VEHICLE ASSEMBLY AND TESTING

VEHICLE ASSEMBLY AND TESTING

Assembly of some 2000-3000 interior and exterior parts as well as major components are fitted on painted body in assembly plant that is generally constituted of :

☞*Trim Line*
☞*Chassis Line*
☞*Final Assembly Line*

A general listing of major parts and components that are assembled in different lines are as follows:

Trim Assembly

- Harnesses and controls-other electrical
- Pedal assembly, insulator
- Air duct, heater, head liner
- Weather-strip, horn, stop switch
- Front/rear shock absorber, shift cable
- Wiper link, washer tank
- Condenser, rear set belt, radiator insulator

Chassis Line

- Brake tube, filler neck, splash shield
- Fuel pipe, fuel tank, canister
- Rear axle, stabilizer
- Clutch tube, heat protector, engine
- Knuckle, tie rod
- Exhaust, undercover
- Tire, front /rear seat
- Front/rear bumper

Final Assembly

- Rear pillar trim, trunklid latch
- License plate lamp, radiator, hose
- Heat hose, steering shaft
- Parking brake, garnish
- Rear combination lamp, sunvisor
- Battery cable, silencer
- Front turn signal lamp, console box
- Front/rear glass, roof molding
- Console bracket, carpet, trunk room trim
- Seat belt, centre pillar trim
- Air-conditioner pipe
- Glove box, battery tray, seatbelt anchor cover
- Air cleaner, front/rear seat
- Front grille, drip molding
- Combination meter, A/c gas

Different parts are handled in different ways. Some require bolting, others are just inserted, still others are fitted together. Sealing, wiring and other processes are also carried out. Basic assembly work consists of compound operations which include grasping, handling, positioning and adjusting of parts. Each of these operations requires many closely controlled steps to assure high quality. For examples, bolting requires control of torque as well as position and screw driver angle. Control of position and attitude is also required in adhesive application and similarly for alignment of head lamp.

TRIM LINE

Painted body are transported to different stations - the number depending on production capacity of the facility. The process of assembly of the car without doors is now almost universal in Japanese plants and is being adopted by western manufacturers also. The layout looks like one shown in Fig.8.1. Doors are removed from the painted body before it goes down the trim line, and are transported by an overhead conveyor to door assembly line at the end of the final assembly line. In one plant, it is almost parallel to the final inspection line. Layout is adjusted through U-shaped line to bring down the distances between the removal point and the assembly line of doors. The process allows easier access to the interior assembly of the car. Moreover, the door trim, glass and hard ware can be installed on a separate door assembly line ensuring better fit and finish. With doors remaining attached to the car body, the chance of damages all along the assembly line when it is opened and closed several times at different stations for inside assembly operations, is very high. Further, the door trim assembly is more difficult in the hanging position. with the doors removed, the aisle can be narrower. The production workers are never more than one step away from the parts they are installing. Workers or the equipment can access different points of installation of parts in the body shell,

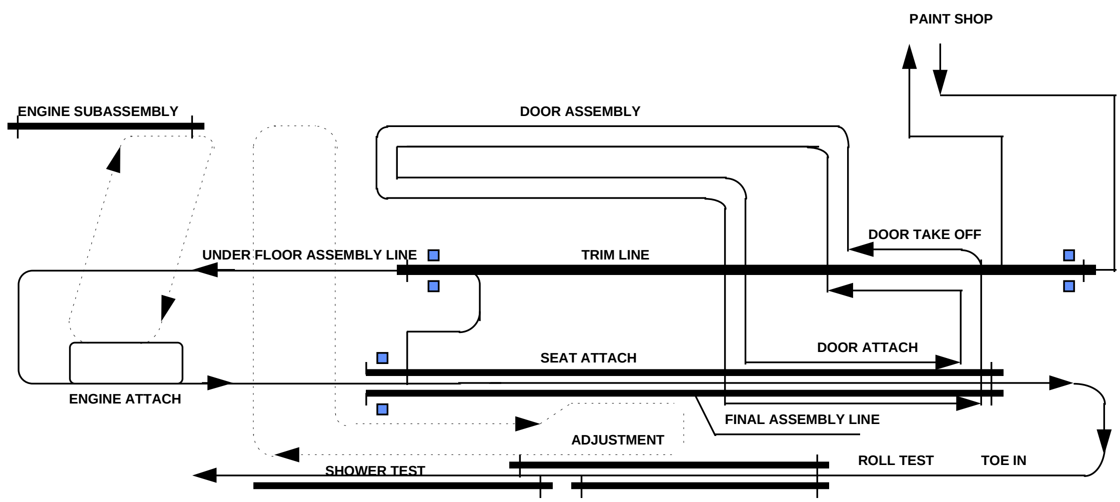


Fig. **8.1 A Typical Layout of Trim and Final Assembly**

Trim line assembly operations are carried out in logical sequence and differs from manufacturer to manufacturer. Mostly the operations are manually performed from both sides of a slat conveyor. Screw driver, box-wrenches and torque wrenches are used as hand tools for the assembly operations. dampers and front wishbones are installed, and so are the facia and instrumental panel. the air-conditioner and/or heater unit may be installed after the instrument panel. The lamps and bumpers-covered with moulded protectors are also installed in trim line. Many subassemblies are carried out in cells located suitably to feed them to the trim line conveyor at appropriate locations. Some assembly such as strut subassembly requires special jigs. For others, some easy aids - mostly developed by the workmen themselves, are used. At the end of the trim line, the car is transferred to a cradle suspended beneath a monorail as shown in Fig. 8.2

