impact tests, for the different sections, are not as advantageous for useful tests as those in current use.

Test Piece and Methods of Testing.—The drop testing machine shall have a tup of 2,000 lbs. weight and the striking face shall have a radius of not more than 5 in., which corresponds to general practice. Placing the rail upon the supports head upwards, only tests it for one general property. More information can be obtained by modifying this test by some tests upon the rails head down, and some upon the sides, and in this way the physical properties of the metal are determined to a greater extent than when the test is only made with the head upwards. The supports 3 ft. apart for the rails is what the writer considers the best practice. That the anvil block shall weigh 20,000 lbs. is not the usual practice, but it is to be commended.

Samples for chemical analysis follow the general custom. It is now customary to make carbon and manganese determinations for each blow and a complete analysis for each day and night turn, representing the average of the other elements contained in the steel, including copper.

Section.—A variation in height of $^1/_{64}$ of an in. less and $^1/_{32}$ of an in. greater than the specified height, will be permitted. This is in accordance with a very old custom, to allow for the variations in height for roll turning, but the variation is too great to lay rails in the tracks so that the running surfaces shall be even and such a variation is larger than should be allowed. The height can be and should be practically constant.

Weight.—A variation of ½ of 1 per cent. for the entire order will be allowed. Rails shall be accepted and paid for according to actual weights. This is not the custom in the United States. The custom is to confine the weight as closely as possible to that specified for the section, and the rails are accepted practically by length instead of weight, though all payments are made on a tonnage basis.

Length.—The standard lengths of rails shall be 30 ft. This is not the standard of length for rails at the present time. A number of railroad companies buy their rails 33 ft. long and some 60 ft. long. The variation of ¼ of an in. in length from that specified will be allowed. This means in practice one rail may be ½ an in. longer or shorter than the next rail from the same bar. In relaying rails in the road this causes a great deal of adjustment; ⅛ of an in. is all that is required in good practice.

It would seem quite easy to draw up standard specifications for rails where the conditions of traffic are uniform from year to year, but when the traffic conditions, owing to commercial requirements, are increasing in severity all the time, standards which were ample at one time are not suitable when the traffic has doubled or trebled in severity. . . .

Freight Yards of the Chicago Transfer & Clearing Company.

[WITH AN INSET.]

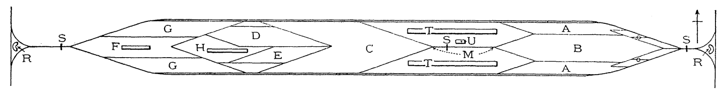
We publish in this issue the plans of the largest railroad yard in the world, which is now building at Chicago by the Chicago Transfer & Clearing Company. This project was started in 1899 when the company was organized. Broadly the plans are: First, to build immense clearing yards in which cars of different roads can be sorted and delivered with greater despatch and economy than now. Second, to build near the yards great commercial warehouses, grain elevators and coal chutes equipped with special appliances for handling merchandise and other freights cheaply. The need of such a clearing and transfer station has long been felt at Chicago and several schemes have been suggested, but the chances are that something of this kind will be needed still more in the near future as track elevation is extended. Raising the present railroad yards involves very costly work, makes it more difficult to reach elevators and warehouses with spur tracks and tends to limit yard extensions.

This whole undertaking is on a big scale. The company now owns 3,700 acres of land bounded on the north by the projection of Sixty-third street, and on the south by Seventy-ninth street projected, this tract being about 7½ miles west of the Lake. On the east side of this land is the Chicago & Western Indiana R. R., and on the west side are the Chicago Junction Ry. and the Chicago Terminal Transfer R. R., all of these being belt and switching roads. The Chicago & Alton and the Chicago & Grand Trunk are also adjacent to this tract. At one corner the company owns land extending to the Drainage Canal and Illinois & Michigan Canal.

The ground where the yards are located is practically level prairie, but rather low, and the first work has been to build a sewer system draining the whole tract into the Illinois & Michigan Canal and the Drainage Canal. The main sewer is 7½ ft. in diam. and of concrete, and there are 11 miles of drain pipe laterals. This work is about finished. The yards are raised 2 ft. above the surrounding level with sand, on top of which is a foot of slag and broken ballast, and 600,000 cu. yds. of material is needed for this filling in each yard. For each gravity mound 264,000 cu. yds. of filling is required. This grading for one yard is nearly all done and it is proposed to have this yard finished and in working order by the latter part of next summer. In what follows only the yard work will be presented, reserving a description of the warehouse system and special machinery until a future issue.

