



Paving with Portland cement concrete

A safety program for use in concrete paving construction should emphasize plant operations, over-road hauling to paving sites and concrete paving operations. Reduction or elimination of hazards surrounding each operation, along with precautions that should be followed, will be discussed in this data sheet.

Batch plant transporting and setup

2. When transporting batch plants to a job-site, federal, state and local regulations must be followed with particular attention to weight, width and height limitations of roads, bridges and structures on the route of travel. (The weight per axle limitation should also conform to state and local regulations.) The towing vehicle and towed equipment should be in good operating condition. Also, speed limitations as required by state and local laws, and as suggested by equipment manufacturers, should be observed.

3. A towing vehicle should have adequate capacity for the weight and size of the load transported. Tag lines should be used when loading and unloading. Ramps also should be supported adequately during all loading and unloading. When required by regulations or if deemed necessary, a lead and follow-up vehicle for large, slow and oversized loads should be provided. Because of the nature and size of this equipment, any curves en route should be traversed slowly. Vehicles approaching gentle- or large-radius curves should slow to a moderate speed until out of the curved section of the road. It is most important that routes be planned for oversize loads. The driver should be very familiar with the route, as well as the obstructions that could be encountered.

4. When these towing vehicles approach sharp- or small-radius curves, they should slow down to a minimum safe speed in a low gear until the curve is passed. (Lower gears should always be used when descending a steep downgrade; the driver should test his/her brakes before starting his/her descent. When drivers traverse roads having high crowns, they should be especially alert to reduce tipping hazards.) All regulations regarding railroad crossings should be strictly observed. Road surface imperfections such as chuckholes, railroad tracks and roads under construction should be traversed with caution to avoid damage to the vehicle and equipment, and to prevent overturning.

5. Batch plants should have adequate bearing support to reduce the possibility of tipping over due to settlement or high wind loadings. Personnel should wear long-sleeve shirts and long pants, hard hats, gauntlet gloves with the cuffs turned part way down, high-visibility vests and sturdy rubber boots. In addition, personnel should stand clear of all overhead loads and not be allowed to ride the load. All equipment shall be provided with rollover protection where applicable, and should be substantially constructed and engineered for the machine to protect the operator in case of rollover or falling equipment. A safety belt and seat should be afforded for the operator or operators when the equipment is equipped with rollover protection.

6. Cranes used to erect or dismantle the batch plant should conform to ANSI standards. Lifting devices should be located on firm ground, and adequately braced or supported to avoid overturning. The crane should be perfectly level and free of the ground. Three degrees out of level may

reduce the lifting capacity of the crane as much as 50 percent, depending on the quadrant from which the load is being lifted. The weight of the load should be determined prior to making the lift. Make certain all built-up and loose material is taken into account, as well as any modifications that have been made to the load when determining the weight of that load. Only qualified personnel should be allowed to operate cranes. Slings, hooks and shackles should be kept in good condition and should be of adequate size, type and strength. All portable ladders used in erection of plants also should conform to ANSI standards. All hand tools such as spud wrenches, alignment pins and the like should be in good condition.

Concrete paving operations

7. Concrete is normally placed on a prepared sub-base; then it is consolidated, struck off and finished to a proper elevation by paving equipment (see Figures 1 and 2).

In various areas, reinforcing steel or mesh also is placed within the pavement. The equipment used should have all the controls easily accessible, and plainly marked or labeled to identify their intended function. The area where the operator's hand(s) contact(s) the controls should be smooth and free of abrasions, cracks, splinters or other imperfections. Automatic control systems should be designed with back-up "fail-safe" operations.

8. Conveyors used in a system should be designed, installed, operated and maintained in accordance with provisions in ANSI standards (see Sources of Information). When conveyors are operated in tunnels and similar enclosures, ample room is recommended to allow safe access and operating space. Emergency stop systems also should be provided for the full length of the conveyors in a system.

9. Fall hazards for concrete paving operations can be reduced by keeping platforms, walkways, ladders, and foot and handholds



Figure 1 shows self-propelled spreading equipment as it is used to distribute the concrete uniformly prior to the final consolidation and finishing operation.