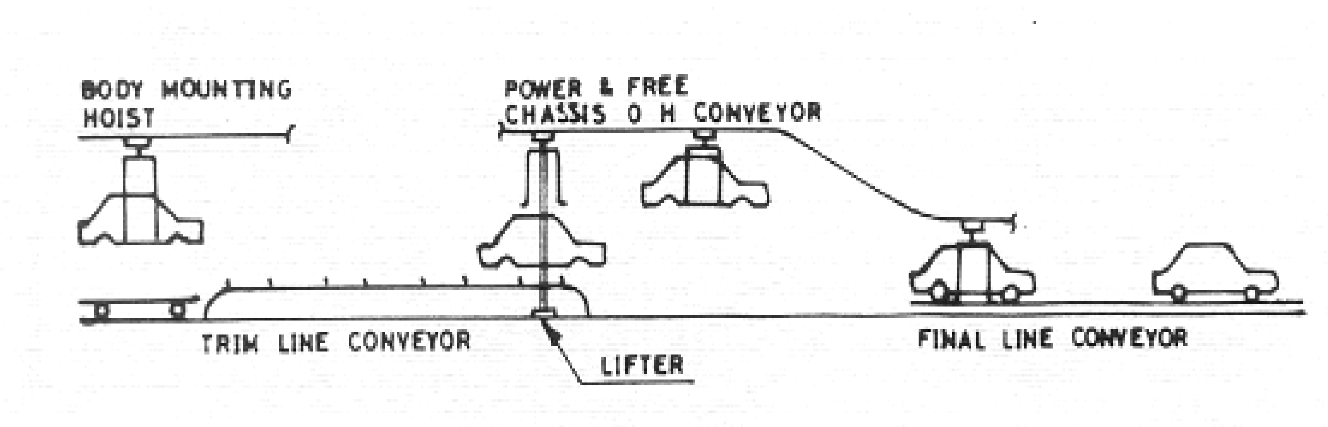


Fig. **8.2 Transfer of Car body from Trim line**

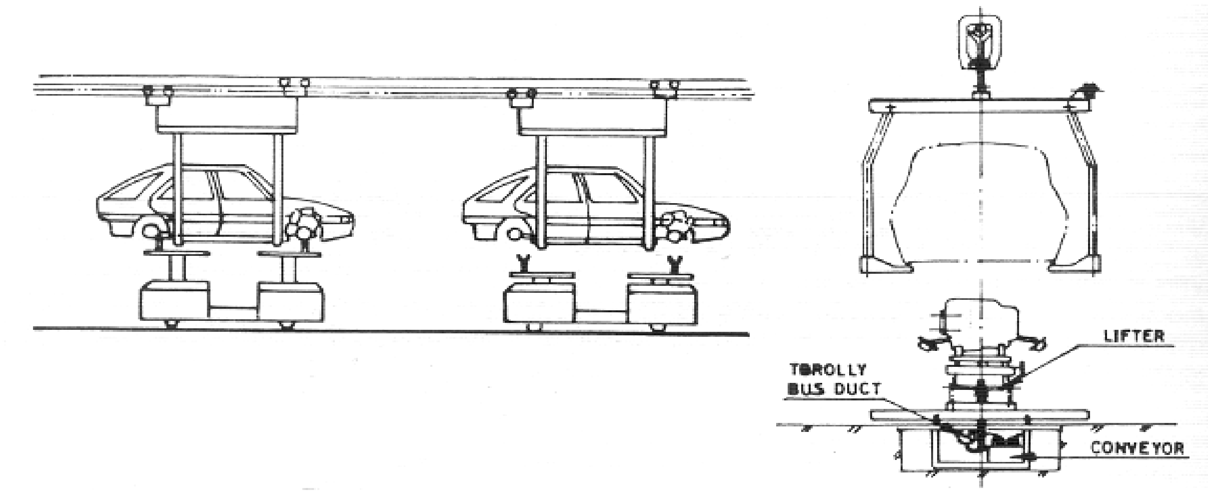
CHASSIS LINE

The car bodies from trim line is picked up by overhead conveyor of chassis line that may be power and free type. Mostly, the parts are fitted from the bottom side. Some of these manual processes require uncomfortable postures, because of the inconvenient position of the car bodies. Tilt conveyors and electric carriages incorporating elevators are being used to overcome the problems. Electric carriages with elevators eliminate a lot of discomfiture to the workmen who had to squat down or crawl into the cars for the processes. The tilt conveyor used in chassis line ordinarily forward car bodies in their normal position but can tilt the bodies on the conveyor some tens of degrees or ninety degrees so that the workers can work on the bodies in comfortable postures without having to stretch or crane their necks.

Near the beginning of the chassis line, the fuel tank is assembled. As the tank generally comes complete with the fuel gauge unit and pump etc., the operator is required to connect only the breatherpipe and some other minor components. The tank itself is light so not much physical effort is required, However, in some chassis line, the tank is just placed on a trolley which has a hydraulic lift. When the car reaches the assembly station, the trolley starts to move forward in synchronicity with the car- all the trolleys that carry tools and fasteners synchronise motion with the track- and the operator pushes a button so that the tank is raised into position. The operator then needs to ensure that the bolts are aligned and to tighten them, in much quicker manner than if he had to lift the tank as well. With lift, only one person is able to the job which required two to do everything manually.

Steering rack is generally mounted on the car directly. However, in some cases the rack is installed on a cross-member at an off-line station and a lift similar to one used for tank, is used.

Docking station relates to mounting of power train to the body and is one of the main operation on chassis line. Engine and Axle setting conveyor is used for fixing engines & axles to bodies. Trolleys installed with lifter operate synchronously with a **OHC** *(Over Head Conveyor)*. The body moves suspended as shown in Fig. 8.3. The power-trains are prepared in an off-line dressing cell. Thereafter, the power-train is mounted on the trolley with hydraulic lift. A separate lift trolley is used for rear suspension. The body remains securely held and assembly operations are carried out with up and down movement of lifter. The large number of operations carried out require trolleys to carry the fasteners and tools- power tools and torque wrenches. The torque wrenches are used to tighten bolts to desired high torque levels.