By reference to Fig. 1, an idea is got of the whole scheme as planned. The yard which is now building is shown as No. 2 on this plan, which it will be seen is but one of four proposed units, space being arranged for yards Nos. 1, 3 and 4 as future extensions. It may be interesting to note here that between the connecting belt roads, on the east and on the west, is from three to four miles. With but a single yard unit, trains will probably be classified for the several roads without respect to order, but with the addition of more units it will be possible to classify trains for participating roads in station order. The erection of a series of commercial warehouses, as shown in plan is contemplated, to be connected and interlaced with a system of tracks providing for immediate delivery of any of their contents to any car in the adjoining railroad yards. The location for elevators and contemplated coal yards is also shown. Fig. 2 of the accompanying inset shows the arrangement of yard No. 2 to such a scale as to make the details of the design apparent. Fig. 3 is a bird's-eye view of the gravity section of this yard and Fig. 4 is a diagram which will be referred to particularly in describing how the yard is worked.

Trains come in either at the east or west end of the yard. If coming head-on from the west the locomotive passes over the outside main tracks into the receiving yard B, where the locomotive is detached and goes to departure yard A A or G G for its return load. If a train comes from the north, south or east, it backs or heads in at the east end to the receiving yard B, the locomotive is detached and passes on thoroughfare tracks into the departure yard A A for its return load. In both cases special tracks next to the roundhouse are provided for the holding of way cars. Receiving yard B holds 3,500 cars. An auxiliary engine takes 18 or 20 cars at a time out of the receiving yard and passes them up the gravity hump M under the signal tower S, leaving the way bills in the signal tower. The cars are then detached and sent by the operator in the signal tower to their proper tracks in the classification yard C; or, if they are empties, held to order, they go into the storage yard D; or if perishable freight into the fast freight yard E, or if needing repairs into repair yard F. The cars get sufficient momentum in running down the grade to enter either the fan-shaped classification yard, storage yard, or fast freight yard. The height of the gravity hump is 22 ft. at its maximum elevation under the signal tower. Grades of 0.9, 1.0 and 1.25 per cent. are used in the gravity mound, the rest of the yard being level. An auxiliary engine takes the classified trains from classification yard C and puts them, over thoroughfare tracks, into the various departure yards A A or G G. The signal tower S on the gravity mound governs nearly all the switches in this yard by an electro-pneumatic interlocking system, now being arranged for by the Union Switch & Signal Company.



Plan of General Yard No. 2 Now Building at Chicago—Chicago Terminal Transfer & Clearing Co.

Yard is 14,500 ft. long and 660 ft. wide.

A = Departure yards,	18	*tracks*,	*capacity* = 1,250	*cars.*	*H = Ice house.*
B = Receiving	" 22	"	" 3,500	"	*R = Round houses, 20 stalls each.*
C = Classification	" 39	"	" 3,500	"	*S = Signal tower.*
D = Storage	" 15	"	" 600	"	*T = Transfer houses, capacity 800 cars daily.*
E = Fast freight	" 11	"	" 300	"	*U = General power plant.*
F = Repair	" 9	"	" 150	"	*M = Gravity mound.*
G = Departure	" 22	"	" 1,250	"	

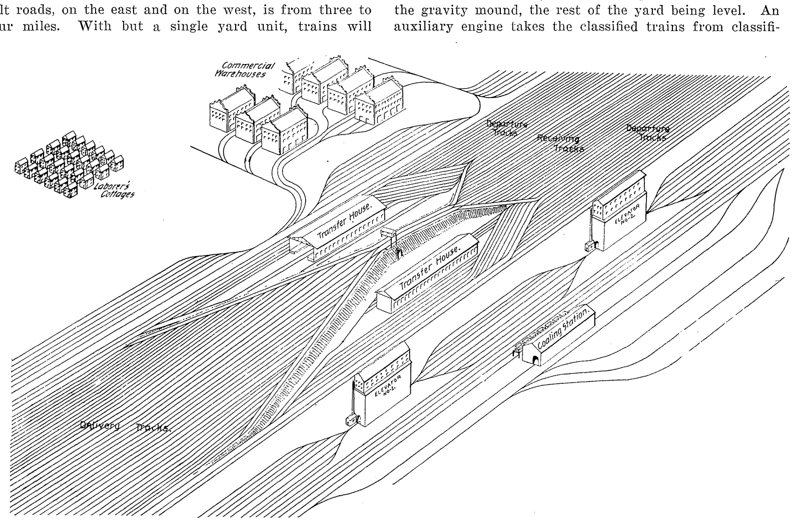


Fig. 3.—Perspective View of Center of Gravity Yard and Transfer System of the Chicago Transfer & Clearing Co.

