CONTENTS

1 Understanding Road Survey Stakes . . . 5
   Survey stakes 6

2 Plan Reading . . . 21
   Subdivision plans 22
   Highway plans and cross sections 37

3 Grade Setting . . . 51
   Setting grade 52
   Grade setting equipment 53
   Checking grade with swedes 55
   String lines 57
   Laser levels 62
   Crows feet 71
   Staking cut and fill 76
   Sewer line projects 79

4 Setting Grade Stakes Using a Contour Plan . . . 83
   Reading a contour plan 84
   Staking the area 86

5 Grading with Lasers, GPS and Other Specialized Equipment . . . 93
   Using a laser level for parking lots 94
   Using a laser level for pads 95
   Using a laser level for road projects 96
   Using a laser level for trench work 98
   Laser receivers on equipment 101
   Other on-board control systems 103
   Grading with GPS 104

6 Road Building Equipment . . . 117
   Slip-form curb machines 117
   Slip-form pavers 119
   Profilers 121
   Reclaiming machines 125
   Other specialty equipment 126

7 Planning for Excavation . . . 133
   The equipment 134
   Soil conditions 141

8 Excavating Rock . . . 145
   Cutting slopes in rocky soil 146
   Ripping and excavating rock 148
   Compacting fill with rock 150

9 Excavating Subdivisions . . . 155
   Selecting the right equipment 156
   Planning the excavation 161
   Erosion control 170
   Grading and compaction 174
   Fine trimming the subgrade 177

10 Excavating Commercial Sites . . . 183
    Take time for planning 184
    Excavating an apartment or office complex 185
    The excavation begins 187
    Curbs and paving 193

11 Highway Grading and Excavation . . . 199
    Staking a highway job 202
    Beginning earthwork 205
    Checking the grade 208
    Subgrade work 213
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Widening Rural Roads</td>
<td>219</td>
</tr>
<tr>
<td></td>
<td>Minimize the inconvenience</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>Preparing the work area</td>
<td>221</td>
</tr>
<tr>
<td></td>
<td>The excavation</td>
<td>223</td>
</tr>
<tr>
<td>13</td>
<td>Building Narrow Embankments</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>Making space for the equipment</td>
<td>234</td>
</tr>
<tr>
<td></td>
<td>Bringing in fill from above</td>
<td>237</td>
</tr>
<tr>
<td></td>
<td>Compacting and finishing</td>
<td>237</td>
</tr>
<tr>
<td>14</td>
<td>Drainage Channels</td>
<td>241</td>
</tr>
<tr>
<td></td>
<td>Controlling water</td>
<td>242</td>
</tr>
<tr>
<td></td>
<td>Rebuilding a channel</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>New channel excavation</td>
<td>248</td>
</tr>
<tr>
<td>15</td>
<td>Unsuitable Material</td>
<td>253</td>
</tr>
<tr>
<td></td>
<td>Testing for unsuitable soil</td>
<td>254</td>
</tr>
<tr>
<td></td>
<td>Excavating unsuitable material</td>
<td>254</td>
</tr>
<tr>
<td></td>
<td>Plugging and bridging</td>
<td>257</td>
</tr>
<tr>
<td></td>
<td>The fill</td>
<td>259</td>
</tr>
<tr>
<td></td>
<td>Remedies for unsuitable soil problems</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>Unsuitable soil around utility lines</td>
<td>264</td>
</tr>
<tr>
<td>16</td>
<td>Compaction</td>
<td>271</td>
</tr>
<tr>
<td></td>
<td>Compaction testing</td>
<td>272</td>
</tr>
<tr>
<td></td>
<td>Meeting embankment standards</td>
<td>276</td>
</tr>
<tr>
<td></td>
<td>Meeting subgrade standards</td>
<td>277</td>
</tr>
<tr>
<td></td>
<td>Selecting the right equipment</td>
<td>281</td>
</tr>
<tr>
<td>17</td>
<td>Curb and Sidewalk Grading</td>
<td>285</td>
</tr>
<tr>
<td></td>
<td>Curb stakes</td>
<td>285</td>
</tr>
<tr>
<td></td>
<td>Cutting curb grade</td>
<td>289</td>
</tr>
<tr>
<td>18</td>
<td>Preparing Subgrade for Aggregate</td>
<td>297</td>
</tr>
<tr>
<td></td>
<td>Rough trimming street subgrade</td>
<td>298</td>
</tr>
<tr>
<td></td>
<td>Fine trimming the subgrade</td>
<td>299</td>
</tr>
<tr>
<td></td>
<td>Trimming highway subgrade</td>
<td>303</td>
</tr>
<tr>
<td>19</td>
<td>Aggregate Base</td>
<td>311</td>
</tr>
<tr>
<td></td>
<td>Placing aggregate in parking lots</td>
<td>313</td>
</tr>
<tr>
<td></td>
<td>Placing aggregate base on highways</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Placing aggregate on subdivision roads</td>
<td>325</td>
</tr>
<tr>
<td>20</td>
<td>Lime-Treated Base</td>
<td>337</td>
</tr>
<tr>
<td></td>
<td>Trimming the subgrade</td>
<td>337</td>
</tr>
<tr>
<td></td>
<td>Spreading the lime</td>
<td>338</td>
</tr>
<tr>
<td></td>
<td>Using lime to bridge unsuitable soil</td>
<td>341</td>
</tr>
<tr>
<td></td>
<td>Using cement instead of lime</td>
<td>343</td>
</tr>
<tr>
<td>21</td>
<td>Asphalt Paving</td>
<td>347</td>
</tr>
<tr>
<td></td>
<td>Removing asphalt pavement</td>
<td>347</td>
</tr>
<tr>
<td></td>
<td>Asphalt paving equipment</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>Setting string lines</td>
<td>361</td>
</tr>
<tr>
<td></td>
<td>Planning the passes</td>
<td>361</td>
</tr>
<tr>
<td></td>
<td>Planning the dump</td>
<td>363</td>
</tr>
<tr>
<td></td>
<td>Placing asphalt with a paver</td>
<td>364</td>
</tr>
<tr>
<td></td>
<td>Paving with a spreader box</td>
<td>376</td>
</tr>
<tr>
<td></td>
<td>Scheduling asphalt trucks</td>
<td>377</td>
</tr>
<tr>
<td></td>
<td>Rolling the spread</td>
<td>379</td>
</tr>
<tr>
<td></td>
<td>Applying the tack coat</td>
<td>380</td>
</tr>
<tr>
<td></td>
<td>Patch paving and trench paving</td>
<td>381</td>
</tr>
<tr>
<td></td>
<td>Chip seal</td>
<td>388</td>
</tr>
<tr>
<td>22</td>
<td>Trenching and Pipe Laying</td>
<td>393</td>
</tr>
<tr>
<td></td>
<td>Trenching for water pipe</td>
<td>393</td>
</tr>
<tr>
<td></td>
<td>Laying water pipe</td>
<td>395</td>
</tr>
<tr>
<td></td>
<td>Trenching for sewer pipe</td>
<td>402</td>
</tr>
<tr>
<td></td>
<td>Laying sewer pipe</td>
<td>408</td>
</tr>
<tr>
<td></td>
<td>Pressure testing sewer pipe</td>
<td>411</td>
</tr>
<tr>
<td></td>
<td>Repairing broken sewer pipe</td>
<td>416</td>
</tr>
<tr>
<td></td>
<td>Trenching for drain pipe</td>
<td>417</td>
</tr>
<tr>
<td>23</td>
<td>Trench Shoring, Shields and Sloping</td>
<td>433</td>
</tr>
<tr>
<td></td>
<td>Hydraulic shoring</td>
<td>434</td>
</tr>
<tr>
<td></td>
<td>Shields</td>
<td>438</td>
</tr>
<tr>
<td>24</td>
<td>Constructing Manholes</td>
<td>443</td>
</tr>
<tr>
<td></td>
<td>Manhole bottoms</td>
<td>443</td>
</tr>
<tr>
<td></td>
<td>Setting the barrels</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td>Setting manhole castings</td>
<td>454</td>
</tr>
<tr>
<td>25</td>
<td>Underdrains, Culverts and Downdrains</td>
<td>459</td>
</tr>
<tr>
<td></td>
<td>Underdrains</td>
<td>459</td>
</tr>
<tr>
<td></td>
<td>Culverts</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td>Downdrains</td>
<td>462</td>
</tr>
</tbody>
</table>

