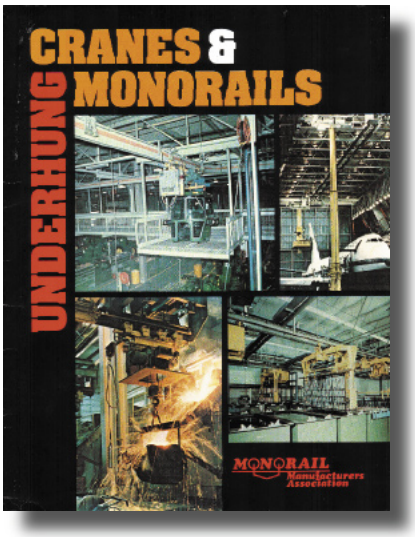
Whiting Equipment Canada Inc.
Underhung Cranes & Monorails



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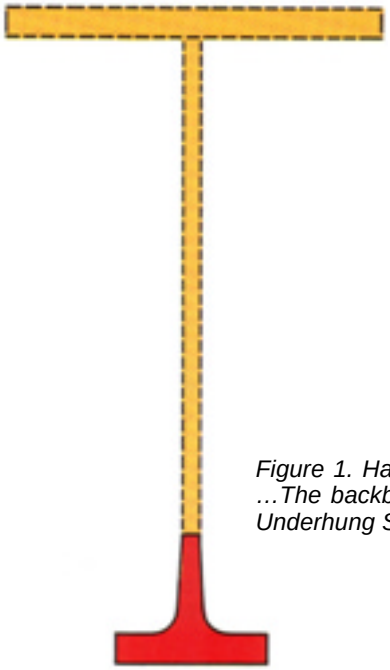


Figure 1. Hard alloy steel inverted T" …The backbone of the track used in Underhung Systems

Introduction:

Over One Hundred Years of Product Development.

An event of far reaching impact occurred in the material handling industry over one hundred years ago with the introduction of Underhung Crane and Monorail Systems.

As early as 1933, the manufacturers of Underhung Crane and Monorail Systems met to discuss ways to improve service to their customers by increasing and accelerating technical advancements in their industry. For more than fifty years, the member companies of the Monorail Manufacturers Association have been continuously improving the safety and quality of their products. Today, MMA member companies are leading manufacturers of Underhung Crane and Monorail equipment.

Monorail Manufacturers Association (MMA) is one of the oldest and most respected trade associations of manufacturers in the United States. It is affiliated with The Material Handling Institute Inc. MMA has been a major contributor in the development of a variety of safety standards and specifications in use today and is called upon for guidance by other organizations including the American National Standards Institute, The American Foundrymens Society, and the National Electrical Code Committee. Also, MMA sponsors a number of its own publications created to enhance the exchange of information and assist the users and specifiers of Underhung Crane and Monorail Systems.

This brochure has been created to acquaint you with the monorail industry and the MMA member companies. It illustrates many material handling and other economic advantages of Underhung Crane and Monorail Systems.

Underhung Crane and Monorail Systems In Your Facility

Underhung Crane and Monorail Systems are used to transport loads weighing from 30 pounds to 30 tons. The heart of the Underhung Crane and the Monorail System is the hard alloy steel inverted "T," as illustrated in Figure 1. Wheels of underhung devices ride on the inverted "T" which is part of a highly engineered system designed specifically for the application. The difference between the Underhung Crane and Monorail is:

- The Underhung Crane System is comprised of a runway and bridge to move a load in a straight or variable path from one point to any other point in a prescribed operating area.
- The Monorail System, using switches, turntables, and other devices, enables loads to be transported in a wide variety of fixed routes.

Underhung Crane and Monorail Systems offer more advantages than alternate forms of material handling equipment.

- The Underhung System operates overhead and does not interfere with productive, on-the-floor activities.
- The Underhung System moves loads quickly and easily to many locations.
- Underhung Systems are more energy efficient and cost less to install and maintain.
- Underhung Systems do not pollute the environment.
- Underhung Systems have taken advantage of modern technology for safety, reliability, efficiency, ease of operation, and reduced cost.

Underhung Crane and Monorail Systems may be used independently and in conjunction with each other, and both can be interfaced with other forms of material handling equipment. As a result, they can satisfy or improve upon most material handling operations.

There can be a place for an Underhung Crane and Monorail System in your business.

The Underhung Crane... Versatility Not Available In Other Systems

The load-moving versatility of the Underhung Crane is illustrated in Figure 2. Loads can be moved from one point to another, anywhere in the shaded rectangle. Another distinct advantage of the Underhung Crane System is its unique ability to transfer loads between adjacent cranes in one bay, between cranes in adjacent bays, and between buildings with ease.

Underhung Cranes can be used for most material handling applications. Examples include:

- Receipt of raw or semi-finished materials or parts
- Storage of materials or parts
- Transportation of raw material or parts to the production areas
- Movement on the production lines
- From production lines to the loading dock
- Loading operations
- UNDERHUNG CRANES APE USED IN *ALL* INDUSTRIES

Underhung Cranes can be hand pushed or hand chain driven. (Figure *3.)* They also can be powered and controlled by a pendant. (Figure 4.): by hardwire remote control; radio control; by cab operation as in (Figure 5.): or automatically.

Hand pushed or hand chain driven cranes are best suited for handling light loads or loads that are moved infrequently. Pendant controlled cranes enable the operator to maintain close watch on the load while it is being moved. Remote or radio controls are used when the operator may not, or cannot, get near the load: or when required to operate several cranes from a remote point.

Cab operated cranes are ideal when floor space is limited, when high-speed travel is required, or when an aerial view of the load being handled is necessary. Automatic operation reduces or completely eliminates the need for operators. All of these control techniques can he used in an overall system.

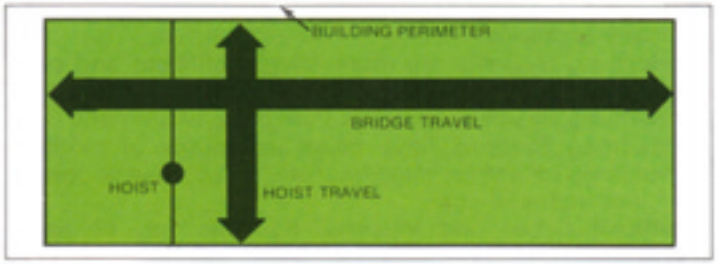


Figure 2. Underhung Crane Systems can *move, lift, and lower loads anywhere in the shaded rectangle. The crane bridge moves left and right on the runways. The trolley hoist unit moves on the bridge toward the top and bottom in this illustration.*

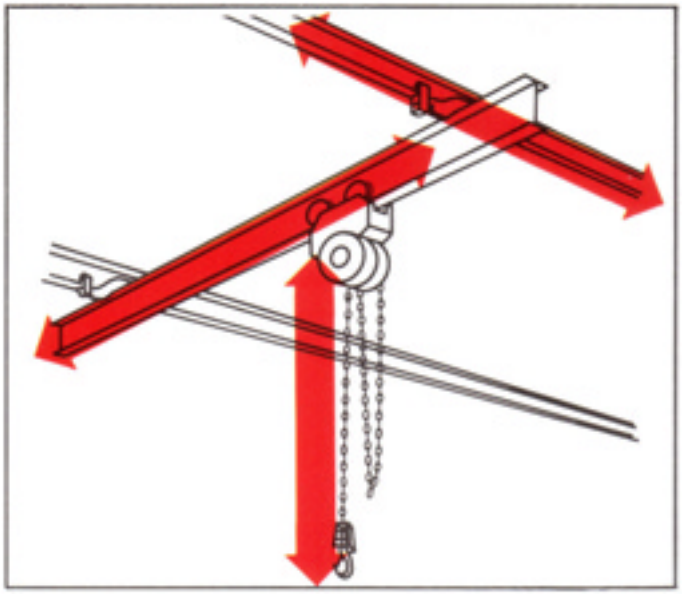


Figure 3*. Hand pushed Underhung* Crane with hand driven *chain hoist*.

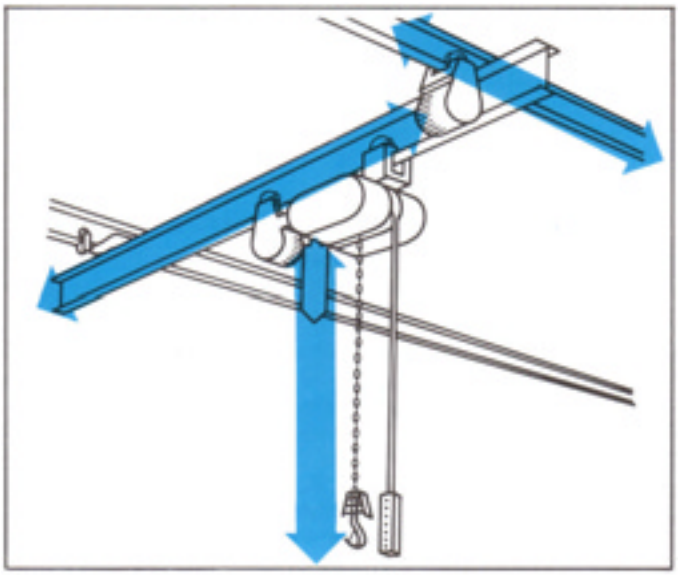


Figure 4. Pendant controlled Underhung Crane.

