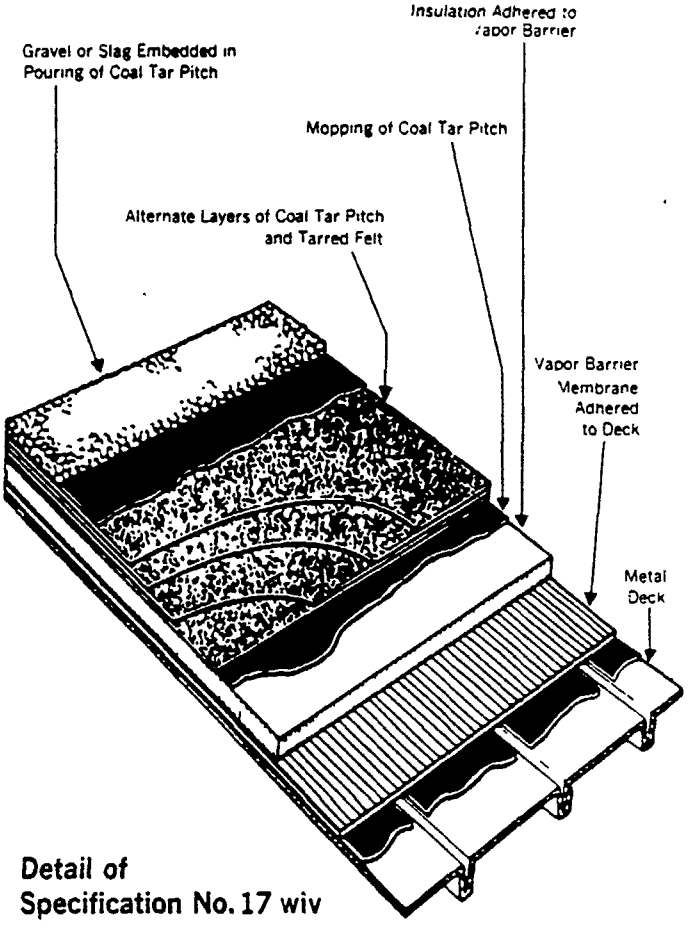
deck construction:

2.3 Metal Decks
(Insulation Required)

SLOPE • Up to 2 in. per ft.
SURFACE • Aggregate

Spec. No. 17 wiv–4 ply
Spec. No. 18 wiv–3 ply
board type insulation and vapor barrier

See Page 13 for lightweight insulating concrete—Section 2.7



Detail of Specification No. 17 wiv

PROCEDURE

Select clauses as required. Optional clauses in italic.

Green copy denotes built-up roofing specification

Condition of Surface to Receive Roofing

Metal roof decks shall be dry, clean and free from rust or oily substances. Immediately before the application of the insulation, thoroughly clean the surface of rust and loose material. Roof deck shall be properly graded to outlets.

Application of Membrane Below Insulation

A. Felt Type

Coat the ribs of the metal deck with Steep Asphalt and then install two (2) full thicknesses of Koppers No. 15 Asphalt Felt, lapping each sheet nineteen (19) inches over the preceding sheet, mopping with Steep Asphalt the full width of the nineteen (19) inch lap. Extend all felt up vertical surfaces and cutoff at height of insulation.

B. Vinyl Type

Fire resistant adhesive and vinyl-type vapor barrier as listed by and applied as specified by Underwriters' Laboratories, Inc., and Factory Mutual may be used. Adequate adhesion of the vapor barrier to the deck and adhesion of the insulation to the vapor barrier for securing the entire system against wind uplift and movement, must be attained.

C. Kraft Type

Kraft "snuffer" lamination, applied with Steep Asphalt as listed by and applied as specified by Factory Mutual. Adequate adhesion of vapor barrier to the deck and adhesion of insulation to the vapor barrier for securing the entire system against wind uplift and movement, must be attained.

NOTE: 1. Care must be exercised so that the vapor barrier is not ruptured during installation, particularly in areas over the flutes of the steel deck.

NOTE: 2. Vapor barrier method A. above is not rated by U.L. or F.M. for insurance purposes.

NOTE: 3. Vapor barrier method C. above is rated for insurance purposes by Factory Mutual only.

Installation of Insulation over Vapor Barrier

A. Felt Type

Apply a continuous, uniform coating of Steep Asphalt into which, while hot, embed the insulation.