Appendix

A. Equipment operating tips 467
B. Glossary 491
C. Abbreviations 497

Answers to Chapter Questions 499

Index 501
This manual is a practical guide to excavation, grading, paving and pipelines. My aim in writing is to provide information on the best methods available to increase your productivity in, and knowledge of, this very important field. This book can benefit anyone in the construction trade, from beginners just starting out to contractors with years of experience — whether you work in this field, or you just need information to help you understand the process. It’s written in simple terms and covers each step of the excavation and grading process, from how to read and understand grade stakes, through paving, laying pipe and cutting drainage channels.

Since the mid 1970s, when my first grading and excavation book was published, there have been many changes in construction methods and equipment. Adapting lasers, sonar, and GPS to control the equipment to carry grade is by far the biggest change I’ve dealt with in this field. Using sonar and slope control on graders to fine trim has greatly increased
production in the last few years. The operator using a GPS has the precise location where he is working right on his screen, showing the parameters of the lot pad and the elevation needed. GPS is now used on dozers, scrapers and compactors, and is also used for surveying. I’ll be covering GPS in detail in a later chapter in the book.

In the trenching department, the biggest change is that backhoes have replaced most trenchers, and hoes with compaction wheels have eliminated most trench jetting.

In the first four chapters of this book we’ll cover the basics: reading and following survey stakes, understanding excavation plans, and how excavation contractors use contour line drawings. If you’ve been working in the excavation and grading business for a while, most of what you read in the first few chapters you probably know already. But if you need a brush-up on plan reading and stake markings, or if you’re new in the field, these chapters explain it in terms I use throughout the book.

So let’s start at the beginning — with surveying and staking. Everyone — the inspector, superintendent, foremen and grading equipment operator, needs a good understanding of how surveyors stake the job. Not understanding the stakes is like having the specifications and not being able to read. Today, most large jobs and many small ones are excavated using GPS to guide equipment. And even fewer stakes will be used in the future, making the stakes that are set more important than ever to read. The basic information on the stakes has changed little in the last few years. However, the way the surveyors compute that information has changed.