Typical arrangement of body marraige over
Power Train and Rear Axle Trolleys

Fig. **8.3 Body position for Docking of Power-train**

At the next station, the exhaust system is installed in one or two stages along with heat-shields. The trend is to bring the exhaust system to the line in one unit on a long trolley.

Generally, at the end of the chassis line, wheels with tyres are mounted. A semiautomatic approach may take away the fatigue of the operation. The wheel and tyre may be presented to the operator vertically on a mechanical arm, which he pulls towards the car. He needs only to align the wheel and push it forward to the hub. Power tool with a special chuck to insert the wheel nuts is used. The special chuck is a circular disc which incorporate gear driven sockets. When not in use, the power tool is placed chuck downward on a nut feeder which feeds nut into the chuck. When the operator picks up the tool, the nuts are held in place. He only runs the nuts onto the wheel studs. The tool is available in chordless-controlled version. Subsequently, the operator uses a multiple nut runner onto the nuts that tightens the nuts. The multiple nut runners may run on autocycle and unattended, and the operator may work on his other assignment during the time. At the end of chassis line, chucking of safety critical items and the adjustments are completed by operator working below.

A tyre/wheel assembly system is located in an off-line assembly cell. For every vehicle, 5 tyre wheel assemblies are required so the cycle time of the system is one fifth of that of vehicle assembly. Tyre/tubes (or tube less tyres) and wheels are fed from two separate conveyors to different stages of the system that consists of :

1. Tyre soaping (or powdering) unit

2. Tyre fitting unit
3. Tyre inflating unit
4. Wheel balancing unit
5. Correction weight fixing unit

The units are linked by integrated conveyors. Fig. 8.4 shows a schematic view of the tyre/wheel assembly system of a tubeless tyre. A tyre handling system picks up and transports tyre to both sides of the vehicle.

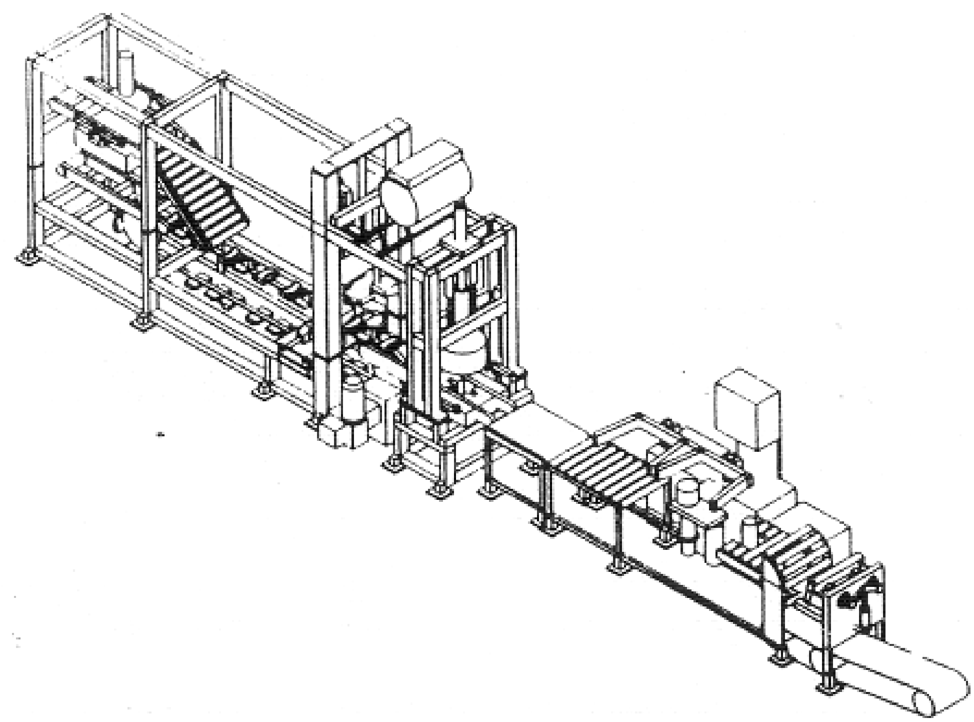


Fig. **8.4 A Tyre- Wheel Assembly System**

FINAL ASSEMBLY

Bodies on tyres come down on double slat conveyor of Final Assembly as shown in Fig. 8.5. In final assembly, all the remaining fitments are carried out. With equipment dependent on sophistication level, the different consumable are injected in the car to the desired quantity measure. Items are Engine oil, Transmission oil, Gasoline/diesel, Window washer liquid, Radiator liquid, Brake oil .

Near the end of the line, the doors are mounted. The door assembly line is generally located near the door mounting stations. Using an overhead conveyor the doors are lowered adjacent to the track. Special trolley on rollers may be used to mount the doors to the car in a well designed line, no adjustment is needed, the operator pushes the door into position, tightens the fasteners with a power-tool, and sheets the door before moving back to mount the second door.

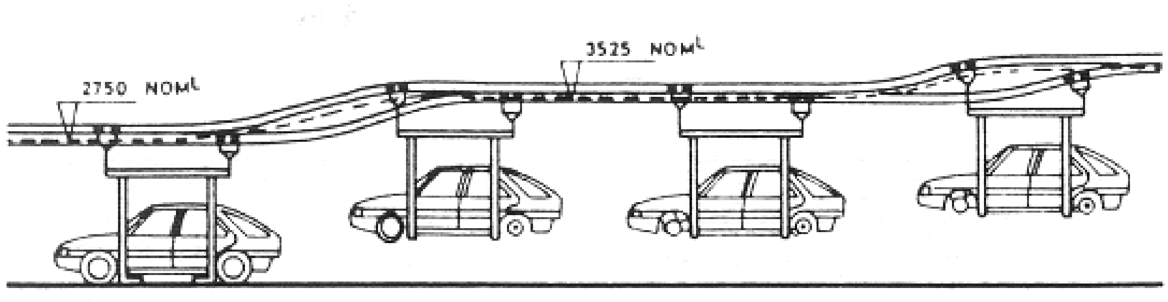


Fig. **8.5 Bodies on Tyres to Final Assembly Conveyor**

SOME WORKING PRACTICES

- Storing of wiring harnesses and rubber mountings in a heated shed to keep them pliable and easy to handle plus the electrical connectors expand because of the heat, making it an easy matter to plug them together.