B. Vinyl Type

Apply approved adhesive over approved vapor barrier in ribbons at rate specified by U.L. and F.M. and place insulation.

NOTE: When the incline of the roof is one (1) inch per foot or more, the insulation shall be secured to the deck in accordance with recommended procedures of the deck and insulation manufacturer.

Application of insulation and roofing materials shall be according to Section 2.2 Page 8, Specifications No. 17 wi and 18 wi.

When vapor barriers other than felt are used, extreme care must be taken to insure that adhesives used will provide sufficient adhesive strength with the insulation used to maintain secure attachment (see Section 1.3.5). While vapor barriers, adhesives, insulation, and insulation fasteners are part of the roof structure, they are not considered part of the built-up roofing. Information on materials other than built-up roofing is offered only to assist the designer in establishing their normal position in the roof structure, and should not be construed as an endorsement or as a part of these specifications other than to establish a suitable roofing base.

General Requirements on pages 3 through 6 and Detailed Specifications on pages 20 through 26 are a part of this specification and must be adhered to where applicable.

It is absolutely necessary to install insulation on a metal deck before the built-up roofing is applied.

A metal deck must be clean, smooth, and properly anchored to the steel purlins and all joints correctly lapped and fastened.

Type of metal deck, flute opening and various other factors determine the type and thickness of insulation required. Consult your Koppers representative for recommendations.

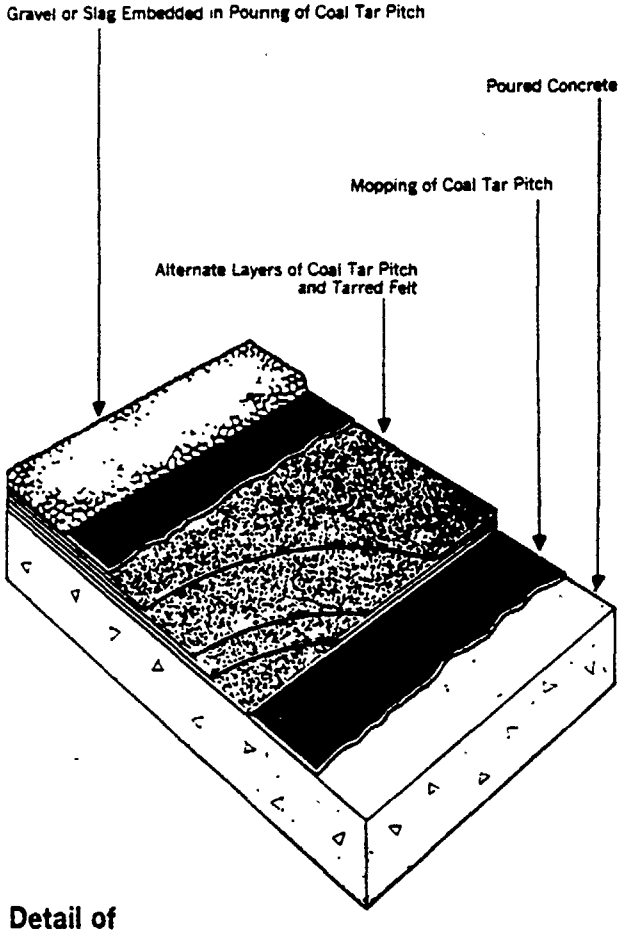
Metal roof decks shall be designed so that they will not have a deflection exceeding 1/240 of clear span under all types of roof traffic conditions including mechanical equipment used for roof application and weather conditions such as snow load.

deck construction:

2.4 Poured Portland Cement Concrete

SLOPE • Up to 2 in. per ft.
SURFACE • Aggregate

Spec. No. 5—4 ply
Spec. No. 7—3 ply



Detail of Specification No. 5

Poured concrete decks sometimes cause trouble because the built-up roofing is laid before the deck is thoroughly dry—such as might happen when the general contractor is anxious to get the building under cover and so urges the roofing contractor to begin work shortly after the deck has been poured. When this happens the result is a blistered and buckled membrane or, just as serious, insulation curls and makes an unsatisfactory job. The roofing contractor, backed by the architect, should insist on a thoroughly dry deck before beginning work. He should also see to it that the deck is free of loose sand, frozen scale and other foreign matter. Projections should be removed, low points filled with cement grout or other suitable material, and all cracks pointed up.