**Survey Stakes**

Excavation for roads, buildings and pipelines begins with a survey of the area where the excavation will be done. A survey crew working for the engineering firm that’s designing the project will set out stakes and hubs that identify points on the construction plans. When a precise distance or elevation is needed, a surveyor’s tack on top of the hub establishes the point from which elevations and distances are measured.

Beside each hub there will be an *information stake* marked in surveyor’s code. It explains the grades at various distances from the hub
or other reference stake or point. It’s essential that you know how to read the markings on these information stakes and follow the instructions they provide. The surveyor may write on one or all sides of the stake.

**Cut Stakes**

The stakes are usually called *cut, fill* or *slope* stakes, depending on the type of excavation required. Figure 1-1 shows the kind of markings you’ll find on an information stake. In this case, we’re looking at a cut stake for a road.
excavation. The front, back and both sides of a cut stake are shown in the figure. Below the stake there’s a cross section drawing of the existing grade and final road grades that are described on the stake. Refer to the drawing as I explain the markings on the information stake in the figure.

Look first at the stake labeled front in the upper left of Figure 1-1. That’s the front of the information stake. The RS at the top of the stake means that there’s a reference stake to be established, and that reference stake is the point from which measurements and elevations are taken. The location of the reference stake is the point that the projected cut slope meets or catches original ground, also referred to as a catch point. Find the reference stake in the drawing. It’s labeled RS and it’s in the upper left-hand corner of the drawing. Below the letters RS on the information stake you see C-1⁰. Below that you see a diagonal line and 5⁰. These markings above and below the diagonal line identify the amount of cut and distance needed to establish the correct grade at the reference stake. The number above the diagonal line is the elevation and the number below the diagonal line is the distance. In this case, the information stake shows a cut of 1.0 foot (below the level of the surveyor’s hub) to be made 5.0 feet from the hub for the RS point.

Some surveyors may use RP instead of RS. RP means reference point. Treat it exactly the same as the RS.

Notice that distances and elevations are measured in feet and tenths (or hundredths) of a foot, not feet and inches. The small number above the small horizontal line shows decimals of a foot. That’s a little different from what you’re probably used to, but you’ll appreciate the difference when adding and subtracting feet and decimals of a foot rather than feet, inches and fractions of an inch. I’ll explain more about this measuring system, called engineer’s measure, later in this chapter.

The two horizontal lines below the first set of measurements are very important. All measurements above the double horizontal line are taken from the hub beside the information stake. The double horizontal line means and then, indicating that all measurements and elevations from that point down on the stake are taken from the RS point and not the surveyor’s hub. Note this very carefully: If the double horizontal line was replaced with a single horizontal line, all measurements and elevations would be taken from the surveyor’s hub rather than reference stake or hub established by the grade setter. On the other hand, if the surveyor uses a double line after each grade, then each cut becomes the reference for the next. We’ll look at this last method shortly.
The next information on this stake shows the elevation and location of the ditch cut (C-10^\text{d}/20^\text{d}). It’s to be 10 feet lower than the RS point and 20 feet from it. The grade falls 10 feet over a horizontal distance of 20 feet, thus creating a 2:1 slope. You can see this indicated on the drawing (about lower middle). For every foot of cut, the grade line moves horizontally 2 feet. Notice that all measurements are made from the reference stake. The ditch is cut 10 feet below the reference stake and 20 feet from that stake. Also note that the 20-foot distance is measured horizontally, not diagonally, from the reference stake. Look again at the drawing to be sure you understand how the 20-foot distance to the ditch is measured. Remember, each square on the survey drawing represents 1 horizontal and 1 vertical foot.

The next reading is the hinge point (HP) grade and distance. Note the hinge point on Figure 1-1. It’s 2 feet above the ditch cut. The HP information on the stake shows an 8-foot cut at 24 feet, indicating the grade must come up 2 feet and move out 4 feet. By computing the amount the HP rises from the ditch and the distance it moves towards the center of the road, you can see that it’s again a 2:1 slope.

Reading down the information stake, the next grade and distance is the edge-of-pavement (EP) point. The grade will be 7.9 feet below the reference stake hub. Notice the cut at EP is 0.10-foot less than the HP cut. The reason for this is that the road grade rises 2 percent in the 5 feet from HP to EP. Multiplying 5 feet by 2 percent gives the amount the shoulder rises in that distance (5.00 \times 0.02 = 0.10).

The next markings give the centerline cut. You can see that the cut is again less than the previous cut at EP. Subtracting the 29 feet at EP from the 49 feet to the centerline leaves 20 feet. So the centerline is 49 feet from RS and 20 feet from EP. The cut at the centerline is 0.40 foot less than EP cut, making the centerline 0.40 foot higher than EP. Again, we have a 2 percent slope from the centerline to EP. You can check this by multiplying the 20 feet by 2 percent (20.00 \times 0.02 = 0.40). These are all finished grades so the grade setter must add the thickness of the road section to the EP and centerline grade to get the correct subgrade elevation that must be excavated.

Look at the back of the cut stake. It’s marked 3+50, indicating that this station is 350 feet from station 0+00, the point from which the survey began. Below the station number is the distance from the
surveyor’s hub to the center of the road. This includes 5 feet to the RS and 49 feet from the RS to the centerline, a total of 54 feet (54').