- An extra wide conveyor allowing production workers to ride along with the car, rather have to walk along it, trying to install parts. The surface of the conveyor is antislip.

- Many trolleys of different sizes move with the lines through one station only, and then move back to start again. Some may carry only fasteners, but others may be as long as a car and carry fasteners brackets, pipes or panels and hand tools. Some may be pneumatically actuated, and others may be cordless electric tools.

- Reusable containers have replaced card board packing or wooden packets.

- Containers are placed on roller racks that are inclined towards the assembly line, while the empty ones are placed on the top rack and roll towards the aisle.

- Where big bins are used because of the weight parts, the bins are designed to tilt forward so that the workers don't have to bend over and reach into them.

- Rollers are freely integrated in the handling and storage facilities to provide ease in push pull, and orient as required for even heavier weight.

- Design of the delivery system for the incoming materials from venders to upto the assembly line is critical. Think of a truck full of 75 engines coming right upto the assembly plant where a chain conveyor operated by the driver itself unloading the two racks in less than 1 minute.

- In multi-model plant, part bins with different lights to indicate which part the workman should pick up to put on the car in front.

- Automatic vehicle recognition and tracking is through a datum medium that can be written and read automatically and is attached to the body. It serves as a source of information for the mechanisms controlling the vehicle throughout all production areas and helps in instantaneous stock calculation and control.

APPLICATION OF ROBOTS IN ASSEMBLY

The final assembly is still the most labor intensive of all the automobile production shops. The share of the final assembly in total man-hours required for the manufacture of a car is almost 50%. Under the condition, the assembly line becomes most sensitive to labour attitude and productivity. Automation through robot is the universal approach in final assembly operations. However, the robot used in these operations require precise control, that is attained in one of the following two ways:

1. The control function is embedded in the tools or implements, and the robot works in a play back mode based on comparatively simple message exchange.
2. The robot is provided with pattern recognition through visual and tactile sensors and is made to operate in an intelligent manner.

The robot functions are improved through combination with peripheral tools, and the superiority of robots over human workers is enhanced. Table below shows some of the improvements because of robot application in final assembly.

OPERATIONS	SUPERVISED ITEMS	TOOLS AND METHODS	EFFECT
Tyre mounting	Tightening torque	● Torque servo-control ● Positioning accuracy by robot	Deviation of torque +/- 1.0 kg.m→ +/-0.5 kg.m
Window-glass mounting	Water tightness	● Constant-volume injection ● Robot path accuracy	Water leakage rate 0.5% → 0.1%
Head lamp aiming	Angular position	● Stable robot repeatability	Deviation of positioning (cm/10m) +/-10cm → +/- 5 cm
Door mounting	Position	● Stability of automatic machine repeatability	Deviation of positioning +/-1.0mm→+/0.5mm

PREFERRED AREAS OF AUTOMATION

Heavy physical work:
In automobile plants, work in which the product of part weight and handling frequency exceeds 20 tons x times / shift is classified as heavy physical work. Tyre mounting where tyres of 20-30 kg are handled 1000 times a shift, is a typical example of heavy physical work. The operation used to engage a large manpower. With automation, the manpower can be reduced to a great extent.

Monotonous work:
Even though the parts are light in weight, but during a shift 4000 to 5000 identical movements are to be made, the work is classified as unpleasant and monotonous.

Other works necessitating automation are :

- Environmentally hazardous work
- Work requiring high concentration
- Work with possibility of accident

ROBOT FUNCTIONS AND ASSEMBLY OPERATIONS

Degree of automa-tion difficulty Rank	Typical characteristics	Robot functions	Examples
A Simple operations	Operations in which parts are easy to grip, move and position	Single purpose repeating machine: -Fixed sequence -Robot with single arm -Parts feeder	- Front grill fitting - Seat installing - Battery mounting
B Combined simple operations	Combined operations in which parts are somewhat difficult to grip, move and position	Playback robot	- Window mounting - Fuel supplying - Spare tyre mounting
C Compound operations	Combined operations in which parts are gripped in multiple places, ability to make positioning decisions is required, and complex movement pattern exists.	Robots capable of recognizing patterns Robot with multiple arms	- Tyre mounting - Guard mould affixing - Rear combination lamp mounting
D Complex operations	Complex operations in which parts are non-uniform and difficult to grip and position, and which require multiple control arms, and precise holding and gripping	Robot capable of complicated decisions (with learning ability, autonomous control)	- Harness installing - Carpet installing -Sealing rubber installing - Hose joining