PROCEDURE

Select clauses as required. Optional clauses in italic.

Green copy denotes built-up roofing specification

Condition of Surface to Receive Roofing

Do not apply built-up roofing to any surface which is not reasonably smooth and free from projections or holes which might cause rupture of roofing membrane. Surfaces must be dry. Immediately before the application of the roofing, thoroughly clean the surface of dust and loose materials. Roof deck shall be properly graded to outlets.

Decks with inclines of one (1) inch per foot or more shall permit nailing, or treated wooden nailing strips must be installed prior to roofing. Nailing strips should be placed not more than three (3) feet apart on center and be run parallel with the slope of the roof and not across it.

Application of Roofing Materials

1st. Mop deck completely with Old Style Pitch.

2nd. Spec. No. 5

Apply over the entire surface, four (4) plies of Koppers Approved Tarred Felt, lapping plies twenty-seven and one-half (27½) inches. Mop solidly between each 27½ inch lap with Old Style Pitch so that in no place shall felt touch felt.

2nd. Spec. No. 7

Apply over the entire surface three (3) plies of Koppers Approved Tarred Felt, lapping plies twenty-four and two-thirds (24-2/3) inches. Mop solidly between each 24-2/3 inch lap with Old Style Pitch so that in no place shall felt touch felt.

For base sheet alternate see Section 1.3.7. Page 6.

Where slope of deck is one (1) inch per foot or more and deck permits nailing, nail along back or upper edge of each sheet on twenty-four (24) inch centers. Where deck does not permit nailing, nailing strips are required and each sheet nailed along back or upper edge at spacings to assure penetration of nailers.

3rd. Pour over the entire surface of the roofing membrane a uniform coating of Old Style Pitch into which, while hot, embed not less than four hundred (400) pounds of gravel or three hundred (300) pounds of slag for each one hundred (100) square feet.

General Requirements on pages 3 through 6 and Detailed Specifications on pages 20 through 28 are a part of this specification and must be adhered to where applicable.

deck construction:

2.5 Poured Portland Cement Concrete

SLOPE • Up to 2 in. per ft.
SURFACE • Aggregate

PROCEDURE

Select clauses as required. Optional clauses in italic.

Green copy denotes built-up roofing specification

Condition of surface to receive roofing see Section 2.4 Page 10

(Humidity Conditions—with vapor barrier)

Application of Membrane Below Insulation

1. Apply a uniform coating of Old Style Pitch to the deck.
2. Lay over the entire surface two (2) full thicknesses of Koppers Approved Tarred Felt, lapping each sheet nineteen (19) inches over the preceding sheet—mopping with Old Style Pitch the full nineteen (19) inches so that in no place shall felt touch felt.
3. Extend all plies of felt up vertical surfaces and cut off at height of insulation.

For other types of vapor barriers see Section 2.3 Page 9

Application of Insulation

Apply a uniform coating of Old Style Pitch over the entire surface into which, while hot, embed the insulation. If there are two (2) layers of insulation mop the entire surface of the first layer with Old Style Pitch into which, while hot, embed the second layer of insulation.

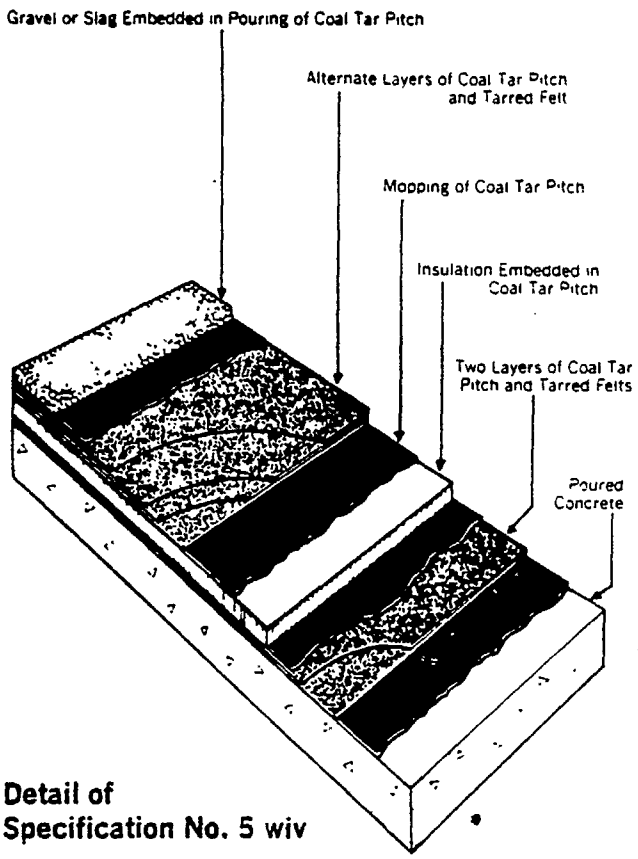
Application of roofing materials see Section 2.4 Page 10