In this manner 4,000 cars a day may be received and classified. The transfer of broken car lots from and between the various roads will be effected in two transfer houses 50 by 1,600 ft. The use of special mechanical appliances for economic and rapid transfer of broken car lots is under consideration. An icehouse, H, is provided for icing trains of perishable freight. Two roundhouses, R R, at the ends of the yard will furnish accommodations for 40 locomotives. U is the general powerhouse providing for electric light, compressed air, fire protection and water supply.

This yard (No. 2) is 14,500 ft. long and has practically 42 parallel tracks in a width of 660 ft. Altogether it will hold 14,000 cars. It will be fully ballasted and is now being thoroughly drained by an extensive system of laterals and main sewers. A complete system of electric lighting of the yards has been designed, also the details for ample fire protection by an independent water supply and the distributing system is now in course of construction. As said, the grading is nearly complete, as are also the drainage works, and it is expected that this yard with its 105 miles of track and accessories will be ready for service during the late summer of 1901.

Mr. A. W. Swanitz is Chief Engineer of the Company, and to his co-operation we owe much in the preparation of this description. Mr. Swanitz has at different times had charge of large terminal and yard work at Port Chalmette, near New Orleans, La., the East Shore Terminals

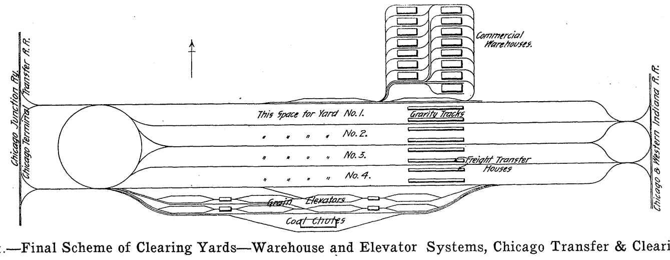


Fig. 1.—Final Scheme of Clearing Yards—Warehouse and Elevator Systems, Chicago Transfer & Clearing Co.

at Charleston, S. C., and the Chicago & Calumet Terminal road at Chicago. He has also acted as Constructing Engineer for the Chicago & Northwestern, and the International & Great Northern.

Tunnels on the West Virginia Short Line Railroad.

BY J. V. DAVIES, C. E.

The State of West Virginia is well named the "Mountain State," for, excepting the plateau tops of the mountains, there is hardly a level piece of country within its boundaries; and consequently railroad construction, if designed for operation under modern conditions of loads, speeds and economy, must be very expensive. The location of any railroad in the State can only be as good as the narrow and precipitous valleys will allow and in order to obtain good alignment it usually becomes necessary to introduce into construction multitudinous bridges as well as tunnels.

The West Virginia Short Line Railroad was located as a short and most advantageous connection from the growing and flourishing district of Harrison County, W. Va., and its chief town of Clarksburg to the Ohio River Railroad; and by the connection of that railroad, to provide an alternative outlet for the West Virginia development of the coal from the Pittsburgh seam either south, west or to the Great Lakes. It is the only feasible or advantageous route across the triangle between the Grafton to the Wheeling line and the Parkersburg Branch of the B. & O.; with the immense advantages over those roads of being a low grade location.

Commencing at Clarksburg, the line follows more or less closely the West Fork of Monongahela River to Lumberport; thence up the valleys of Ten Mile and Little Ten Mile Creeks and its tributary streams, using a maximum adverse grade close to 18 ft. per mile (equated for curvature at the rate of $^{34}/_{1000}$ per degree) for a distance of 5½ miles to the summit of the range of hills which forms the eastern divide of the valley of the Ohio. The descent to the Ohio River is down the tortuous valley of Fishing Creek, using a maximum equated grade of 50 ft. per mile for 4½ miles; and the connection to the Ohio River Railroad is effected at Brooklyn, Wetzel County. In order to pass through the range of hills above mentioned there were found to be two locations feasible, in each of which the line followed up small branch creeks to the head waters, the valleys heading up against those on the other side of the divide. The route adopted involved the longer tunnel but allowed of the flatter approach grade and lessened the difficulties of approach construction.