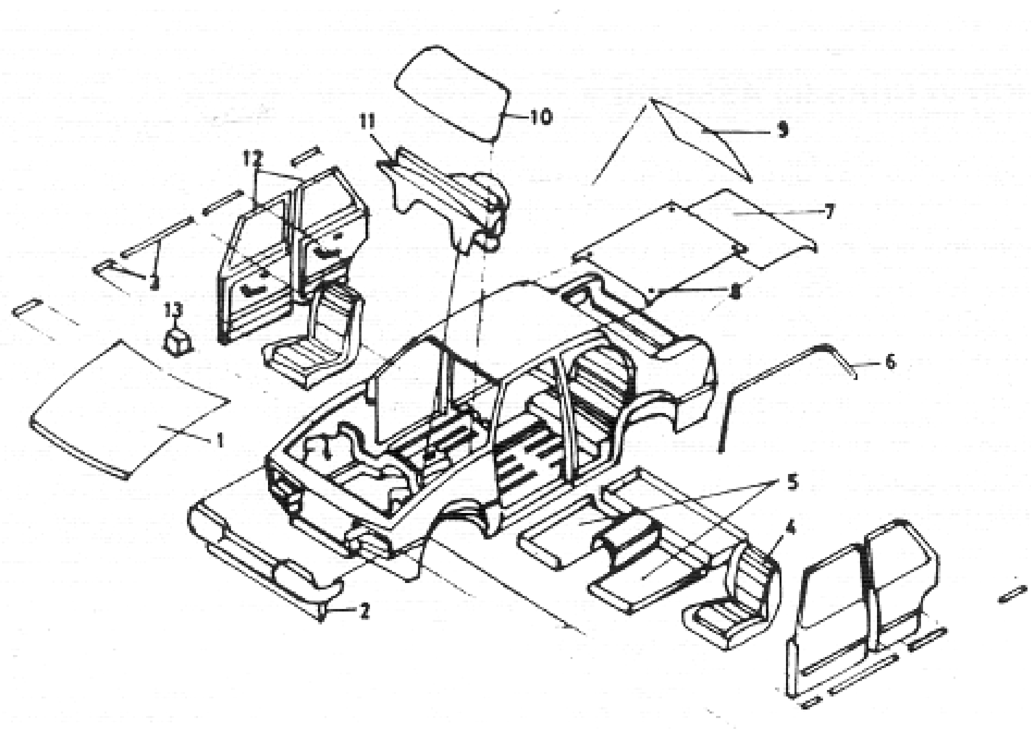
Operations listed as A and B are comparatively simple , and account for about 30% of assembly man-hours. Robots required for the operation are cheaper and in many cases may prove to be costwise more efficient than the human workers. Operations listed as C require robots with a high degree of intelligence or multiple arms that raises the cost to a level where it becomes unviable. Operations classified under D categories account for a large share of final assembly operations. Due to complexity of C and D type operations, two considerations are important:

1. Robot capabilities regarding speed, freedom of movement and intelligence level
2. Introduction cost that may be very high with respect to possible saving

AUTOMATION IN TRIM ASSEMBLY

Many operations in the area of trim assembly can be automated , Fig. 8.6 .

Installation of door liners: A robot takes a liner for the interior door trim from a magazine, moves it under a stationary applicator for hot adhesive and attaches it to the door. The fast measuring system makes it possible to find the precise position of the door quickly.

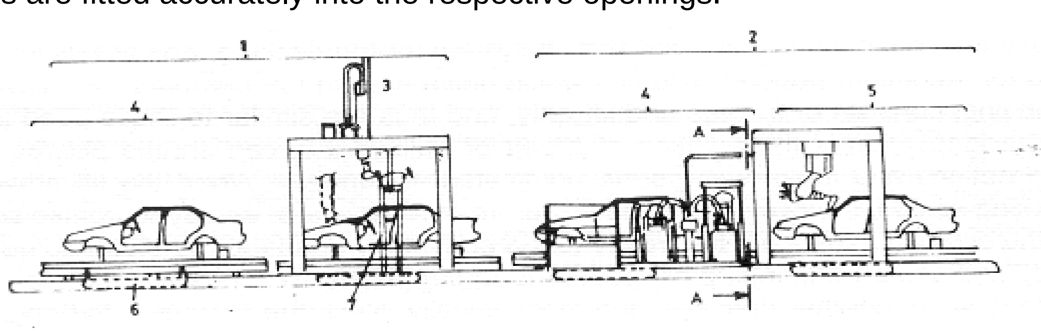


1. Hood 2. Front module 3. Guard Rail 4. Front Seat 5.Front/Rear Carpet 6. Drip Moulding 7. Trunk Lid 8. Headliner 9. Rear Lite 10. Windsheild 11. Cockpit module 12. Front/Rear door 13. Battery

Fig. **8.6. Area of Trim Assembly with Possibility of Automation**

Installation of cock-pit: The cockpit are preassembled separately. The cockpit is lowered into the body from above. A robot gets the sealant applied beforehand to seal the joint. The cockpit is also automatically bolted to the body on the sides. Fig. 8.7 shows stations of system for automatic cockpit installation.

Windshield preparation and fitting: The windshields are automatically (or manually) loaded into pallets and centered. A robot attaches the required number of clips to hold the trim-frame to the outer edge of the windshield with special attachment. Primer and adhesive are also applied by a robot on down-the-line stations. Continuous monitoring of the process ensures that the adhesive is metered and dispensed in proportion to the robot's speed of travel. The wind shield are fitted into the opening by a robot with an integrated vision system (sensor system based on principle of laser-light intersection) in order to guarantee that the windshields are fitted accurately into the respective openings.

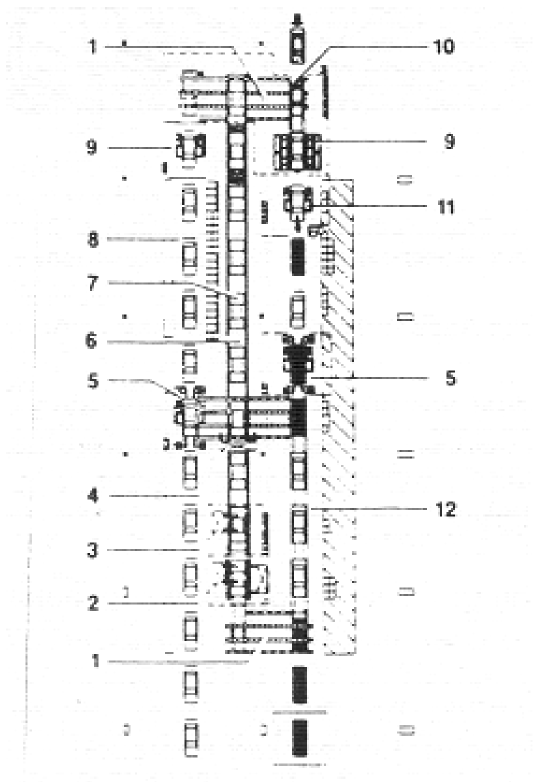


1. Automatic cockpit installation 2. Adhesive application 3. IR 460/100 4. Manual stand-by station 5. Automatic station 6. Transport Pallet 7. Cockpit locating equipment