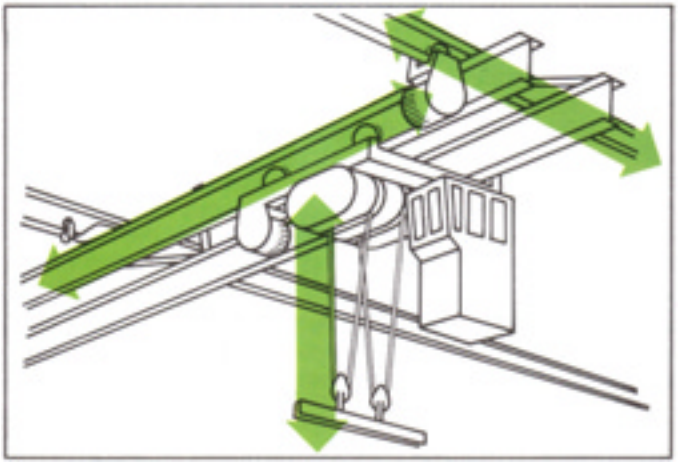


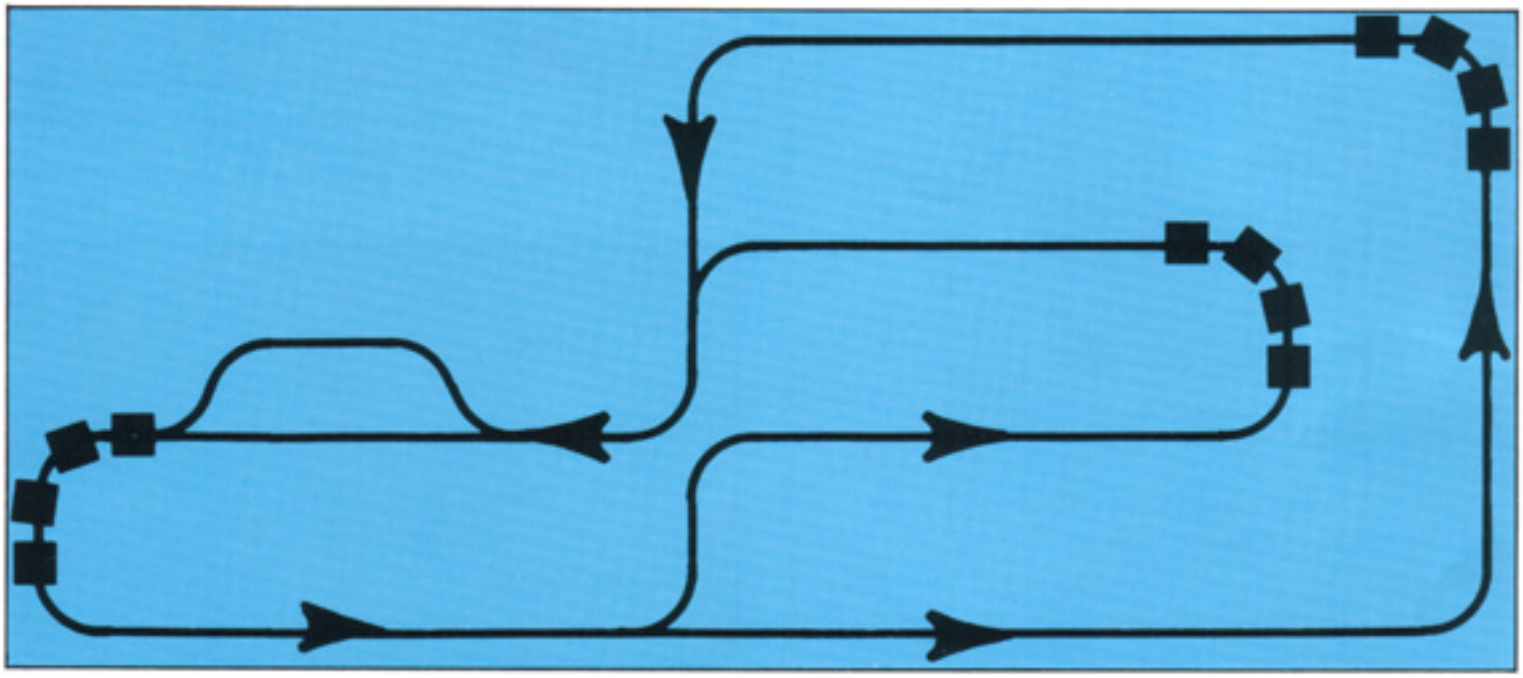
Figure 5. Cab operated Underhung Crane,

The Monorail System… Takes the Load Where You Want It… When You Want It

Like the Underhung Crane the Monorail System can be used for many material handling applications … from receipt of raw material to delivery of finished goods. Monorail Systems move loads along fixed routes as illustrated in Figure 6, using any number of switches to alter the route of the load.

Carriers for Monorail Systems are either hand propelled or power driven. When power driven, they may be controlled by pendant, cab, or from a remote station. In some cases, loads are automatically moved for a predetermined distance, then moved under manual control at load or unload areas. Loads can be moved non-stop, or they may be programmed to stop at intermediate stations along the route.

Figure 6. Monorail Systems use switches and other devices to alter route of travel. They can also use lift and drop sections to raise and lower loads. Modes of operation include automatic, electric remote control, cab, pendant, by hand, or in any combination.



Automation in a Monorail System can be as basic as simply picking up and delivering loads without operator assistance. An automatic Monorail also can be programmed to raise, lower and rotate the load: automatically store finished or semi-finished goods; or route coded products to appropriate points on the assembly line. Automatic Monorail Systems have been built with multiple routes and multiple elevations. The variety is endless.

All types of Hoisting Mechanisms can be used with Monorails. A wide variety of below-the-hook lifting devices designed to handle many different sizes and types of loads can be suspended from the hoist.

As with the Underhung Crane, a Monorail system is primarily designed to operate overhead and not interfere with ground level activities, Because Monorail and Underhung Crane track systems use the same inverted “T,” they can interconnect easily through the use of interlocking devices as illustrated in Figure 7. Additional advantages of Monorail Systems are discovered with each new installation. Now is the time for you to discover some.

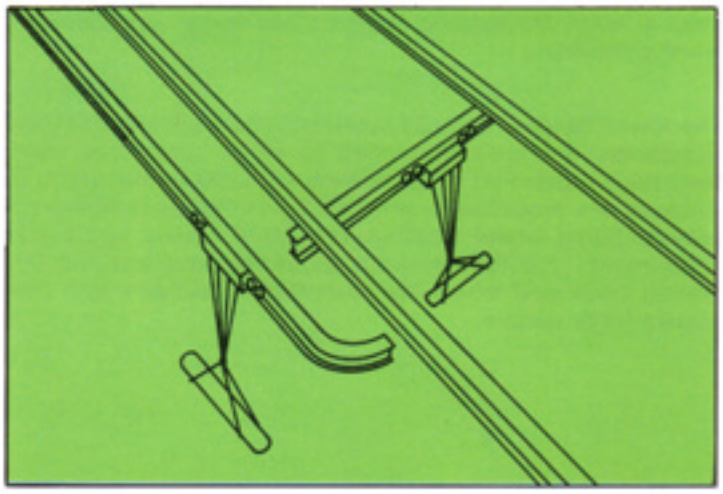


Figure 7. Switches and interlocking devices in Underhung Systems enable Monorail carriers to move onto Underhung Crane Systems.

Hard Alloy Steel Track Vs. I-Beams

There are two basic types of Underhung Systems available today:

1. Systems which use a hard alloy steel track designed and produced specifically for Underhung Crane and Monorail applications.
2. Systems which use construction-grade I-beam track.

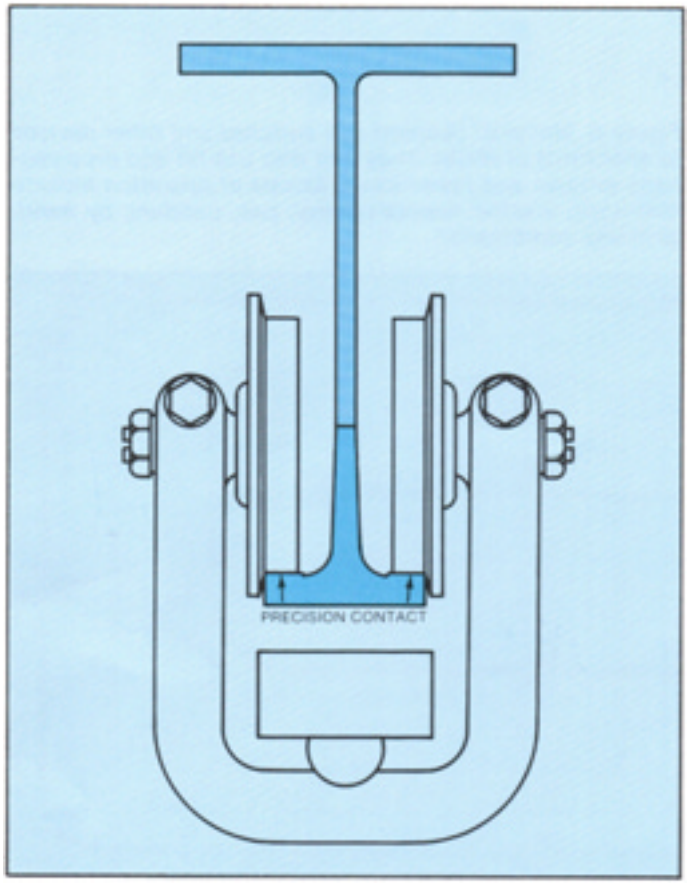


Figure 8. Hard alloy steel tracks and articulated trolleys used in Underhung Systems last longer and operate MMA more smoothly.

The lower flanges of tracks manufactured by MMA member companies are specially rolled to close tolerances from hard alloy steel. Flat tread wheels with hardened wearing surfaces are mounted in articulating trolley assemblies to provide equal wheel loading. The MMA trolley and track combination provides smooth operation and assures far greater track and wheel life than that obtainable with the I-beam track system.

The flexible suspension of the MMA track system results in less stress transmitted to the building structure, which, in turn, reduces building construction and repair costs. Flexible suspension is not readily available in I-beam systems.

An additional benefit from using MMA track systems is a uniform tread width throughout; despite varying load conditions and track depths. This uniformity allows complete interchangeability of trolley and track, resulting in the most efficient and economical overall system.