(Courtesy Maxon Construction Co. Inc., Dayton, OH)



Figure 2 shows a slip-form paver as it consolidates, screens and finishes the concrete.

of mobile equipment clean and clear of all tools, materials and debris. Working platforms and walkways should be guarded adequately with railings and toeboards. Employees should be instructed to use the steps, hand-holds and ladders for mounting and dismounting equipment.

Note: Workers should not be allowed to stand between the back of a truck and a receiving hopper while a truck is discharging its cargo. Also, when ready-mixed concrete trucks are used, no worker should stand in front of or under a discharge chute, nor stand beneath or pass under a raised dump body of a vehicle (unless absolutely necessary and then only when the dump body is properly blocked.)

10. Reject-conveyor spouts or chutes of subgraders should be designed and geared to prevent all workers from walking in the path of discharging material. Steel reinforcing mats should be blocked when stored on trucks or on the ground to prevent them from sliding about or falling off trucks.

Vehicle and equipment maintenance

11. A large percentage of the hazards involved in concrete paving is associated with movement of materials by vehicles. To eliminate hazards characteristic of vehicles, a preventive maintenance program should be established and maintained.

12. Brake linings should be checked and replaced with approved brake materials when worn below the manufacturer's suggested thickness. Brake drums should be in sound mechanical condition, free from cracks, warps and other imperfections. Hydraulic lines, cylinders and fittings should be free from leaks, restrictions and air pockets, and they should be constructed to conform to SAE standards. Brake fluid reservoirs should be filled to the manufacturer's suggested level and properly covered to keep foreign material from entering the system. (Air receivers should be moisture-free.) Air-brake hoses, pumps and fittings should be connected properly, free from foreign matter, airtight (no leakage) and well main-



tained. All moving parts requiring lubrication should have the proper lubricant.

13. Electrical systems and lights should be in proper working order, conforming to federal, state and/or local codes. Minimum lights, such as headlights, directional signal lights (with four-way emergency flashers), brake lights, backup lights and running lights indicating the outline of the vehicle should be provided and maintained in proper working condition. All electrical connections for trailer accessories should be secured, and all wiring should be free of worn or frayed areas and conformed to SAE standards. (Audible alarms should be installed, kept in proper working condition and be audible above the noise level of the vehicle. The back-up alarms should be installed so they may not be overridden. It is recommended that all equipment that is bi-directional, even if there is a clear view to the rear, be equipped with audible back-up alarms.

14. Vehicle windows should be of safety glass and should be clear and free from cracks, holes, chips or other imperfections, as well as from stickers, labels and decals that would reduce an operator's vision. Windshield wipers and defrosters should be in proper working order. Rearview mirrors should be free from cracks, holes and other imperfections and installed in accordance with federal, state and/or local codes.

15. Exhaust systems should be free from leaks, designed not to create excessive noise and kept in good mechanical condition. Exhaust vapors should be directed away from the vehicle and its operator. Spark arresters and exhaust systems purifiers should be provided and maintained in proper working condition in those states requiring them.

16. All power transmissions and moving parts, such as chain drives, fans, revolving drums and rotating shafts, should be guard-

ed. The fifth wheel should be properly maintained, lubricated and kept in good mechanical working order. Dolly wheels or skids on trailers should be in good mechanical condition, properly maintained and lubricated and able to be locked in stored as well as employed positions.

17. Where accessibility to elevated locations on vehicles is required, properly designed, constructed and maintained ladders, as well as hand- and foot-holds, should be provided. Ladders should be kept clean and free of grease, oil and other foreign matter. Running boards, floors and platforms also should be kept free of debris, oil, grease and tools. All vehicles should carry those emergency supplies and equipment required by federal, state and/or local regulations. This equipment includes, but is not restricted to, fire extinguishers, flares, reflectors or flags, chock blocks, and first aid kits.

18. The vehicle's cargo-carrying body should be designed and constructed to perform its intended duty without causing injury to personnel or damage to equipment. The body should be free of holes, cracks or other imperfections to eliminate leakage of the cargo. Tailgates should close tightly to eliminate leakage and have a positive locking mechanism. The tailgate-locking mechanism and control lever should be plainly marked and located to prevent cargo from falling onto an operator upon release of the lever. In addition, all control valves should be easily accessible and plainly marked or labeled for their intended purpose and free of other imperfections. Some states may require tarping the load to minimize spillage.