Fig. **8.7. Installation Of Cockpit**

AUTOMATION IN CHASSIS ASSEMBLY

The docking process has already been automated. In one case, the power train, suspension, steering and exhaust are mounted on 4 sub-pallets on a standard pallet in the form of a frame suitable for any model. Some uses two separate pallets - one for the power train etc. and the other for the rear suspension. Fig. 8.8 shows a chassis assembly system. The assembly system includes a preassembly line for the undercarriage and drive-train components, the main assembly line for automatic assembly of chassis module to body. A large pallet holds the individual pre-assembled undercarriage and drive-train units in the proper position. The units are manually assembled to form the chassis module. After the chassis module enters the main assembly line, the chassis module and the body are automatically decked in a lift station. The remaining fastening operations are completed manually.

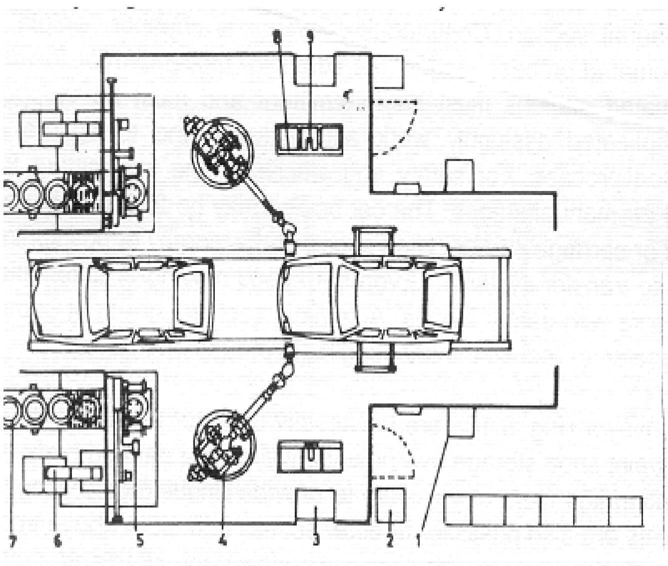


1. Crossover transport
2. Unloading front-axle and rear-axle carriers.
3. Loading front-axle and rear-axle carriers
4. Loading engine and Transmission
5. Lowering Station
6. Pre-assembly line
7. Main Pallet
8. Bypass Line
9. Lift and decking station
10. Crossover station for bodies
11. Fastening station
12. Main Assembly Line

Fig. **8.8 A Chassis Assembly System**

Some use the conventional carousel and lift system for the docking, and the system may be adapted for automatic working. The lifts which move around the carousel synchronised with the main line, consists of fixtures and lift only, and thus are similar to those used in manual lines. The innovation is the addition of a pair of trolleys that can shuttle between the two docking stations and these incorporate automated nutrunners. When the lift arrives at the first docking station, the two other trolleys start to move forward, and synchronise speed with that of the carousal. To locate the trolley to the body, they push four pins up into holes in the car body and some horizontal pins locate the trolley to the lift. Thus the three trolleys and body are located together precisely and mechanically. Next, the lift raises the engine to the body, and immediately afterwards the nutrunners move upwards and insert and tighten the bolts. The complete operation is performed quickly, and simply , and because the method of locating the trolleys to the body is mechanical, it is easy for the operators to see the cause of any problem.

Wheel mounting is another area where automated assembly has reduced the inhuman working load from workmen. In one of the system, the production conveyor is not stopped for automatic wheel mounting The robots mounting the wheels track and follow the moving car. By using a vision system and a binary image processing sensor computer, the orientation and position of the wheel hub hole pattern are recognized and the motion of the robot is controlled accordingly. Front and rear wheels can thus be mounted on both sides simultaneously. Fig. 8.9 shows a schematic layout of one such assembly cell.



1. Nutrunner Controls
2. TV evaluation unit
3. Robot Controls
4. IR 600 with gripper/nutrunner
5. Bolt inserting equipment
6. Bolt feeder
7. Wheel Delivery
8. Lighting
9. TV Camera

Fig. **8.9 Wheel Mounting on a Moving Assembly Conveyor**

Operations that have been typically automated are:

- installation of complete facia with instrument
- installation of power train, front and rear suspension, heat insulation shield, exhaust system, gear shift lever and mechanism, and fuel tank
- tightening of the strut upper mounts
- installation of roof lining
- installation of rear seats in car
- installation and fastening of front seats
- mounting of wheels to hubs
- application of urethane and primer around windscreen
- installation of windscreen and rear window
- installation of spare wheel
- filling of all fluids-

With the present construction of automobile and available production technologies, a maximum of 30% of all the jobs can be automated, as the process involves a large amount of complicated work. To achieve higher rate of automation, if at all required, a transfiguration of body construction is essential. Several parts may be reassembled into modules in special cells and the modules can be automatically installed in the car bodies on the main conveyor. Some such components are

- *Dash board panels*
- *Chassis parts*
- *Front end parts*

But the viability of the proposed system are to be looked into at the development stage itself with simultaneous effort of experts. It will require real innovation to marry every dream of stylist into automatically manufacturable reality.