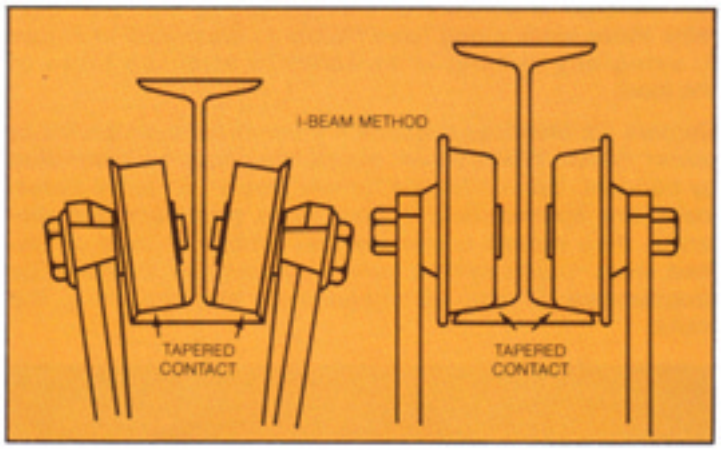


Figure 9. Rigidly mounted wheels operating on tapered I-beam track cause *excess wear, and require more effort to propel, resulting in higher maintenance and replacement costs.*

FEATURES	ADVANTAGES	BENEFITS
Flexible Track Suspension	• Less Stress Transmitted to the Building • Smoother operation of Trolleys	• Lower building costs • Longer Hanger Rod Track and Wheel Life
Articulated Trolleys	• Equal Wheel Loading	• Track and Wheels Last Longer
Flat Trolley Treads	• Less Friction • Less Thrust • True Vertical Loading	• Longer Bearing Life • Longer Track Life
Hard, Flat Tread Rail	• Less Friction	• Longer Track and Wheel Life
Uniform Tread Width	• Variable Spans with Consistent Wheel Gauge • Optimum Rail Size	• Lower Initial System Cost • Lower Total System Weight
Interlocks & Switches	• Integrated Handling System • Eliminates unnecessary Load Re-handling	• Lower Material Handling Equipment Cost • Increased Productivity

Underhung System Vs. Top Riding Cranes

A top running crane can be designed to lift massive loads but is far less versatile than the Underhung Crane, Figure 10 illustrates one of the major advantages of an Underhung Crane…its ability to interlock with a fixed Spur, crossover, and adjacent cranes. This interlocking capability allows a load to be transported throughout the plant system without the need to set it down, thereby eliminating re-handling.

In wide crane bays, adjacent Underhung Crane runways can be suspended directly from the overhead building structure without the need for interfering support columns. Under-hung Cranes operate side-by-side without interfering with each other or the overall operation. They have the ability to pass each other on their independent runway Systems. To accomplish the same multiple service with top riding equipment, you must either add auxiliary columns to the building or gantry legs to the bridge: both of which interfere with the plant operation.

In general, for equal spans, capacity and runway support centers, the Underhung Crane system is lighter than the top running system. In extremely wide building bays, one long Underhung Crane can operate on a multiple-runway System minimizing the depth of the bridge girder and the weight of the operating equipment. These features result in lower initial equipment cost and lighter design requirements in the building or supporting structure.

If your loads are 30 tons or less, the light and versatile Underhung Crane System probably is your best choice.

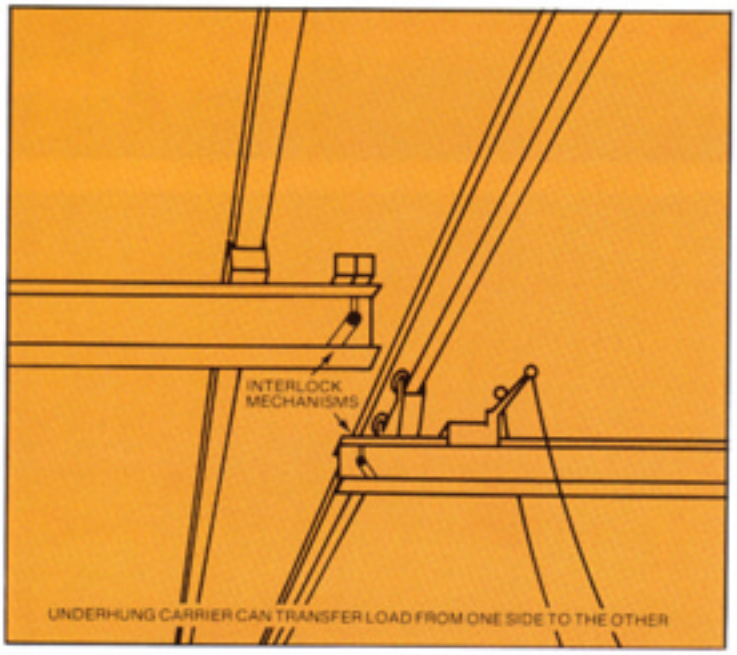
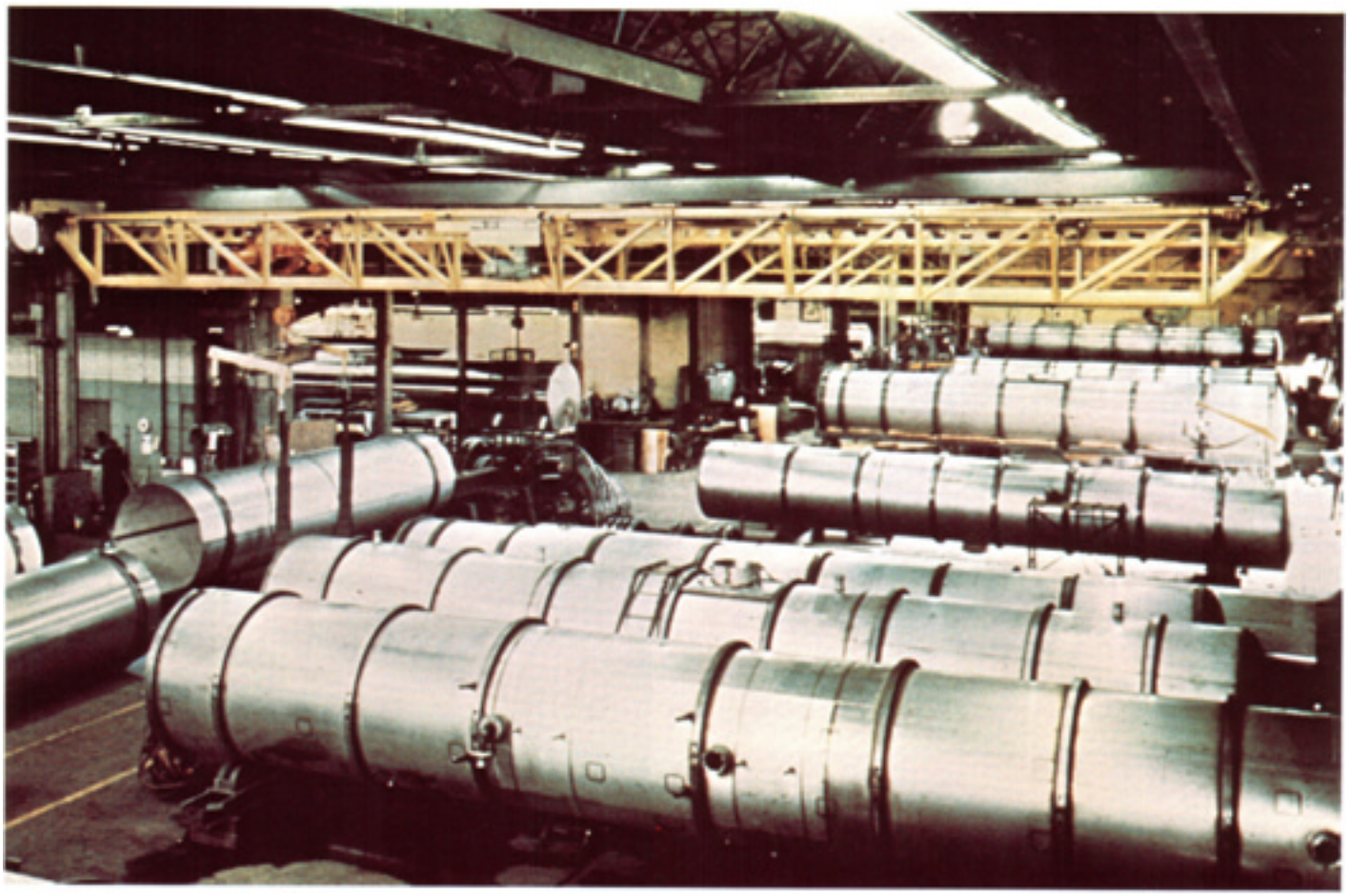


Figure 10. Interlock mechanisms enable the Underhung Crane to transfer loads between bays. This device also produces a connection between Underhung Cranes and Monorail Systems.

FEATURES	ADVANTAGES	BENEFITS
Interlocks & Switches	• Integrated Handling System Eliminates Unnecessary Load Re-handling	• Lower Material Handling Equipment Cost • Increased Productivity
Multiple Runways in One Crane Bay	• Ability to Pass Load in the Bay • Multiple Individual Hook Usage	• Lower Material Handling Equipment Cost • Increased Productivity
Flexible Track Suspension	• Less Stress Transmitted to the Building	• Lower Building Costs
Multiple Runway Crane	• Lighter Weight crane	• Lower Building Cost • Lower Crane Cost
Track Suspended from Above	• Concentric Column Loading	• Lower Building Cost • Fewer Building Columns

Underhung System Vs. Fork Lift Trucks



Underhung Systems are more space efficient in many aspects than fork lift trucks because they operate overhead, Underhung Systems move loads more quickly and directly from one point to another. Underhung Equipment does not interfere with ground activity and requires no aisles.

Additional benefits of Underhung Crane and Monorail Systems compared to fork lift trucks are:

- Lower Building Maintenance Costs (floor re-surfacing)
- Far Lower Equipment Maintenance Costs
- Less Product Damage
- Lower Operating Costs
- Handling of *a* larger variety of loads
- Greatly increased operating life of equipment
- Operator has better visual control of his load resulting in safer operation.