Traffic hazards

19. The traffic pattern at a jobsite should be preplanned and laid out to eliminate any congestion or possible hazards. It is recom-



mended that left-hand traffic patterns should be discouraged when there is an alternative. Points where signals or flagmen are required should be considered in the construction planning. Barricades and warning signals should conform to ANSI D6.1, *Uniform Traffic Control Devices for Streets and Highways*, Part V, "Traffic Control for Highway Construction and Maintenance Operations," or federal, state or local standards. (See also National Safety Council Data Sheet 1-239, *"Barricades and Warning Devices for Highway Construction Work."*) The Federal Highway Administration's publication, "Manual on Uniform Traffic Control Devices," is recognized throughout the United States.

General site conditions

20. To reduce electrical hazards, all electrical equipment and wiring should conform to the National Electrical Code, NFPA 70, and to state and/or local codes. Whenever operations are less than required minimum distances from overhead or underground powerlines, contractors should contact the power company concerned and have lines located and moved or insulated or have the current shut off. If this is not possible, the required distance between the powerlines and equipment to ensure safe operation must be maintained. The minimum clear distance required is not less than 10 feet from any powerline.

21. To reduce fire and explosion hazards, all combustible materials should be stored in isolated areas away from exposure to open flames, work areas and equipment. Engines should not be refueled while they are running. Smoking also should be prohibited during all refueling operations. All internal combustion engine exhaust pipes should be equipped with a spark arrester in good working order that is maintained

properly. A proper fire extinguisher should be carried on all motorized equipment, and personnel should be trained in its use. Firefighting equipment, as required, should be provided for fuel storage areas. All fuel tanks should be color-coded and labeled for contents.

22. Pinch-point hazards should be controlled by guarding them in accordance with ANSI standards. Mixing boxes should be provided with adequate guards to prevent personnel from falling into them. All wheels or tracks supporting paving equipment should be guarded effectively to eliminate the possibility of a worker's feet being crushed by them. Any adjustment for regulating the rates of discharge or feed, belt alignment, major maintenance and lubrication should be performed only after equipment has stopped and the drive mechanisms are locked out, whenever these operations place individuals in a hazardous position. Equipment that is shut down should have the motor shut off and the parking brakes set, and should be placed in low gear.

23. Collapse hazards can be eliminated by designing all component buildings, elevators, dust collectors, storage tanks, bins and reservoirs to withstand applied loads of contents, high-wind loads and dynamic loads. Gravity-feed pipes and discharge chutes should be substantially constructed to support and contain their contents when full, should the open ends become temporarily constricted. Bulkheads, bins and storage reservoirs should be designed and constructed to withstand the forces of impact from the materials during loading.

24. Where endloaders are used to charge hoppers, the bulkheads should be strong enough to withstand the impact thrust of the loading equipment as it moves the aggregate into position over the hopper. Where trucks must back onto earth-filled ramps to discharge their cargo into bins or



hoppers, the retaining wall supporting the ramps should be designed and constructed to withstand the movements of the loaded vehicle. Midaxle-height berms should be provided on the outer banks of elevated ramps or elevated roadways to prevent overturning. Dump-truck bunkers should have wheel-bumper blocks installed to prevent the truck from backing too far. Cranes used to stockpile and convey aggregate to bins, hoppers and the like should be designed to be compatible with the bins being serviced in order to prevent material from becoming jammed or lodged in the bin when it is fully open to discharge materials. Workers should not be allowed to stand or pass beneath the area of travel of the clamshell or bucket.

25. Dust and vapor hazards can be controlled around batch plants and concrete paving operations by installing adequate dust-collection systems that conform to federal, state, local codes and regulations (see OSHA regulations, Section 1926.55, "Gases, Vapors, Fumes, Dusts and Mists").

26. When dust may be objectionable or when it interferes with the efficient operation of the plant, a wet-collecting system should be installed. Where wet- or water-type dust collectors are used, the discharge of slurry should not be expelled in areas where it may pollute the water supply. Slurry ponds should be fenced and constructed to conform to federal, state and/or local regulations.

27. Employees working with cements and additives, and who are required to enter dusty hoppers or bins or work in dusty locations, should wear approved respirators and eye protection. Safety lines and belts should be provided for every employee required to enter any bin, and such employees should be attended by another worker similarly equipped outside the bin. Air quality should be monitored prior to entering

the bin and on a continuous basis while personnel are in the bin.