CONVEYOR SYSTEMS IN ASSEMBLY PLANT

The car is to be stopped for automatic operations, whereas it can keep moving on a conveyor through the manual section. Continuous conveyor is cheaper, simple and less prone to trouble. For automated process stages, the conveyor movement for forwarding the car bodies to the automated stations must be intermittent and must be stopped at the stations to perform complicated assembly work automatically and to ensure improved reliability of the automated process. For safety and efficiency, the intermittent forwarding method is not often used for manual stages. The car bodies may be forwarded intermittently by direct transfer method or carriage system. High speed and accuracy of positioning are the basic requirement of these transfer systems. Even if it keeps moving in automatic section, the area must be made safe with safety fences. Automatic sections are kept separate from manual sections. Trend is also to reduce the line lengths to reduce inventory.

Single slat or two slat conveyor (Fig. 8.10), are universally used for trim assembly and final assembly line. From the paint shop storage overhead conveyor, the painted body is dropped on slat conveyor on locating jigs fixed to the slats to provide unobstructed access from all sides. Varied working levels are also possible- to allow access from both above and below of the body. Sometimes, the slat conveyors with floor pits between the slats are used to permit work on the upperside and undersides of car bodies simultaneously.

For chassis line, overhead power pulled conveyor or power and free conveyor are used. OHC and floor conveyors employ two types of transporting lifters for transporting bodies from each other:

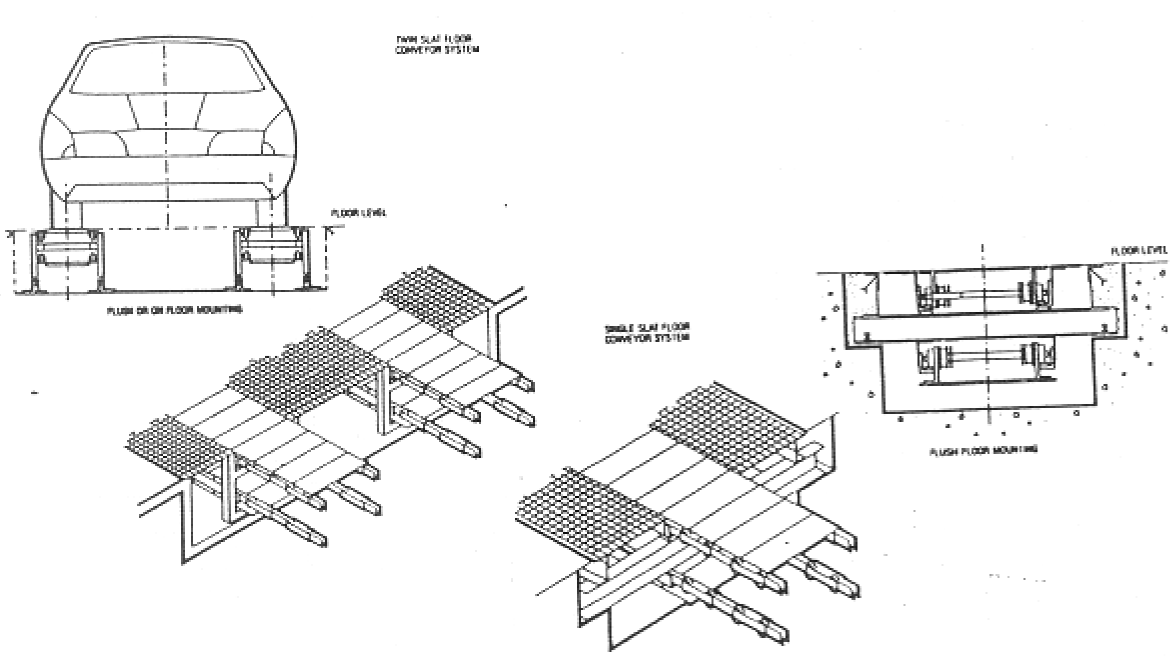


Fig. **8.10 Single Slat or Two Slat Conveyor**

1. *Drop lifter* : The floor transfer of bodies between OHC and dolly is accomplished by part of the OHC truck which moves up and down with hanger. Drop lifter Fig. 8.11a is suitable when manual operations are necessary.

2. *Arm lifter* : A body is raised and transferred to a hanger of OHC .With arm lifter, the structure of the OHC is simplified and cycle time is shortened. Arm lifter Fig.8.11b is suitable for fully automatic transfer system.

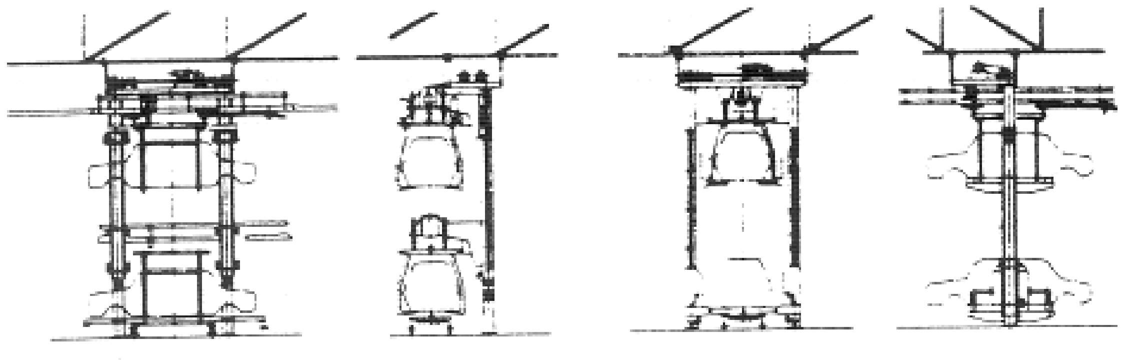


Fig. **8.11a Drop Lifter** Fig. **8.11b Arm Lifter**

VEHICLE TESTING

After the vehicle comes out of the Final assembly line, it is driven on its own power to Vehicle Testing area. Inspection equipment include :

1. Wheel alignment tester
2. Turning radius tester
3. Headlight tester
4. Side slip tester
5. Drum tester
6. Brake tester

1. **Wheel Alignment Tester:**
It performs measurement/adjustment of toe of the front and rear wheels as well as camber of the front and rear wheels of an assembled vehicle. It also sets the steering wheel at a position where it becomes horizontal during the straight ahead running.