Now let’s look at the sides of the stakes. Note the first drawing of the stake labeled side. This side of the stake identifies the percentage of slope from the centerline to HP. The minus sign indicates that the centerline slopes down to the HP. If it were a plus sign instead, the centerline would be sloping up to the HP. The second side stake drawing shows the rate the cut slope falls from RS to the ditch. In this case, it’s 2 feet out for every foot downward. The second group of numbers is the elevation of the surveyor’s hub above sea level.

Here’s another method a surveyor might use to indicate measurements and elevations. I mentioned earlier that the line between each grade on the surveyor’s information stake was very important. A double horizontal line means and then. So, if the surveyor uses a double line after each grade on the information stake, then each cut becomes the reference for the next. The information stake in Figure 1-2 shows the same information as the one in Figure 1-1, except it’s written with a double line between each grade. Notice that by adding the double line, the last three distances change.

In Figure 1-2, if you add the distances on the stake to centerline together (the distances indicated under the diagonal lines), you’ll get 54 feet from the surveyor’s hub to centerline. Now look at the back of the stake in Figure 1-1. It also reads 54 feet to centerline from the surveyor’s hub. By using the double lines between grades, the last three cuts in Figure 1-1 become fills in Figure 1-2. The reason is because the HP grade must now be computed from the ditch grade, which is 2 feet lower, creating a fill of 2 feet. This method is also used to determine the centerline grade. The EP grade is 0.10 foot higher than the HP, and the centerline is 0.40 foot higher than EP.

If you encounter a stake marked like the one shown in Figure 1-2, for better control and accuracy you should set a hub at each point as a reference to shoot your next grade from. If you study Figures 1-1 and 1-2 carefully, you’ll notice each distance and elevation are exactly the same. Only the methods for computing them are different.
Comparison of Inches and Decimals of a Foot

Setting grades requires many additions and subtractions. Using decimals speeds the work and makes errors less likely. Figure 1-3 compares inches with decimals of a foot. If you’re uncomfortable reading distances in tenths and hundredths of a foot, think of one foot as being like a dollar bill. One dollar is the same value as 100 pennies; one foot is the same distance as 100 hundredths of a foot. One dollar is the same value as 10 dimes; a foot is the same distance as 10 tenths of a foot. Pennies are hundredths. Dimes are tenths.

Fill Stakes

We’ve looked at a cut stake where material must be excavated to reduce the existing grade to the finish grade (Figure 1-1). Figure 1-4 shows a typical fill situation where soil has to be deposited to build up the existing grade. Again, the illustration shows four sides of the stake and the road cross section. The RS at the top of the stake means that the
The reference stake (to the right of the hub) is the starting point and the place from which all measurements and grades are measured. Cut or fill information given for the RS point will be measured from the surveyor’s hub. Here, the RS is located 1.8 feet above the hub and 3 feet from it. The grade setter will have to set the reference stake at the indicated horizontal distance from the hub and draw a horizontal line on the stake at the elevation given on the surveyor’s information stake. If the ground hasn’t been disturbed at that point, his line will match the existing ground.

The grade setter should add a boot to his stake with a horizontal line 1 foot above his RS grade. Because this is a fill, if the fill is made correctly, the overfill will cover his finished grade line. By placing a 1-foot boot above his finished mark, he’ll save the time it would take him to dig it out.
later. So when the grade setter returns to set a second slope stake at HP, he can use the 1-foot boot to compute the next vertical grade needed. He’ll just subtract his 1-foot boot from the vertical grade he wants.

Reading down the surveyor’s stake, the two horizontal lines mean *and then*, indicating that the grade setter must measure from the RS point for the next fill and distance, instead of measuring or shooting grades from the original surveyor’s hub. For the hinge point (HP), measure 10 feet from the RS hub or lath. At this point, a fill of 5 feet must be made to obtain the required grade. The hinge point is the place where the fill slope stops and the road grade begins. A stake won’t be set at HP until the fill reaches that point. It would be in the way. The operator will get that grade from the RS stake set by the grade setter. It’ll show the fill needed 10 feet out, and that the fill slope should be 2:1 for the HP grade. If the fill were to be 20 feet high (rather than 5 feet), the grade setter would set slope stakes every 5 feet the fill rises to HP.

There are times when the grade setter must offset the reference stake. Let’s look at how he would do this. We’ll say that the grade setter set his reference stake 5 feet out from the surveyor’s hub. It often happens that the ground level is disturbed during clearing. What if, during the clearing operation, 1 foot of the existing ground is removed and the grade at the RS no longer matches the surveyor’s information stake? When there is a 1 foot difference in grade, the grade setter working a 2:1 fill should move the reference stake back 2 feet. He must then mark his RS lath to reflect the change. His new fill and distance to HP will be F-6/12. By moving the RS 2 feet back, once the fill is made 1 foot high at a 2:1 slope, it will match the grade and distance on the original RS set at 5 feet. If he didn’t do this, the slope would be off line with the remaining RS points that were not undercut during clearing.