28. Dust created by material hauling vehicles, public traffic and other sources should be controlled. Exhaust vapors from internal combustion engines should be discharged away from or above the working stations or areas.

29. To prevent material from falling off overhead conveyors, they should be constructed to restrain spillage of material. Overhead protection should be provided over walkways and roadways. All elevators, screening systems, weighing hoppers and mixers should be enclosed to confine materials. Crane buckets should be capable of fully closing to avoid leakage. All rivet or bolt holes in the crane bucket should be closed. Overhead piping, steam lines, dust-collecting ducts, etc., should be supported to prevent them from falling in the event of adverse weather conditions or from material build-up from within.

30. To prevent workers from falling, substantial walkways and working platforms equipped with guardrails, toeboards and handrails should be installed. These areas include, but are not restricted to:

- Top of elevators
- Atop or around dust collectors
- Mixer platforms
- Control stations
- Weighing stations

31. Noise levels in the plant or concrete paving operation should be checked with an appropriate instrument to determine if noise levels are above those listed in current standards (see OSHA Regulations, Section 1926.52, Occupational Noise Exposure). Some plant equipment, when operating at full capacity, will exceed the recommended noise level. In these operations, a hearing conservation program should be instituted and personal hearing protection used.



32. Medical and sanitary facilities should be provided in accordance with federal, state and/or local laws to treat any injuries that might occur (see OSHA Regulations, Section 1926.51, Sanitation; and Section 1926.50, Medical Services and First Aid).

33. Illumination for a plant should be in accordance with federal, state, and/or local codes or ANSI standards and OSHA 1926.56, Illumination.

34. All accumulation of concrete spillage around a plant should be cleaned up and hauled away each day. Accumulated cement dust should be periodically collected because it tends to become slippery when compacted and wet. Providing a clean layout for all operations is possible by keeping grease, oil and other foreign material from equipment and walkways. Good housekeeping is a must.

Personal protective equipment

35. Personal protective equipment should be used when needed for the tasks and hazards involved. Personal protective equipment recommended for plant and concrete paving operations are gloves of the rubber-gauntlet variety with cuffs turned down (heat-resistant, if necessary), safety hats, safety shoes, rubber boots, safety goggles and approved respirators. Clothing should consist of long-sleeve shirts and long pants. Respirators should be of the type for the hazards encountered and be approved by NIOSH/MSHA (see OSHA Regulations, Part 1926, Subpart E, Personal Protective and Life-Saving Equipment).

Acknowledgment

This data sheet was revised by the Construction Division, National Safety Council, 1121 Spring Lake Drive, Itasca, IL 60143.

Sources of information

American National Standards Institute, 1819 L St., N.W., 6th Floor, Washington, DC 20036. (Note that standards promulgated as regulations under the Occupational Safety and Health Act are identified by section of Part 1926, Chapter XVII, Title 29 - "Labor" of the *Code of Federal Regulations*, which is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402):

Conveyors, and Related Equipment, B20.1-1984.

Mobile and Locomotive Truck Cranes, B30.5-1982. (OSHA Regulations, Part 1926-Subpart N.)

Portable Wood Ladders, A14.1-1982. (OSHA Regulations, Part 1926-Subpart L. Section 1910.25.)

Portable Metal Ladders, A14.2-1982. (OSHA Regulations, Part 1926-Subpart L.)

Mechanical Power-Transmission Apparatus, B15.1-1984. (OSHA Regulations, Part 1926-Subpart V.)

Safety Requirements for Floor and Wall Openings, Railings, and Toeboards, A12.1-1973. (OSHA Regulations, Part 1926-Subpart M.)

Practice for Industrial Lighting, RP7-1983.

Uniform Traffic Control Devices for Streets and Highways D6.1-1978.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169:

National Electrical Code, NFPA 70. (OSHA Regulations, Part 1926-Subpart K.)

Flammable and Combustible Liquids Code, NFPA 30. (OSHA Regulations, Section 1926.152.)

Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096:

Hydraulic Hose Fittings, SAE J516a.

Truck, Truck-tractor, Trailer, and Motor Coach Wiring, SAE J555z.

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