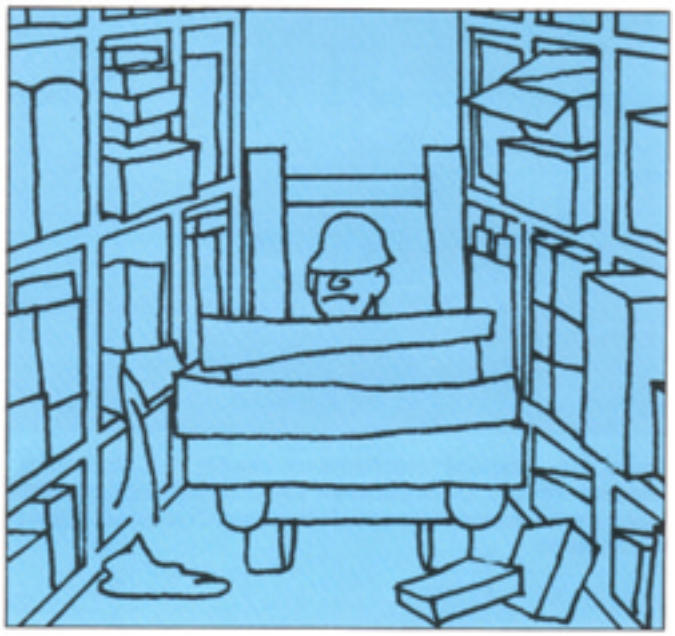


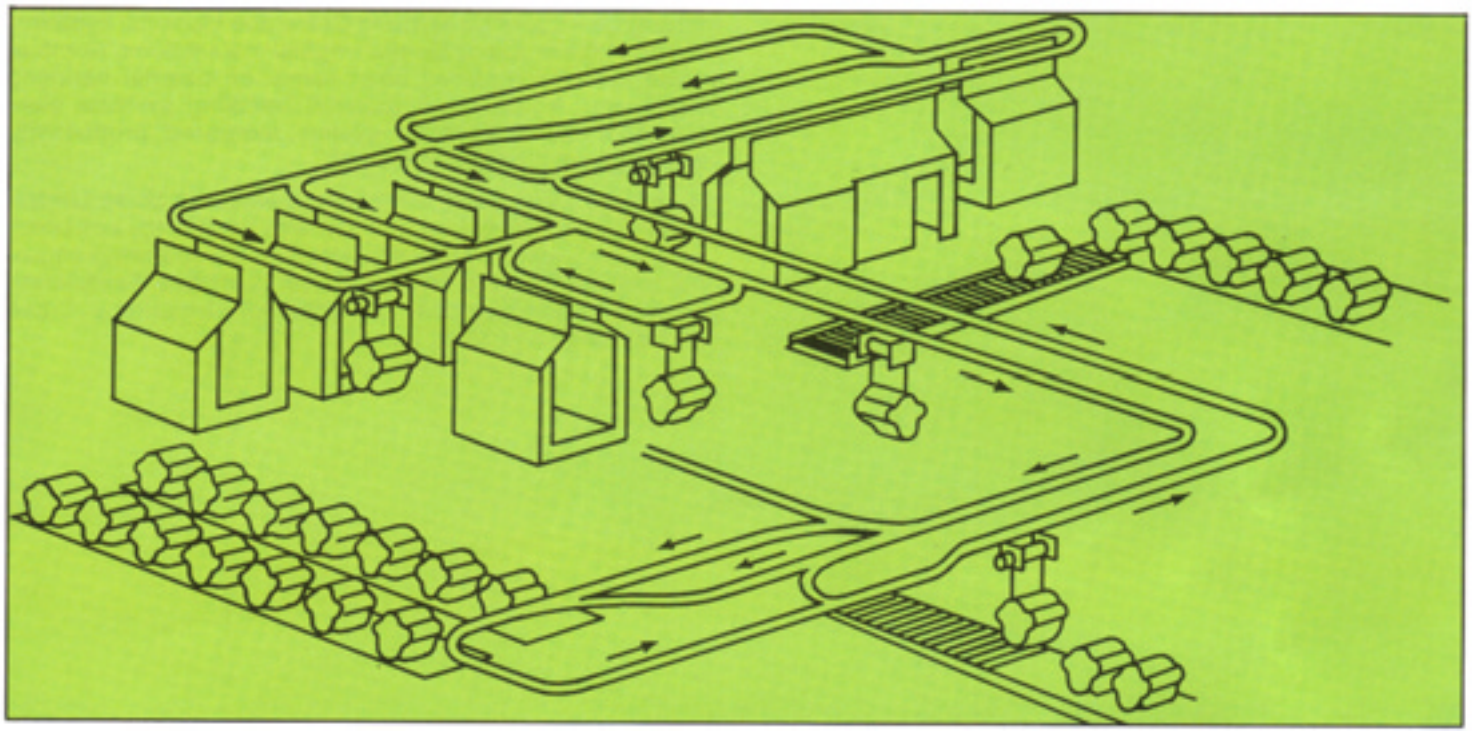
Figure 11. Handling loads overhead results in less building and product damage.

Automatic Monorail Vs. Power and Free Conveyors

Several years ago, power and free was introduced to the industrial market as an advancement to the simple trolley conveyor. Even though it appears to provide answers to some material handling problems, it has shortcomings that can be eliminated by substituting a programmable automatic monorail system.

Monorail carriers are driven individually and can be removed from the system when necessary and the system operation continues. As the power and free conveyor has a single drive, the entire system stops when repairs are necessary.

Figure 12. In an Automatic Monorail System, repairs are possible without shutting down the entire system because each carrier is powered individually. In a power and free conveyor, the entire system must be stopped to make repairs.



Monorail carriers are electrically blocked to eliminate collision, either accidentally or intentionally during accumulation, resulting in a quid operation. The power chain in the conveyor is continuously running and passing over mechanical latching dogs. This results in noisy operation and excessive wear of the equipment.

Because an automatic monorail system requires a continuous series of conductor bars to supply power for transportation, the power also can he utilized for lifting and performing other motor functions that might be on board the carrier which is not so with a conventional power and free conveyor system.

Important features of Automatic Monorail Systems:

- Handling of heavier loads
- Operation at higher speeds
- Variable carrier speeds
- Reversible carrier travel
- Individually driven carriers
- Fewer wheels and moving parts resulting in lower maintenance costs
- Longer track life
- Lower installation cost
- System alterations are easier
- Accumulation without carrier contact, thereby reducing product damage
- Lower noise level
- On board motor functions can be performed on individual carriers.

Case History Introduction

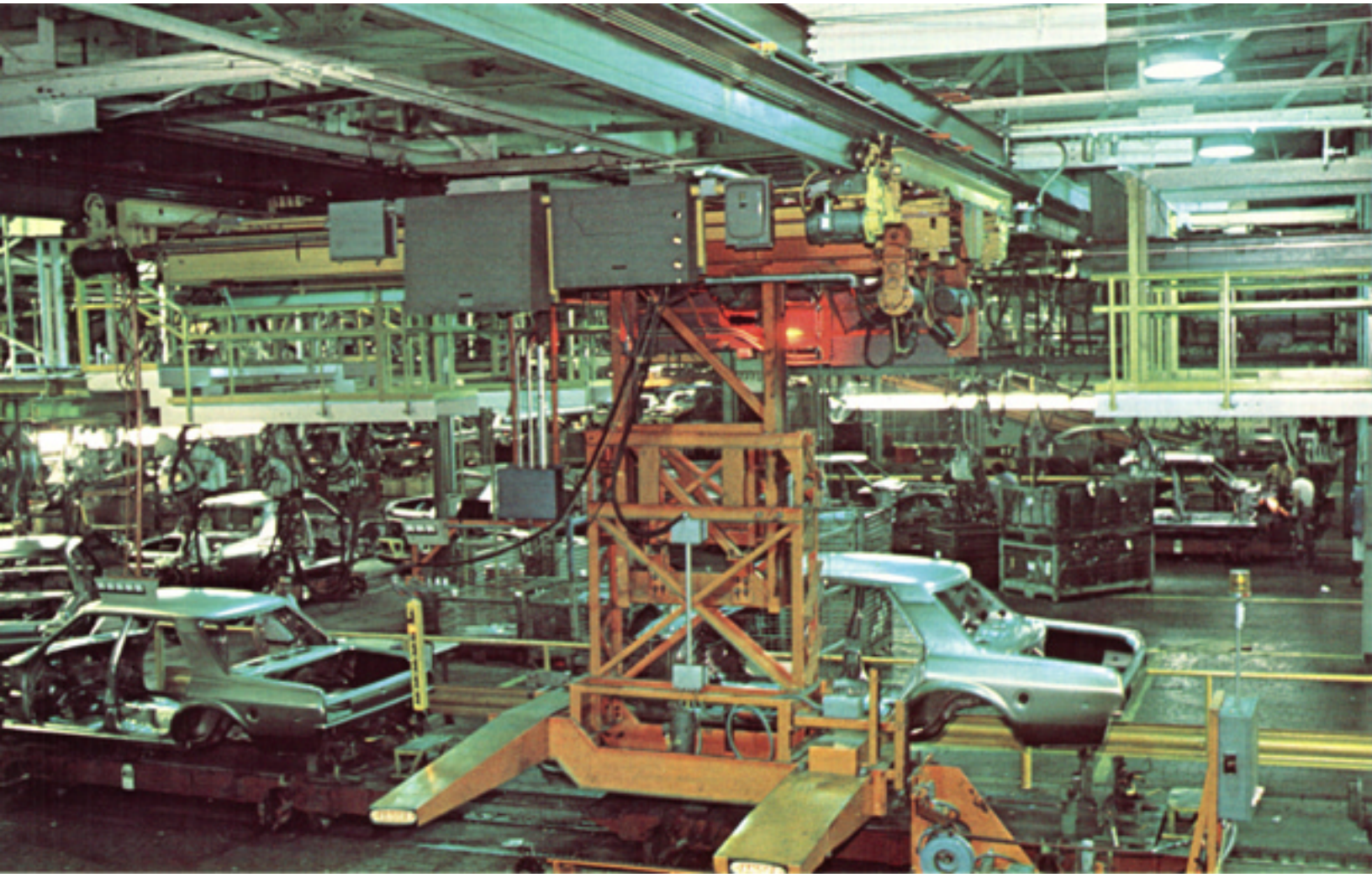
This booklet began with basic information on Underhung Cranes and Monorails. Then came a series of illustrations of the benefits of Underhung systems when compared to other methods of handling material.