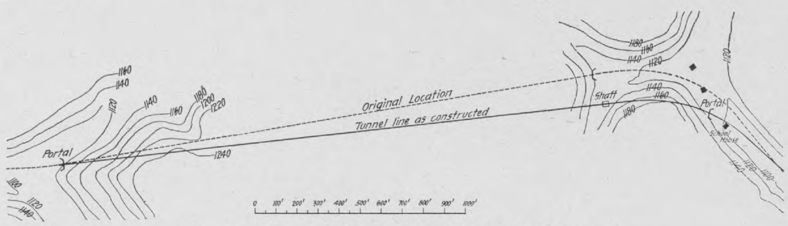
On the final located line the shortest tunnel length would have brought the portal and approach cut on the west end under the steep slope of the hillsides, so as to endanger very seriously the maintenance of the railroad in case of cloudburst or snow storm. This portal was therefore moved some distance down the valley, lengthening the tunnel some 600 ft., but shortening the total distance from grade point to grade point and reducing the depth of open cut at portal from about 35 ft. to about 20 ft. This change, however, involved a short length of 8 deg. curve within the tunnel itself from near the portal to the main tangent of the tunnel, but in view of the fact that this location brought the tangent under one of the forks in the valley of Manion Run, it allowed a shallow shaft being advantageously installed from which to drive the west end heading of tunnel, and the point below the shaft was made the summit of the intersecting grades and it is planned thereon to construct a low chimney to assist ventilation after operation. At the east end the waste material from the tunnel could all be used advantageously, with some 7,000 ft. haul to construct a high embankment, and it was therefore arranged to take out the approach cut to grade, before driving in the tunnel bench. In the meanwhile the upper lift of approach cut was taken off to grade of the bottom of timber sills carrying the roof sets, which was the made level of the top of tunnel bench, and so the heading was started and driven in, some distance in advance of the commencement of the bench excavation, and the size of the heading was worked throughout the tunnels the full width as called for by the drawings, and the height (9 ft.) as required above the sills to the roof back of the timber sets.

In the alignment of the Summit Tunnel, the heading from the western end required to be carried in on the tangent from the vertical shaft. This shaft was made about 15 ft. wide on the axis of the tunnel, and as the depth was very shallow, and in order to avoid the use of plumbing wires, the Resident Engineer, Mr. Isaac Dox, arranged a very satisfactory method of cutting a narrow diagonal trench from the surface down to the tunnel heading on each side of the shaft, and by setting up the transit on the center line at the surface, on either side of the shaft, was enabled, by taking vertical angles, to extend the base line on to the floor of the tunnel by two extended points about 75 ft. in length. This gave an admirable base from which to extend the heading alignment and the result worked out in every way almost exact in the meetings of the headings.

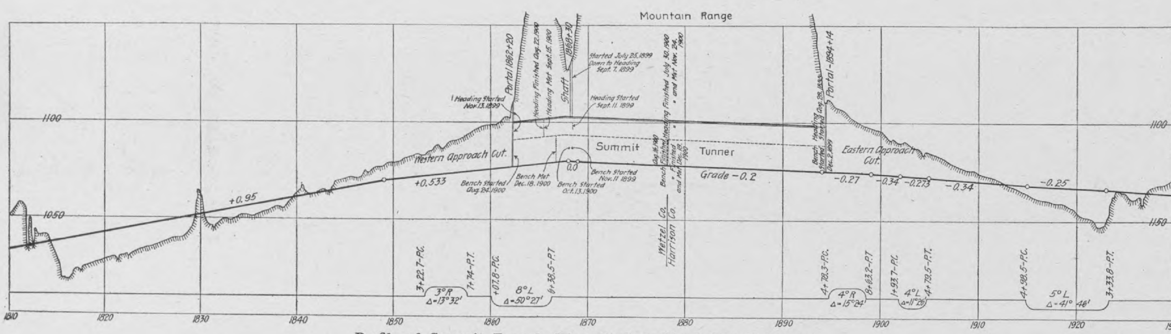
At this Summit Tunnel, the westerly approach cut with the end embankments, and also the one-half of the total length of the completed tunnel were constructed by Messrs. Carpenter & Boxley, while the exactly similar section on the east end was executed by Messrs. Rinehart Sons & Co. Each of these contractors installed identically the same plants consisting of a Rand straight line air compressor, 16 in. x 24 in., with an equipment of five No. 3 B "Little Giant" Rand percussion drills. The lighting of headings and tunnel was done largely by natural gas, piped from a gas well a short distance from the tunnel. At the east end, the contractors used a small 30-in. gage locomotive engine for disposal of the excavation, which was hauled in this way right out from the face with train of rotary dump cars (having capacity of about 2½ cu. yds. each), and the material disposed of about a mile and a half distant from the portal. At the west end of the tunnel, however, the contractors used mule service from the face of the bench to the bottom of the shaft, and also on the surface from the shaft to the spoil bank. The approach cut excavation and that from the west portal was hauled by locomotive engine and dump cars a distance of about a mile to the approach embankments.