The vehicle is driven onto the tester and is centered roughly by means of the equalizers and by its own propelling force. The roller for driving the wheels are rotated. Simultaneously the side rollers are pushed against the side of each wheel for accurate centering. The side rollers are used as measurement rollers. The amounts of toe and camber of the wheels are measured under the rotating conditions. The mean values of alignment measured during rotation is indicated.

2. **Turning Radius Tester:**
It measures the right and left turning angle of the front wheels of an assembled vehicle in order to ensure that the turning angles are with in the specified limit. The test vehicle is driven

on to the tester, the front tread setting is automatically made. As for the rear equaliser, the rear tread is set forcibly by the air cylinder.

3. **Head Light Tester**:
At about 4 meters ahead of the turning centres table of the turning Radius Tester, an opening / closing type screen device is provided. The director of photometric axis of head lamps of an assembled vehicle is aimed on the screen. The headlamps are adjusted in such a way that the light patterns on the screen get aimed on the specified positions. In test position the turn table remains locked.

4. **Side Slip Tester:**
It measures the amount of side slip of the front and rear wheels of the assembled vehicles. The vehicle driven by the driver passes slowly over the tester tread plates with the steering wheel held at its straight ahead position.

5. **Drum Tester:**
It conducts evaluation of the indication of speedometer of an assembled vehicle by driving the vehicle or rollers. It also checks the driving condition. The Tester consists of the front wheel section and rear wheel section connected with each other by means of a transmission section (comprising of V belt and pulleys in one case). During the test, the rollers driven by the driving wheel are put under the actual running conditions. Speed indication is compared with the speed applied and evaluation regarding meeting the specification is made.
6. **Brake Tester:**
It conducts evaluation of the brake system of an assembled vehicle by measuring braking force of each wheel (drag, service brake, parking brake). In the tester, each of the rollers for right and left is rotated by a motor. When the brake is applied, a strain gauge detects the reaction force applied to the rollers and measures it as the braking force.

PRESENT TRENDS

✓ Logistics in the automobile manufacturing are getting importance. Methods and system are being developed with the objectives as follows:

- Reducing stocks and thus blocked capital
- Improving parts availability and thus compliance with schedules
- Reducing door-to-door time
- Making the manufacturing more humane.

Particularly noticeable logistical efforts are being made in the field of *just-in-time* **(JIT)** production and delivery **(Lean Production)** *i.e. demand and deadline based production.*

✓ Vendors are being given responsibility to supply complete pre-assembled components ready to go straight in car on the designated work station of assembly conveyor

✓ The use of long assembly lines are being replaced by a line that runs up and down the same shop from 3 to 6 times. It becomes possible to divide the line into smaller, more manageable sections, while an operator working on one part of the line can see any problems in the section before or after his own. With more gangways, delivery of components is simplified. It further eases the installation of small islands of automation. Fig. 8.12 shows a similar concept.

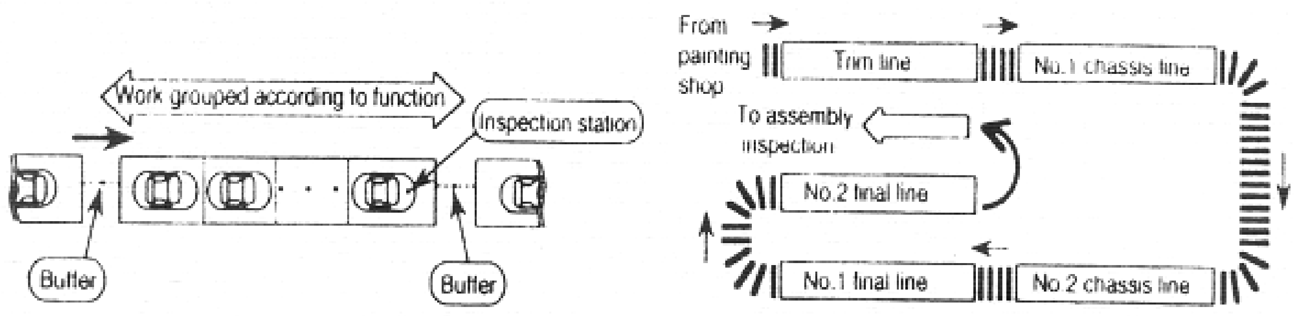


Fig. **8.12 Conventionally Long Assembly Line Divided in Small ones**

✓ Another trend is to shorten the length of the line as much as practical. Inventory is reduced - not just of components but of bodies and major units. The plant can respond more quickly to changes in specification.

✓ Another trend is to assemble the cars on AGVs (automated guided vehicles) with lifts, so that the height of the car can be altered to suit the job being done. A group of two to four persons carry out a complete set of technically related operation on a body.

✓ A rethinking about increasing of automation of assembly operations is being done by the leaders of the industry. Even the automobile company such as Toyota is decelerating the effort of automation in assembly area with a logic that it is only human being who can improve the method on continuous basis and thus inert the goal of increasing cost competitiveness.

✓ A lot many of innovative assisters developed by the group working on the task are being used in assembly operations to improve the productivity and to bring ease of operation.

✓ Increasing demands are being imposed on flexible mechanisation systems in automobile manufacturing - the reason being the increase in number of models and faster engineering changes.

✓ Advanced technology of highly reliable sensors and image processing system will be used for quality assurance of the vehicle assembly processes so that subjective assessment of the inspection personnels may be dispensed with.

✓ Finally, computers will extensively interlink planning, control and monitoring functions of the vehicle assembly and will reduce the time required for passing on information and the system response to the information.