This “Case History” section will describe 12 actual installations of Underhung equipment. These installations were designed and built by the member companies of the Monorail Manufacturers Association, These are typical examples and illustrate bow a variety of industries are benefiting through the use of Underhung Crane and Monorail Systems. Many of these examples are original installations. Some of these systems replaced other forms of material handling equipment. When other material handling systems were replaced, the Underhung system increased productivity and decreased production costs.

Hard alloy steel track is the vital element in these Underhung systems. This type of track was used in the construction of every case history contained on the following pages. All members of the Monorail Manufacturers Association employ track specifically designed for Underhung Crane and Monorail Systems.

1 Automated Underhung Stacker Crane Interfaces With Robot Welding Line To Shuttle Car Bodies

Unload transfer stacker in synchronized travel with framing line places auto body on the same framing line station from which if was removed prior to respotting.



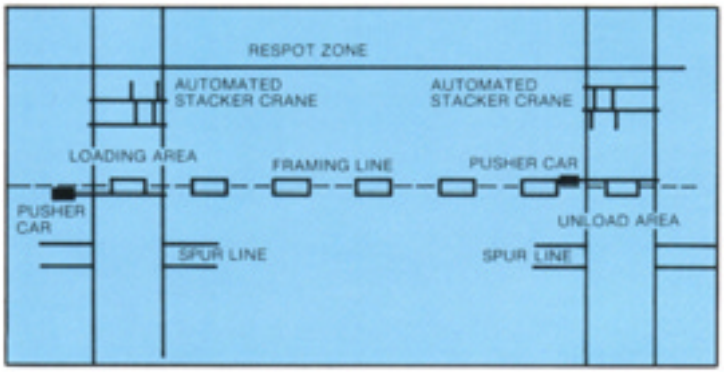


Figure 13. Tack welded car bodies are *moved from a framing line to the respot welding line by an automated underhung stacker crane at a rate of 65 bodies per hour. A similar Underhung device returns the now firm, welded bodies to within .035 of an inch of original station on the framing line.*

At a large automobile plant, tack welded car bodies are carefully positioned on framing line stations. After the body's position is indexed to the station, it is automatically lifted from the framing line—which runs continuously atop bodies per hour—and relocated with precision by a unique under-hung stacker crane system to a respot line where different sections of the body are automatically welded, After 454 precision spot welds are made to the body, a second under-hung stacker crane system picks it up and returns it automatically to the continuously moving framing line. This system is so precise that the car body is returned to the same framing station from which it was originally lifted. The returned body is positioned to within .035 of an inch of its original location. This system represents a cost-saving production technique adapted to an existing production line.

2 Dual Monorail System Moves Hot Metal From Furnace to Pouring Line Efficiently And Economically

A 5-ton cab operated monorail carrier moves ladles of hot metal from the holding furnace to tilt stands.

The monorail carrier lowers a 4,000-pound ladle onto a tilt stand while pouring (left) continues on one of two mold lines.

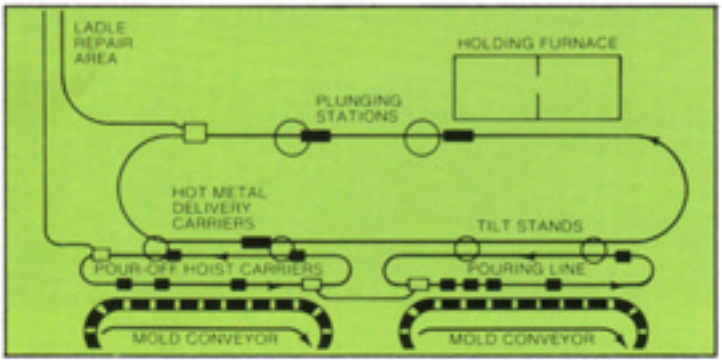
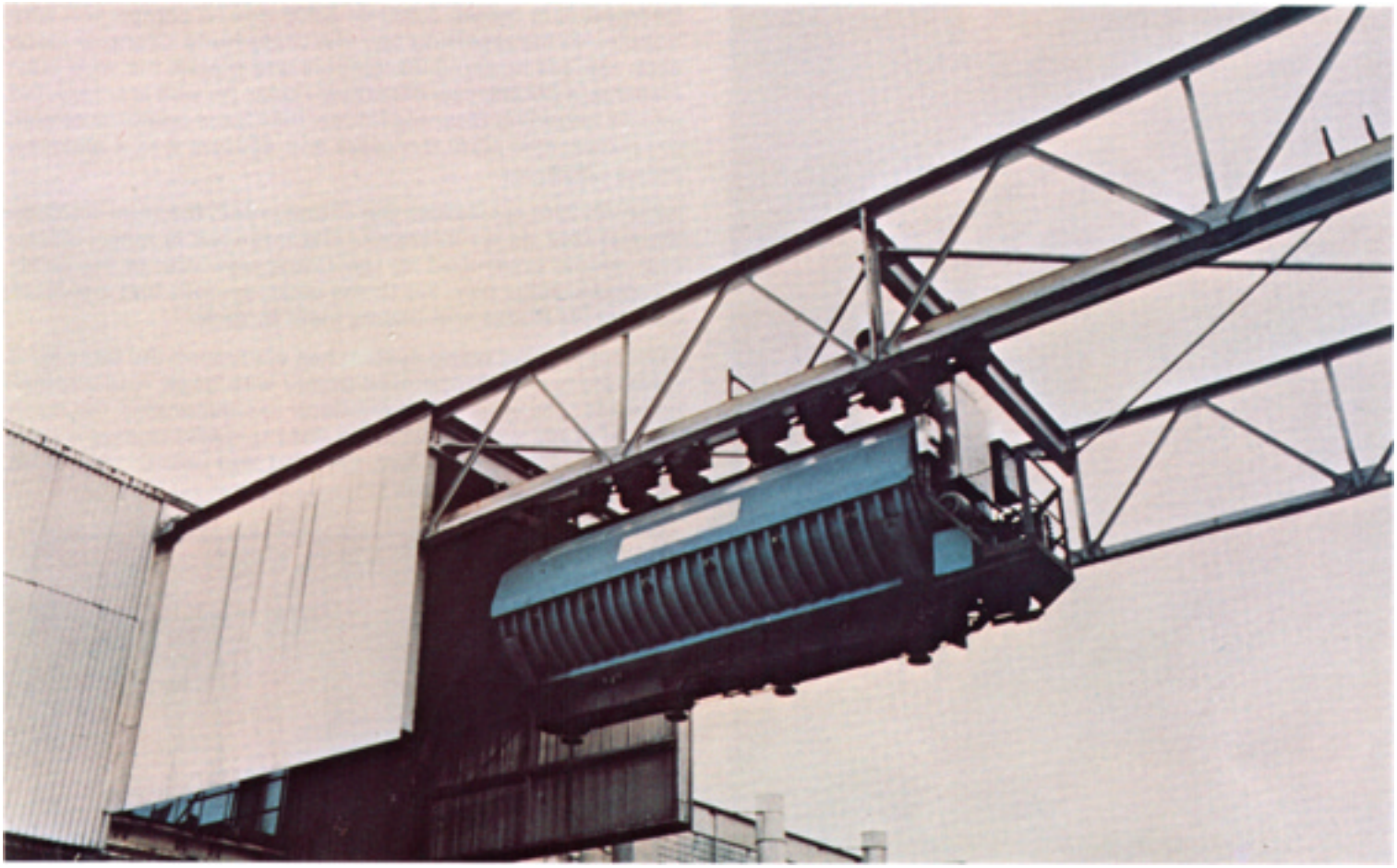


Figure 14. A total of three monorail loops are used in this system. Three 5-ton monorail carriers distribute hot metal on the large loop. The metal is poured into "pour-off" ladles which are suspended from carriers operating on the two smaller monorail loops.

Three 5-ton capacity, cab operated monorails move hot metal between twin holding furnaces and twin plunging stations to tilt stands where hot metal is poured into ladles suspended from 2-ton capacity monorail carriers. The "pour-off' ladles are used to transfer hot metal into molds which ride on a conveyor system.

A total of three monorail loops are used in this system. Glide switches and spur tracks provide easy access to the ladle repair area when necessary.

3 Automated Monorail System Enables One Shipping Department to Service Two Mills



A paper plant in Florida built a new mill next to an existing facility and wanted to improve efficiency and economy by consolidating some mill operations. A 900-foot long automatic monorail system connecting the two facilities was the answer.

Once every eight minutes, 24 hours a day, 365 days a year, three to five 1,000 pound paper rolls are automatically loaded into a watertight container and transported by monorail to the shipping area in the mill next door. Loading, traveling, unloading, and the return trip are all done automatically. Three five horsepower tractors propel the unit at 400 feet per minute. The unit travels 18,000 miles a year. The system will withstand hurricane winds and the container is painted with a special epoxy paint to withstand salt air corrosion. This unique monorail installation eliminated the need for highway or industrial trucks, truck drivers, paper loading and unloading personnel.

The blue, watertight container moves on a monorail track system to the main shipping department from the new mill. Special epoxy paint prevents salt air corrosion and the structure will withstand hurricane winds. The system is constructed to accommodate another unit when needed.