When vapor barriers other than felt are used, extreme care must be taken to insure that adhesives used will provide sufficient adhesive strength with the insulation used to maintain secure attachment (see Section 1.3.5). While vapor barriers, adhesives, insulation, and insulation fasteners are part of the roof structure, they are not considered part of the built-up roofing. Information on materials other than built-up roofing is offered only to assist the designer in establishing their normal position in the roof structure, and should not be construed as an endorsement or as a part of these specifications other than to establish a suitable roofing base.

General Requirements on pages 3 through 6 and Detailed Specifications on pages 20 through 26 are a part of this specification and must be adhered to where applicable.

Spec. No. 5 wi–4 ply
Spec. No. 7 wi–3 ply
board type insulation

Spec. No. 5 wiv–4 ply
Spec. No. 7 wiv–3 ply
board type insulation with vapor barrier



Detail of Specification No. 5 wiv

Poured concrete decks sometimes cause trouble because the built-up roofing is laid before the deck is thoroughly dry—such as might happen when the general contractor is anxious to get the building under cover and so urges the roofing contractor to begin work shortly after the deck has been poured. When this happens the result is a blistered and buckled membrane or, just as serious, insulation curls and makes an unsatisfactory job. The roofing contractor, backed by the architect, should insist on a thoroughly dry deck before beginning work. He should also see to it that the deck is free of loose sand, frozen scale and other foreign matter. Projections should be removed, low points filled with cement grout or other suitable material, and all cracks pointed up.

deck construction:

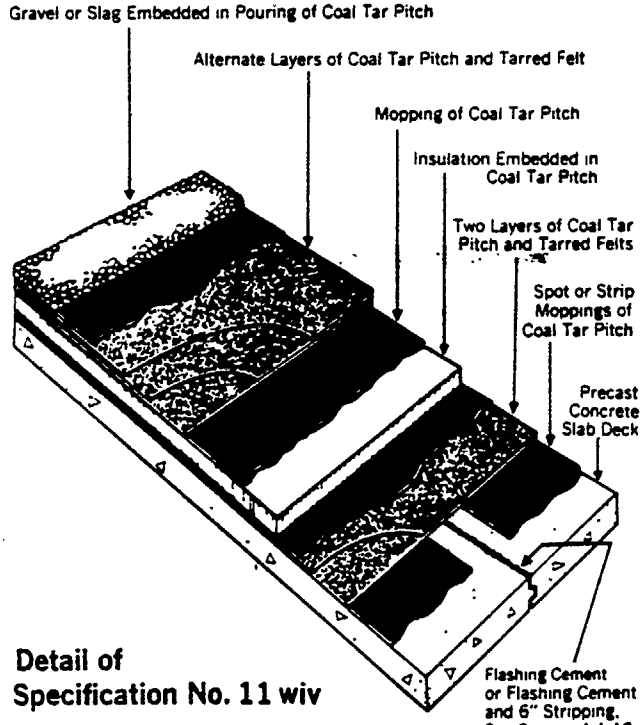
2.6 Precast Structural Concrete Sections

SLOPE • Up to 2 in. per ft.
SURFACE • Aggregate

Spec. No. 10–4 ply
Spec. No. 11–3 ply

Spec. No. 10 wi–4 ply
Spec. No. 11 wi–3 ply
board type insulation

Spec. No. 10 wiv–4 ply
Spec. No. 11 wiv–3 ply
board type insulation and vapor barrier



Detail of Specification No. 11 wiv

Precast concrete structural section should receive the same careful scrutiny recommended for poured concrete decks, although as a rule the possibility of moisture being present due to insuffcient drying time is not likely to be encountered. However, the contractor will often find one or more slabs resting unevenly which results in edges projecting above the surface. This may have been due to poor workmanship in laying the slab and should be corrected by resetting or leveling off. Where it is necessary to fill low areas, the use of cinder aggregate is not permitted since this material traps air and moisture, causing it to expand and crack when covered. The result is a badly blistered built-up roofing surface. All joints, whether grouted or not, should be caulked with trowel-grade asphaltic plastic cement. Sides and ends of slabs should be square. Slabs must rest firmly and evenly on supporting members. Slabs must be installed to prevent lateral and vertical movement.