On a cut slope, you may have to offset the RS for the equipment. You’d again move the RS back 2 feet to provide clearance for the grader’s blade. This will keep the grader operator from having to slow down and adjust his cutting edge in from its normal grading position to avoid the stake. The grader would use the same cut and fill given for the 5-foot RS distance, but the grade setter would mark a 2 in a circle at the top of his lath to indicate the actual RS point is offset 2 feet. He should also mark the actual RS point with a paint line for the grader operator to follow. It’s very important to set the RS point precisely because it controls the entire cut or fill elevation and alignment.
Let’s return to reading the information stake in Figure 1-4. The next point referenced is the **EP**. This is the edge of the pavement and it shows a fill of 5.12 feet (F-512) at 14.0 feet from RS.

Below the EP data is the **centerline**, represented by a C and an L (one overlapping the other). From the RS, you measure 32 feet and fill 5.66 feet. This will put the centerline 18 feet from the EP and 0.54 foot higher.

The back of the stake has **25+00**. That signifies that this stake is 2,500 feet up the line from the point where the measurements started (the beginning of the road construction in this instance). The point the surveyors start from is most likely marked 0+00. These are station numbers. The number **35.0** below C means that the center of the road is 35 feet out from the surveyor’s hub (not RS). Look again at the front of the stake and notice that when the RS distance of 3 feet is added to the C distance of 32 feet, the total is 35 feet, the same distance as that marked on the back of the stake.

The first stake labeled **side** is marked **SE − 3%**. This is the percentage that the roadbed slopes from the centerline to the hinge point. On the right-hand stake marked **side**, the first reading is **2:1** (2 to 1). This is the rate the fill slope will rise from RS to HP. Notice that the front of the stake shows HP with a 5-foot fill over a 10-foot distance. This is what the 2:1 indicates. The next item on the side stake is **EL 9660**. This is the elevation of the hub at the surveyor information stake. The surveyors computed all cuts or fills from that hub.

What I’ve described so far in this chapter is more or less standard procedure for indicating elevations and distances on road stakes. However, surveyors in some counties and cities follow slightly different procedures. Some surveyors provide more information on the stakes and some less. The surveyor stake in Figure 1-5 shows what you might see on some county or city road stakes.

The front of the stake begins with a 2 with a circle around it. This indicates that the first cut starts 2 feet out. The next markings indicate that the ditch cut is 4 feet at a distance of 10 feet from the stake. The slope will again be 2:1 because the first 2 feet aren’t cut and the cut over the next 8 feet is 4 feet. Look at the figure again. Notice that there’s no double and then line. This means that you must take all measurements and grade shots from the hub set by the surveyors rather than from an RS or RP point, as on the previous stakes we’ve looked at.
Reading down the stake, we find a second group of numbers that show the top of the shoulder cut (Sho). This is the HP, or hinge point, referred to on previous stakes. Notice there’s no EP distance or elevation on this stake. You must look at the plans for the distance from the shoulder to the edge-of-pavement, and the elevation. Notice that there’s only 13 feet from the shoulder to the centerline, which indicates a possible aggregate shoulder. In this case the shoulder would be brought up to subgrade and not finished grade.

Engineering companies follow different conventions when marking their stakes. But the plans should clarify what’s intended and which points are actually indicated. If something isn’t clear, don’t guess. Call the engineering company that created the drawing and marked the stakes. They should be eager to help.

The second drawing in Figure 1-5 is the back of the stake. It shows the rate of fall of the cut slope (2:1) and the station number (8+00). It doesn’t have the centerline distance because all the front measurements are from the hub and not an RS or RP point. Many stakes have just the details required to allow you to set the grades. Even though other information may be absent, they always have the station number on the
back. The side of the stake is shown in the right-hand illustration. It gives the elevation above sea level (EL 82\textsuperscript{56}). In some cases the hub elevation won’t be on the stake at all. It may be replaced with the percentage of slope for the road, or both may be omitted entirely.

**Miscellaneous Information Stakes**

**Curb stake** — Now look at Figure 1-6. The stake at the left is what you’d expect the surveyor to set for cutting and setting curb grades. From the hub at the base of this information stake, you’d move out 5 feet and down 1.50 feet to the top-back-of-curb (TBC) to set the curb forms or for the top of the concrete pour.

In some cases, the surveyors may also give the front lip grade or even the flow line grade. If not, you’ll have to determine the distance from the back of the curb to the lip. This information is available in the plans or job specifications. When setting curb subgrade, determine the thickness of the
curb plus any aggregate base, if it’s called for under the curb. The thickness of one or both must be added to the cuts and subtracted from the fills to find the subgrade rather than the finished grade level. Notice that there’s a tack in the hub in front of the curb stake. The tack marks the exact spot from which the surveyor took his measurements. Without this marker, the measurements could be as much as 1½ inches off (using a 2 × 2-inch hub). The tack provides greater accuracy.

**Street stake** — The center stake in Figure 1-6 is a street stake you’d expect to find on a rural road first cut. The front of the stake indicates the centerline of the street and the cut or fill to the finished grade. In this case, there’s a 2-foot cut to the finished grade (FG). The plans should show the road width, percentage of slope or crown, and the thickness of the road section. Remember to add the thickness of the road to this cut. The station number may be on the back or front of the street stake. Surveyors rarely stake the street centerline. The stakes are usually offset behind the back of the curb or a roadside ditch and will carry enough information for the grade setter to establish a centerline grade. Those are the common methods for staking roads.