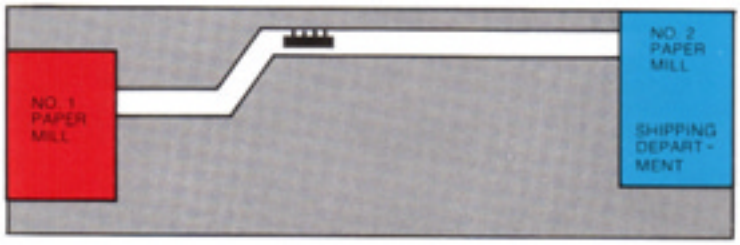
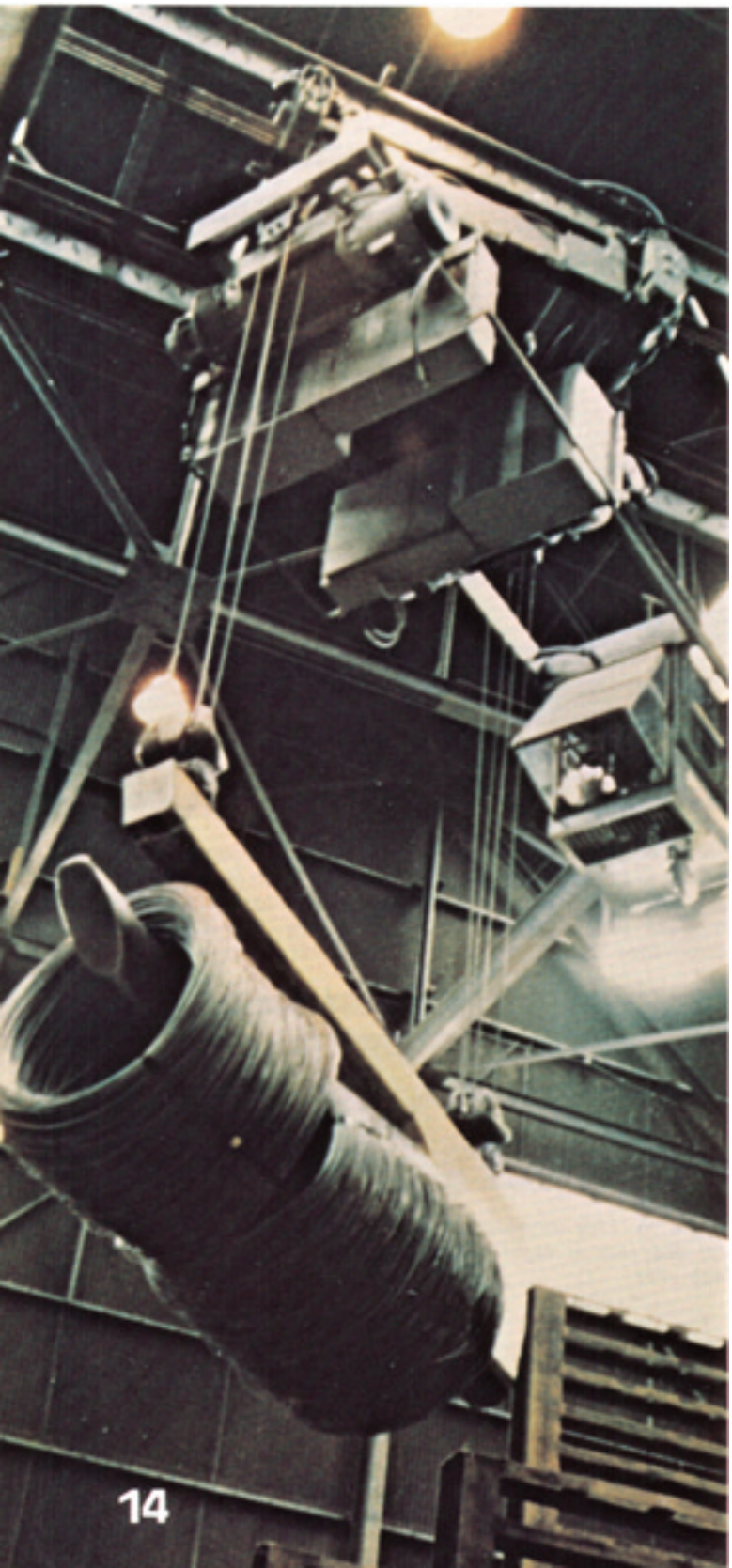


Figure 15. This monorail system is completely automated and operates at eight minute intervals, all day, 365 days each year.

4 Rotating Cab-operated Crane Feeds 24-hour Production Line in Eight Hours



Railroad cars deliver 3,000 or 3,600 pound compacted wire bundles to the receiving bay. An Underhung Crane unloads each rail car in about 30 minutes and places the wire bundles into a double row of vertical racks. As wire is scheduled into an adjoining cleaning house, the Crane operator selects the proper wire from the racks and delivers it to a cleaning house conveyor.

After the wire is cleaned, the Crane enters the semi-finished storage bay via an interlock. The interlock is motor driven and remote controlled by the Crane operator. In the semi--finished storage bay, the Crane picks up coils that are delivered by lift trucks and places them in racks.

The interlocking crane system has eliminated the need for a second crane, cab operated trolley with book, and another operator. The rotation of the hook has eliminated the need for additional workmen on the floor to assist in loading the hook and the need to turn the load and carrier 180° on a turn-around loop of track.

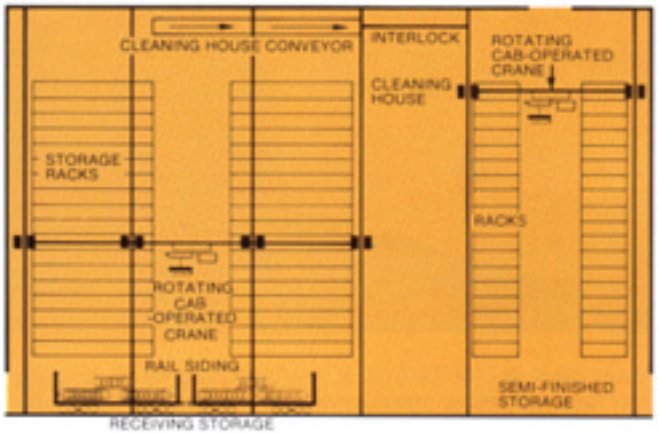
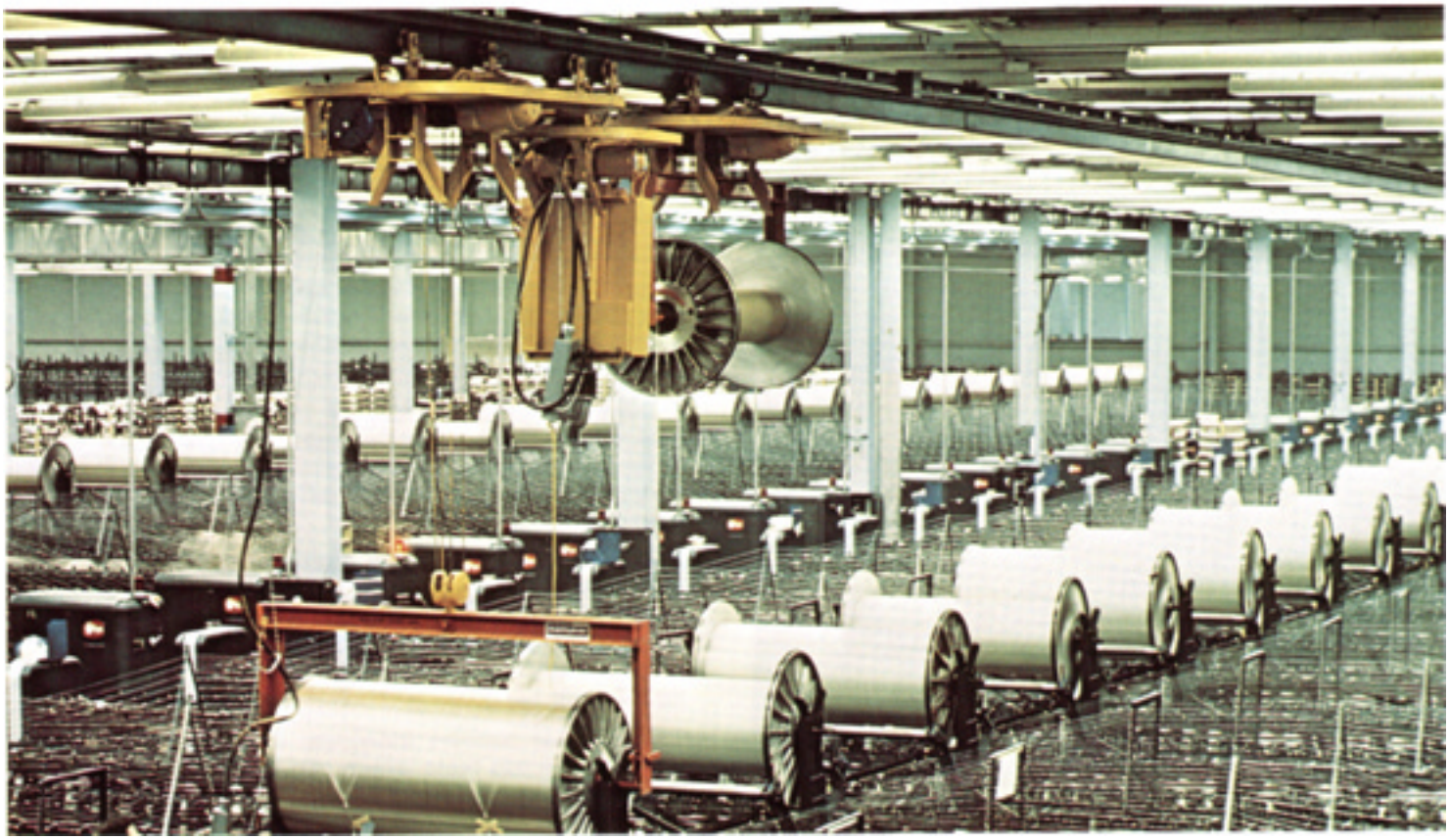


Figure 16. Rotating cab-operated Underhung Crane unloads railcars and places wire bundles in vertical racks until they are scheduled for cleaning. The crane operator then moves bundles to the cleaning house conveyor, and after cleaning, the crane enters the semi-finished storage bay via an interlock to interface with a lift truck and moves the coils back into storage racks.