The geological formations in which this tunnel was constructed are the clay shales and micacious sand stones of the upper coal measures of West Virginia, which have a normal dip to the West of about one to one-and-a quarter per cent. All these shales disintegrate very rapidly on exposure to air, and it was therefore found absolutely necessary to timber the entire tunnel as excavation proceeded; and even by doing so and notwithstanding the greatest care exercised in placing the shot holes in the heading, it was found almost impossible to prevent these shales from breaking up to the nearest bench of hard stone in the roof, which commonly involved an additional height over that called for of some 3 or 4 ft. above the roof timbers of the tunnel. All these cavities, both in the roof and in the sides, were packed with the best material available out of that excavated as the work proceeded, and the inspection was very close and rigid in respect of the careful packing of all cavities in the rear of timber laggings.

In carrying out this work in the Summit Tunnel the holes drilled for excavation of heading varied somewhat according to whether the rock was hard or shaly. Usually the complete round consisted of from 18 to 22 holes fired; and of depths of from 6½ to 10 ft. These were grouped partly for three and partly for four shots fired per round. In the first case the cut was arranged for 8 holes having a dip of from 1 to 2 ft. and fired first. Then the breast holes, 6 in number, having dip of from 1 to 1½ ft., were fired second, and the third shot, consisting of 4 holes for the uppers, for rounding out the form of the arch.



Alignment of Summit Tunnel—West Virginia Short Line.



Profile of Summit Tunnel—West Virginia Short Line Railroad.

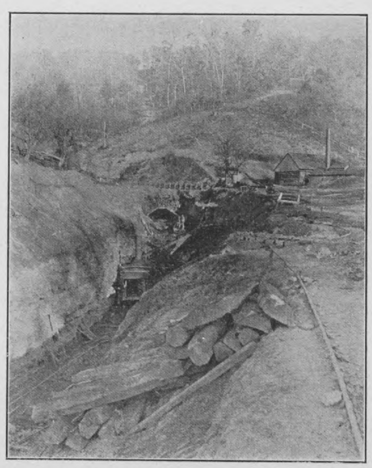
In the second case the holes were usually grouped as follows:

Cut holes ....First shot fired 6 holes dip 1½ to 3 ft.
First breast upper holes ....Second shot fired 6 holes dip 1 to 1½ ft.
Second breast lower holes ....Third shot fired 4 holes dip 1 to 1½ ft.
Upper holes ....Fourth shot fired 6 holes dip ½ to 1 ft.

In either of these cases the net result was about the same, or 5 ft. advance in heading for the round.

In excavation of the bench which was for the most part in shale rock throughout all the tunnels, it was removed as a double bench, using for the top lift 4 holes from 7½ to 9½ ft. deep, fired in pairs, and for the lower lift from 4 to 6 holes, also fired in pairs. This round of holes was drilled about 5 ft. from the face, making an advance in bench excavation of that amount for each complete round of holes. The contractors used an average of 3.6 lbs. of 40 per cent. dynamite, per cu. yd. of material excavated, from the heading and 1.4 lbs. for material excavated from the bench, or an average for the entire tunnel section of 2.17 lbs. per cu. yd. of excavated material. Progress accomplished was not unusually rapid and amounted for the entire tunnel to an average of 110 ft. per month of excavated tunnel of full section which was lined with timber as the work proceeded.

The tunnels on this line were constructed only for single track railroad, being designed for a measurement in width inside of permanent linings, 16 ft.; and for a height above the base of rail to the soffit of arch 18½ ft. The Summit tunnel measures 3,194 ft. from portal to portal, while the Twin tunnels were respectively 738 and 1,032 ft. in length.



East End Summit Cut—W. Va. Short Line.