**Ditch channel stake** — The stake at the far right in Figure 1-6 is a grade stake for a ditch or small channel. The 3 in the circle (read 3-foot offset) is the distance from the hub where the first cut starts (which would be the catch point or top-of-slope). The west toe grade indicates the first slope and the bottom of that slope. The east toe is the bottom of the slope on the opposite side of the ditch. Both toe cuts are the same, so the bottom is flat. The east top cut is where the cut will be started on the opposite side. Subtracting the 3-foot offset from the 23-foot distance to the east top cut gives the distance across the top of the ditch, 20 feet. Subtract the small toe distance from the larger. This gives the width of the ditch bottom, 4 feet.

To find the rate of slope from the top cut to the toe of the channel, subtract the distance given to the top cut from the distance given to the toe cut. The 3-foot offset must be subtracted from the west side distance of 11 feet. This will make the distance 8 feet from top cut to toe on each side. Dividing the cut of 8 feet into the 8-foot horizontal distance gives an answer of 1. This indicates that for every foot cut vertically, the slope moves out 1 foot horizontally. That’s a 1:1 slope.

A stake with only a few markings will usually provide all the information you need to do the excavation. If something is still unclear, the plans should have the answer you’re looking for.
In this chapter we’ve described grades by either a ratio of run to rise, or as a percent above the horizontal. Most grades in excavation work are expressed as a ratio of horizontal distance (run) to vertical distance (rise), or run to rise (run:rise). Figure 1-7 illustrates the four most common slope ratios, and should help you visualize most of the slopes you work with in excavation.

If you’re still confused about the work required after reading the surveyor’s stakes and checking the plans, ask the survey crew about it if they’re still on the job. If they’ve left, call the engineer and have him clarify the problem or send the survey crew out for a field meeting. Be sure you know what’s required before beginning the work. Earthmoving is far too time-consuming and expensive for you to be taking your best guess and hoping you’re right!

**Figure 1-7 1:1 to 4:1 slopes**
CHAPTER 1 QUESTIONS

1. What does RS stand for?
   A) Rate of slope  
   B) Road surface  
   C) Reference stake  
   D) Rear station

2. What do the markings above and below the diagonal lines on a cut stake indicate?
   A) “And then”  
   B) The amount of cut is above the diagonal and the distance is below  
   C) Take all measurements below the diagonal from the next cut  
   D) The amount of cut is above the diagonal and the fill is below

3. What other abbreviation means the same as RS?
   A) PG  
   B) IS  
   C) EP  
   D) RP

4. If the RS distance is followed by a double line, where must the remainder of the grades and distances be established from?
   A) The surveyor’s hub  
   B) Grade setter’s RS hub  
   C) Each following cut or distance  
   D) The HP
5. How much will a 2 percent slope rise or fall in 20 feet?

A) 0.20 foot  
B) 0.30 foot  
C) 0.40 foot  
D) 0.60 foot

6. Where is the elevation on the side of the surveyor information stake taken from?

A) The survey hub  
B) The centerline  
C) The reference stake  
D) The catch point

7. What does it mean to the grade setter if every distance on a surveyor’s stake is followed by a double line?

A) He must take the next grade and distance from each preceding point  
B) He must measure back to the survey hub for distance and elevation  
C) He must measure back to the survey stake for distance only  
D) It indicates that all the following measurements are cuts

8. Which of the following is equal to 4 inches?

A) 0.16 foot  
B) 0.20 foot  
C) 0.33 foot  
D) 0.40 foot

9. What is the purpose of a second horizontal line on a fill stake located 1 foot above the finished grade?

A) To locate the hub set by the surveyor  
B) To indicate the overfill point to the equipment operator  
C) To help the grade setter set the next fill stake  
D) To help the grade setter establish the elevation at the projected centerline grade

10. What do the west and east toe grades on a ditch channel stake indicate?

A) The distance across the channel  
B) The amount of fill required at the base of the west and east slopes  
C) The slope of the channel from west to east  
D) The bottom of the slope on each side of the channel
The markings on survey stakes are a shorthand way of expressing what’s on the plans. You need to be able to read and understand both the survey stakes and the plans to develop a picture in your mind of how the finished job will look.

This chapter covers how to read survey drawings of street and subdivision plans, including grading plans and contour lines, underground pipelines, profile sheets, road sections and cross sections and detour plans. During the course of a project you’ll frequently be referring to the plans. It’s essential that the grade setter and foreman understand the plans completely in order to do the work correctly. Any time a surveyor uses an unfamiliar abbreviation or notation on a stake, the foreman or grade setter will have to check the plans to see what it means. We’ll look at the most common notations so you’ll recognize them when you see them on plans you’re reading.
Figure 2-1 shows two street cross sections. These street section drawings, usually referred to as the “typicals” are found in the front section of the subdivision plans. The engineer may elect to draw only half of each street, as that’s all you need when both halves are exactly the same. However, the engineer who drew the typicals in Figure 2-1 chose to draw the full width of the street section.