5 Automatic Pendant Controlled Monorail System Cuts Costs and Increases Production Rate



A Kentucky manufacturer produces over five million pounds of nylon and polyester tire cord fabric each month for a well known tire company and its affiliates.

Beams of yarn are used to make this polyester tire cord fabric. An automatic pendant controlled Monorail system moves these beams between warehouse storage and the fiber twisting machines in the plant. The Monorail system consists of seven tandem beam carriers that travel on over 5,579 feet of track. One hoist on the carrier bandies empty beams and has a 1,000 pound capacity. The other hoist on the carrier handles full beams with a capacity of 3,000 pounds. The carriers travel at 75 feet per minute. Wrap around bumpers on the carriers automatically open and close fire doors between rooms.

When a full beam of yarn is needed at a twisting machine, the machine operator sends a request to the warehouse through a dial call station. Automatically and unattended, a loaded carrier passes from the warehouse storage through the fire doors and switches, and stops at the programmed twister. A machine operator then takes over control using a pendant. The empty beam is removed from the twisting machine and the full beam is put in place. When the pendant is released, the empty beam and carrier automatically return to the warehouse. An operator in the warehouse removes the empty beam and loads the carrier with a full beam for the next call.

The tandem beam carrier pictured here has just been used to remove an empty beam and the operator is now positioning a full beam of yarn on the twisting machine.

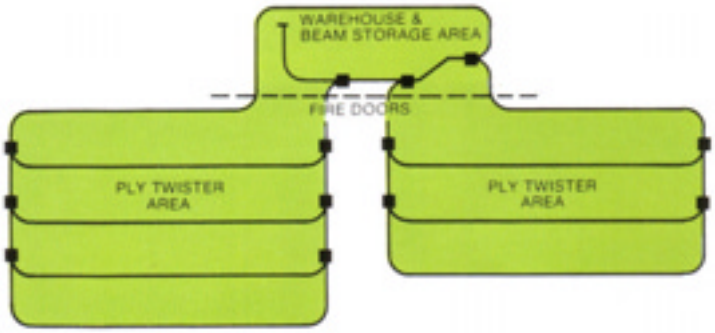


Figure 17. Beams of polyester fire cord move automatically from the warehouse to the ply twister areas on automatic pendant controlled monorail tandem beam carriers. The empty beam is dispatched from the twisting machine and returns to the warehouse and beam storage area for reloading.

6 20 Underhung Stackers Travel on Monorail Runways to Reduce Shipping Cycle by 70%

The records area holds 33 shelves in its 36 foot height. File clerks place a working table over the ball top fable when filing.

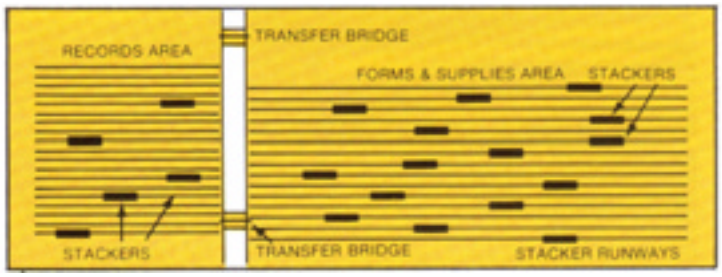


Figure 18. Underhung stacker system consists of a supplies area and a records area. Transfer bridges enable stackers to move from one area to another to meet demand.

A large insurance company's supply and records center uses this storage and retrieval system to increase efficiency, reduce space use, and save operating costs. Twenty stackers handle records and 25,000 different office supply items stored on 17 miles of racks.

During the day shift, fifteen stackers operate in the supplies area and five stackers operate in the records area. From 2,000 to 2,500 supply requisitions are picked each day. At night, when supplies are not being processed, the supplies area stackers move via transfer bridges to the records area for all night filing.

Each stacker handles individual unit cartons through the use of a ball top table which can he raised out of the way when handling pallets. A hydraulic lift raises each stacker at 42 fpm to a height of 31'-6¾". Travel along the aisle is 250 fpm. The cab and stacker operate in aisles only 32" wide.

In the forms and supplies area, 30 rows of racks are 36 feet high with 12 shelves each. Pallets are *deposited in the first open storage pocket in the aisle. Location records are noted on a receiving tab card.*

7 Underhung Crane System Services Entire Area in "L" Shaped Building Through Use of Rotating Crosstrack

A Midwest Tank Manufacturer uses one, two-ton, single girder, Underhung Crane and three, five-ton, long span truss type, Underhung Cranes to lift and move steel plates through a tank fabrication process. The fabrication process includes roll forming, clamp welding, barrel tacking, hydro testing, grinding, frame mounting, landing gear bogey mounting, and final assembly.

The tank fabrication process occurs in an "L" shaped building. One pendant controlled, five-ton crane works in one wing while two cranes work in the other wing. An air operated cross track enables the cranes to move into the portion of the building where the wings overlap.
This Underhung Crane System replaced manually operated floor carts and fork lift trucks. Its use resulted in a 25% time savings, a 10 to 15% labor savings, and the company can now fill larger orders.

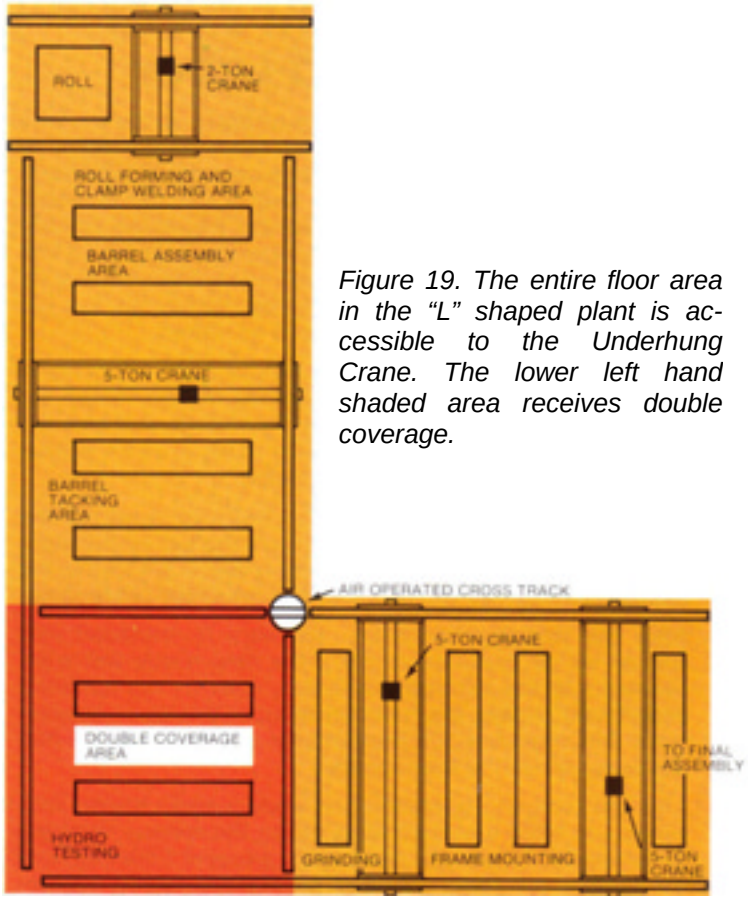


Figure 19. The entire floor area in the "L" shaped plant is accessible to the Underhung Crane. The lower left hand shaded area receives double coverage.

The long span truss type, live-ton Underhung Crane in the foreground is operating in the double coverage area of the plant. An air operated cross track enables the crane to move into this area to assist in Hydro testing of the tanks.

8 Gravity Powered Monorail System Saves Floor Space and Labor

More than a mile of overhead monorail winds its way through this four-acre commercial linen supply plant to recycle nearly 100,000 pounds of linen each day. Soiled laundry arrives at the receiving dock and is sent by monorail carrier to the sortation tables. Because the soiled laundry is carried overhead on a monorail, floor space is saved and there is a reduction in labor to sort the soiled laundry. In addition, no heavy lifting is required—otherwise the job classification may be limited to male operators.

An air operated lift is used and full advantage of gravity is planned into the design of the system. Trolley stops are strategically located to implement the storage and also the stops permit the operators to hold work at their station until the sorting operation is completed.

Soiled laundry is stored in slings overhead awaiting the needs of the washers. The washers are loaded by pulling a release on a specially designed sling which is tailored to the requirements of the washers and the overhead limitations.

After the washing operation, the work is unloaded into special slings designed to carry the now heavy wet work overhead to the extraction process, then to the tumbling department. Again, the function reduces the labor requirement and improves the productivity of the machines that are being served by the monorail.

After the tumbling operation, the work is again loaded into slings and lifted overhead for *a* trip to the various finishing departments. These can be ironing, garment finishing, and the tumble dry functions. For specialized textile maintenance operations, this system could transport gloves or shop towels to the finishing area.

The monorail system reduces the heavy work traditionally associated with the laundry process. It is more pleasant for the employees, and management benefits through a labor cost reduction and improved productivity.

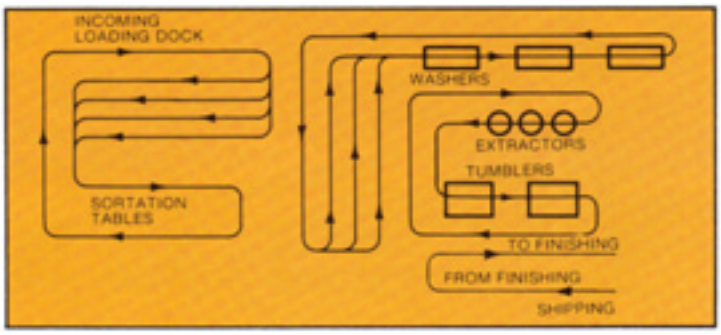


Figure 20. Although simplified, this system begins at the loading dock, passes through all the departments necessary to process laundry, and delivers it ready for the customer at the shipping dock. The actual system uses more than one floor level.