PROCEDURE

Select clauses as required. Optional clauses in italic.

Green copy denotes built-up roofing specification

Condition of Surface to Receive Roofing

Do not apply built-up roofing to any surface which is not reasonably smooth and free from projections or holes which might cause rupture of the membrane. Surfaces must be dry. Immediately before the application of the roofing, thoroughly clean the surface of dust and loose material.

All joints between precast concrete slabs whether grouted or not shall be caulked with plastic cement which shall be applied so that the top surface is level with the deck. (Felt strips four (4) to six (6) inches wide may be set in the trowelling of cement for additional protection when so specified by the architect. Felt stripping in flashing cement assists in leveling uneven joints and bridges the joint opening providing a better base for the roofing materials.)

Decks with inclines of one (1) inch per foot or more shall permit nailing, or treated nailing strips must be set in the deck flush with the surface. Where insulation is specified, nailing strips may be secured to the deck surface and shall be level with the surface of the insulation. These strips should be spaced not more than three (3) feet apart and placed up and down and not across the slope of the roof. Roof deck shall be properly graded to outlets.

Application of Membrane Below Insulation

1. Apply a uniform coating of Old Style Pitch to the deck. On precast concrete slab or tile deck, strip mop with Old Style Pitch up to four (4) inches from the edge of each joint. Not less than 30% of the surface must be mopped.
2. Lay over the entire surface two (2) full thicknesses of Koppers Approved Tarred Felt, lapping each sheet nineteen (19) inches over the preceeding sheet—mopping with Old Style Pitch the full nineteen (19) inches so that in no place shall felt touch felt.
3. Extend all plies of felt up vertical surfaces and cut off at height of insulation.

For other types of vapor barriers see Section 2.3 Page 9

Application of Insulation

Apply a uniform coating of Old Style Pitch over the entire surface into which, while hot, embed the insulation. If there are two (2) layers of insulation mop the entire surface of the first layer with Old Style Pitch into which, while hot, embed the second layer of insulation.

Application of Roofing Materials

1st. Each slab shall be spot or strip mopped with Old Style Pitch, keeping pitch moppings back at least four (4) inches from all edges of each slab joint. Not less than 30% of the surface must be mopped. When applying over insulation, mop insulation completely with Old Style Pitch.

2nd. Spec. No. 10

Apply over the entire surface four (4) plies of Koppers Approved Tarred Felt, lapping plies twenty-seven and one-half (27½) inches. Mop solidly between each 27½ inch lap with Old Style Pitch so that in no place shall felt touch felt.

2nd. Spec. No. 11

Apply over the entire surface three (3) plies of Koppers Approved Tarred Felt, lapping plies twenty-four and two-thirds (24-2/3) inches. Mop solidly between the 24-2/3-inch lap with Old Style Pitch so that in no place shall felt touch felt.

For base sheet alternate see Section 1.3.7. Page 6

Where slope of deck is one (1) inch per foot or more and deck permits nailing, nail along back or upper edge of each sheet on twenty-four (24) inch centers. Where deck does not permit nailing, nailing strips shall be installed and each sheet nailed along back or upper edge at spacings to assure penetration of nailers.

3rd. Pour over the entire surface of the roofing membrane a uniform coating of Old Style Pitch into which, while hot, embed not less than four hundred (400) pounds of gravel or three hundred (300) pounds of slag for each one hundred (100) square feet.

Membrane below the insulation and insulation including methods of application are not part of built-up roofing. Suggestions described in this section are ofiered to assist the designer in establishing their normal position and to indicate requirements for a suitable base for the built-up roofing. See Section 2.3 Page 9.

General Requirements on pages 3 through 6 and Detailed Specifications on pages 20 through 26 are a part of this specification and must be adhered to where applicable.