Subdivision Plans

Figure 2-1 Typical street sections
If there’s a gap in the stationing on the typical street sections, it’s because there’s a transition area from one street section detail to another. Always check the station numbering closely to avoid a mistake. If the numbers indicate a missing section, you must look for the street section or sections that complete the distance. For example, if the stationing marked under the street section reads 31+00 to 36+00 — 40+00 to 68+00, you must locate the section that covers the 400-foot gap between station 36+00 and 40+00.

The two street sections in Figure 2-1 are part of a plan with a total of eight street cross sections for the same job. We selected these two because they show the greatest change in street width. Notice that the station numbers in street section A represent 490.31 feet of the street (subtract 118+38.40 from 123+28.71 or 11,838.40 from 12,328.71). Also notice that in street section B, the information provided covers a longer section of the left side of the street (31+00.00 to 92+42.38 = 6,142.38 feet) than the right side (31+00.00 to 92+18.58 = 6,118.58 feet). LT indicates the left side of the street and RT indicates the right side. That tells you that the change on the left side of the street goes 23.8 feet beyond the change to the right side.

**Reading Station Numbers**

Let’s take a closer look at how to read station numbers. We’ll use the last station in Figure 2-1B, 92+18.58, as our example. The first number to the left of the + is a 2. That indicates 200 feet. The second number to the left of the + is 9, which indicates 9,000 feet. So, the numbers to the left of the + represent 9,200 feet. Now let’s look at the numbers to the right of the +, 18.58. They represent feet and hundredths of a foot, just as they appear, 18.58 feet. The number to the right of the + can only go to 99 feet before it moves to the left and becomes 100 feet (represented by a 1), just like the numbers after the decimal point can only go to 0.99 foot before they become 1.0 foot. All station numbers begin at 0+00, so when you see station number 92+18.58, that tells you this point is 9,218.58 feet from the first station at 0.00.

To better understand this numbering system, let’s read some other station locations:

- Station 7+00 = 700.00 feet
- Station 12+05.30 = 1,205.30 feet
- Station 25+19 = 2,519.00 feet
- Station 130+42.10 = 13,042.10 feet

Remember, these are all distances from the first station at 0+00.
Street section A in Figure 2-1 indicates that it may be found on the plans from Station 118+38.40 to 123+28.71, and there’s 54 feet from right-of-way line to right-of-way line. Notice that each right-of-way line is indicated at the back-of-curb. This is important for the grade setter. He needs to check the cross section to be sure that the back-of-curb and the R/W are the same distance. A street cross section shows details of the street in 50-foot sections, and will show any deviations in widths not shown on the typical. The surveyor may only give the distance to back-of-curb with a cut or fill to the top-of-curb. The surveyor’s stake would be set 4 feet back-of-curb, so the front of the stake would read 4 (the 4 is circled). R/W & BC with a grade for the curb and centerline. If it were a subdivision street, the surveyor would set a stake at the lot setback line with distance and grades for back-of-curb, centerline and lot grades, but not for right-of-way.

The note directly under the curb tells the grade setter that 4 inches of aggregate base (AB) are required under the curb. He’ll have to add the thickness of the curb and the 4 inches of AB together to compute his subgrade elevation. The ideal subgrade situation occurs when the curb subgrade and street subgrade are the same and there’s no need for a notch to be cut up or down from curb grade. Looking at the street section, you can see that this is the case here. There’s a line drawn the width of the street for subgrade with no notch, indicating that the subgrade and curb grade match.

Below the right-of-way line (R/W) measurements, you’ll see the measurements for a 13-foot dirt shoulder, 3-foot curb, 17 feet of pavement and 7 feet of island from the face-of-curb to the centerline (CL). The same measurements are shown for the other side of the road as well, with both sides matching.

Now let’s look at the finished slope grade, starting at the far left. First you’ll see 2:1 max / per plan on one line slanting up and one line slanting down at the same angle. This indicates you must build a two-in-one (2:1) slope from the dirt shoulder, regardless of whether it’s a cut or a fill. This is the same on the right side slope as well; the slope moves 2 feet horizontally for every 1 foot of rise or drop.

Next you see 2.0% above the shoulder. That tells you that the 13-foot shoulder slopes 2 percent from the slope hinge point (HP) to the top-back-of-curb. Continuing towards the centerline, there’s a notation saying that a Type 2 C&G (curb and gutter) is required. The grade setter will then have to find a cross section of the Type 2 curb. Usually it’s in the agency’s specifications rather than on the plan. The specifications will show the
height from the top of the curb to the bottom, and the thickness of concrete required. It will also show the rate of slope of the curb pan, the flat or gutter portion of the curb and gutter.

Continuing to read to the centerline, you’ll see the percentage of fall for the pavement from the island curb to the curb and gutter. Notice that the island curb is a vertical curb, not a curb and gutter. The rate of fall is shown as 2.0% and the distance is 17 feet. So the grade setter will compute the fall rate by multiplying 17 feet by 2 percent. Using a calculator, enter $17 \times 2$, and then press the percent key — the result will read 0.34. The 0.34-foot fall is from the front of the island curb to the lip of the curb and gutter. To cut subgrade, the curb width on each side must be added to the 17-foot pavement width. An island curb is usually 8 inches wide and the curb and gutter 3 feet wide, for a total of 3.67 feet. So the distance would then be 20.67 feet. Multiplied by 2 percent, that gives you a 0.41-foot fall across the entire subgrade.