Above photo shows the complex system of switches used to route laundry to the washing machines.

Extractors in the foreground of the lower photo squeeze water out of the laundry before it moves on to the tumbler dryers seen at rear.

9 Truck Manufacturer Uses 150 Underhung Cranes to Supply Assembly Line

This photograph illustrates how hand-pushed cranes work in conjunction with a floor conveyor on final truck assembly.

Here two hand-pushed cranes assist in final assembly of heavy components on off-highway construction equipment.

This system uses approximately 150 versatile Underhung Cranes to supply assembly lines with components, while in-the-floor conveyors move heavy highway trucks and off-highway road construction machinery through final assembly. The Underhung Cranes vary in capacity from ½ ton to 5-tons, and most are hand-pushed with air operated hoists.

Multiple Cranes operate on each runway to service *a* given assembly line. Hand-pushed Underhung Cranes are ideal for this application where travel distance with the load is short, but frequent. The band-pushed feature facilitates accurate spotting of the load and equipment costs are less.

In addition to the Underhung Cranes used for the main assembly lines, there are other hand-pushed Cranes, motor driven Cranes, and Monorail systems in use for other tasks such as mounting tires onto chassis, moving equipment into paint areas, and sub-assembly work.

10 Automatic Monorail System Delivers Sound Guard Cabs

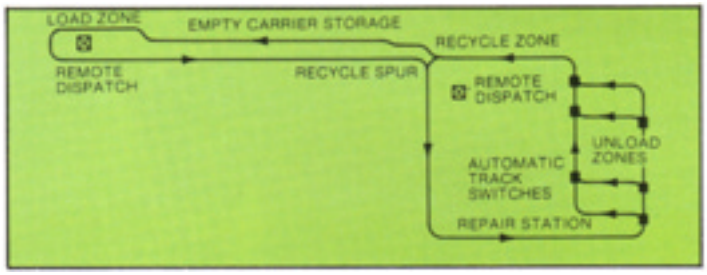


Figure 21. Tractor sound guards (cabs) are loaded onto monorail carriers at upper left area of this system. After loading, they are dispatched to far right area of system where they are lowered onto tractor chassis for assembly. Carriers automatically return to load zone.

A tractor manufacturer uses this 1,600 foot Monorail system consisting of automatic carriers, automatic switches, necessary block zones, and card readers and writers for tractor assembly.

After a sound guard (cab) is attached to the 2,000 pound capacity hoist on the carrier, the operator directs it to one of three assembly line destinations by information punched into a floor-mounted console. The operator presses the dispatch button on the pendant which automatically raises both the load and the pendant. The destination is printed on a magnetic code card which is permanently mounted on the carrier by *a* card writer attached to the monorail track.

Carriers move at 180 feet per minute on straight track and at 60 feet per minute around bends and through switches. When the carrier approaches its destination, it stops at a wait station just prior to the sound guard drop area. When the sound guard is required, another operator pushes a call button and the carrier automatically positions itself over the tractor chassis. When in position, the pendant automatically drops down to within reach of the operator. The operator uses the pendant to lower the sound guard into position on the tractor chassis. The books which hold the sound guard are then released and the carrier is sent back to the load area.

On the assembly line, sound guards are lowered into position on the tractor chassis and the Monorail carriers are automatically dispatched back to the load area.

11 Rotating Cab-Operated Underhung Crane Loads Railroad Freight Car Sides After Painting

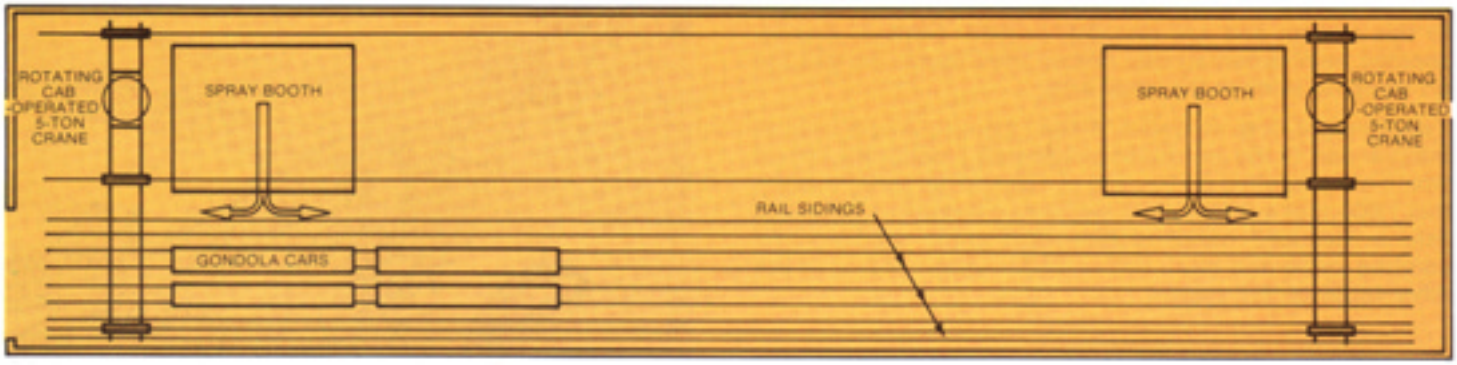


Figure 22. Two rotating cab-operated Underhung Cranes lift railroad freight car sides from spray paint booths, rotates them 90 degrees, and places them into gondolas for shipment to rail car manufacturers.

Cab-operated, Underhung Crane with freight car side from paint spray booth rotates it to load onto awaiting gondola car.

Twin hook, double-girder, cab operated. Underhung Cranes load assembled and painted railroad freight car sides into gondola cars in this shipping area.

The cranes begin by lifting car sides out of the spray booths, rotate them 90 degrees, and place them into gondolas for shipment to rail car manufacturers. The crane and hoist is capable of rotating 180 degrees when necessary.

Three runways support two 5-ton capacity cranes. The crane operates at 300 feet per minute, carrier speed is 150 feet per minute, hoist speed is 40 feet per minute with eddy current braking, and rotation speed is 1 revolution per minute.

12 Semi-automatic Monorail System Helps Increase Production 200%

Unfinished diesel engines become airborne upon delivery to this system and are cleaned, primed, painted, and inspected semi-automatically before they touch the ground on shipping skids in the dock area.

Twenty-eight, lug mounted, 4-ton, electric hoists are an integral part of the motorized single girder Monorail carriers which are propelled by tractors at 125 feet per minute along this 1,000 foot system. Limit switches prevent rear-end collisions. Reduced handling time during the washing and painting cycle and more use of floor space are two of the advantages of this system.

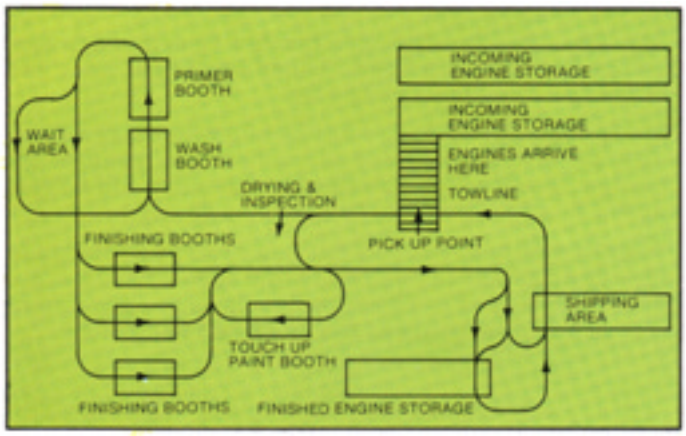
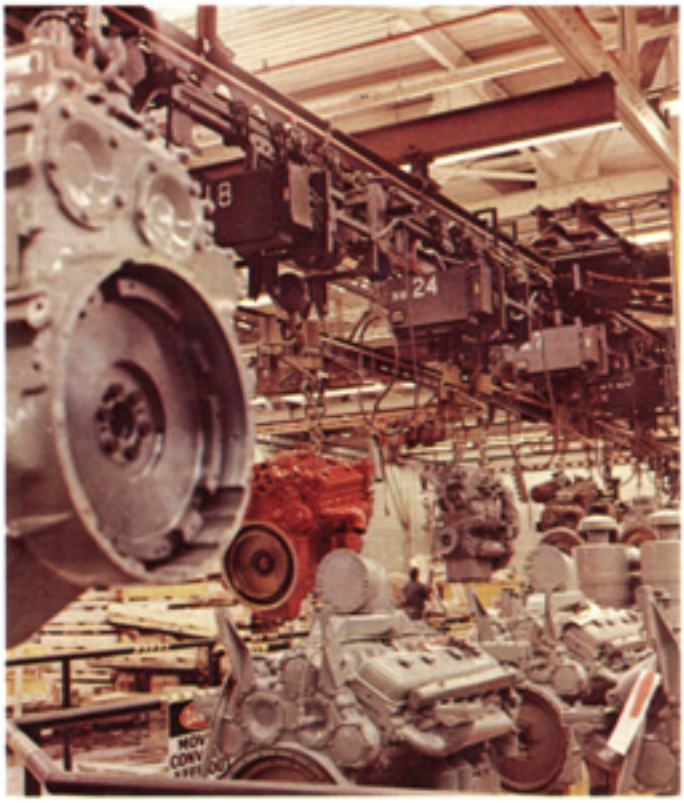


Figure 23. Diesel engines are picked up upon arrival, thereby putting the production line in the air a few feet above the floor. The engines advance to the wash booth and then receive a coat of primer. Depending upon the engine type, they proceed to one of three finish painting booths, then on to the drying and inspection station. Another booth is for touch up painting, when necessary. The engines do not touch the ground again until they reach shipping area where they are placed on skids for out-processing.



Diesel engines move semi-automatically on this Monorail system from the receiving doors to the shipping dock. In between, they are cleaned, primed, and painted.

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