The street detail shows a minimum of 4 inches of aggregate to be placed under the curb. The street section calls for 3 inches of asphalt concrete (AC) plus 8 inches of aggregate base (AB) for a total depth of 11 inches. This information is located on the drawing just above the street name, Camino South. Cutting the subgrade 2 percent, which is a 0.41 drop in 20.67 feet across from the back of both curbs, would make the subgrade and the curb subgrades the same. The curb grade is often steeper than the street grade. If you cut 2 percent to back-of-curb, it’ll add more than 4 inches of aggregate under the front lip-of-curb. These are items the grade setter and foreman must take into consideration when excavating to subgrade elevations.

The next item we come to is the barrier curb at the island. The note above indicates a *Type 5 vertical curb*. Again, the grade setter must check the specifications for the height and width of the Type 5 curb. The 2.0% indicated on the top of the island is the amount the finished landscaping will fall from the centerline to the back of the island curb. Again, the specifications or notes on the plans will specify what material is required for the island section and how much below top-of-curb the subgrade should be.

There are two important things the grade setter must pay attention to: first, that the aggregate road base runs to the back, not the front, of the island curb; and second, that the subgrade between island curbs must be left 4 inches below the finished landscape grade. This is indicated by the note under the island on the street detail sheet and the
INDEX

A
AASHO 274
Abbreviations 497-498
Access, equipment 234-236
ramp, channel excavation 247
Aerial photograph 52
CAD design 52
marking boundaries 51
surveying 51-52
topo map 52
Aggregate
asphalt patching 386
bony grade 315
calculating for road base 325-326
calculating tonnage 311-313
culverts 224
dumping 320-321
estimating 313
fines 315, 317
hauling schedule 324
marking dumps 314-315
problem 278
replacing unsuitable soils 257-258
Aggregate base (AB) 24, 311-332
compaction 214, 324
highway tolerances 325
oiling 332
paving on 320
paving on highways 320
placing base 227
placing on highways 320
placing on parking lot 313-318
spreading 322
subbase, asphalt 349
subdivision roads 325
subgrade compaction 278-279
trimming parking lot 317
trimming rural road, 226-227
trimming sidewalk and curb 327
under curb 24, 25
Air relief valve (ARV) 33
Air test, sewer pipe 413-415
Airport paving 387
American Association of State Highway Officials (AASHO) 274

And then 8, 10, 13
Angle, 90-degree, using tape 89-90
Answer sheet,
chapter questions 499-500
Apartment pad
excavating 185-190
grading 95
Arrow boards, hwy construction 200
Articulation system, grader 473
Asphalt
cold mix 126
core sample 381
depth specifications 368
grinding 348-349
hand dumping 364
hand placing 365
loading with scraper 353
milled 121
plug, unsuitable material 257
reclaiming 125
receiving 121
saw-cut shoulder 222
spread temperatures 366
stab rod 367
thermometer 366
trenching through 126
Asphalt concrete (AC) 25
placing dikes on 215-216
pouring dikes 119
Asphalt paving 347-389
chip sealing 388
compaction 379-381
compaction test 387
core samples 381
equipment 354
grade changes 369
hand tamping 381
mat 368
mix 365-366
oil balance 365-366
on and off ramps 369
parking lots 373
patching 384-386
paver breakdown 375-376
paving machine 354
paving 354
placing fabric 383-384
planning dumps 365-364
planning passes 362
pushing up 354
raking 385
reflector and striping 387-388
removal with scraper 353
removing old surface 347, 350
rolling 379-381
screen settings 368
setting string lines 361
spreader box 376-377
tack coat 382
trenches 386-387
truck flow 376
work crew 364-365
Asphalt rake 385
Asphaltic emulsion 388
Auger
extensions 359
screw 357, 358
Auger-type curb machine 119
Auto laser-controlled equipment 102
B
Back-of-curb (BC) 24, 25
offset 289
Back-of-walk 41
Back scatter test 274, 387
Backfill
drain pipe 423
sewer pipe 410
water lines 400
Backhoe
Cat 325 hoe 351
attachments 127, 243, 394, 404
loading with 351, 481
operating tips 479-482
stabilizing for digging 480-481
traveling 479
trenching 394, 480-481
Bacterial test, water 401-402
Balancing equipment 137
subdivisions 158
Balancing site, soil 192-193
Banding pipe 424
Bank plugs 303-304, 491
highway subgrade 213-214
highway subgrade trim 303-306
Barrels, manhole
precut 450-451
sealing joints 451
setting 450-454
Barricades, construction 199
Barrier curb 193-194, 318
Base, aggregate 311-332
Base station, GPS 105-106
Baseline, 90 degree angle 89-90
Bedding material
sewer pipe 402
undercut for 395
Begin vertical curve (BVC) 32
Bell and spigot pipe 396
bell end upstream 408
concrete drain pipe 421
HDPF drain pipe 423
lubricating bell end 421
setting pipe barrel 408
Bench cut
channel slope 248
embankment 234, 235
Bench mark 66, 87, 97, 491
Bend, pipe 409
Berm, erosion control 171
Blade angles, grader 472
Blasting, rocky soil 147
Bony grade 315
Boom truck 403
Boot truck, tack coat 382
Boots 12-13, 492
grade setter’s rough trim 174-175
setting, commercial site 186-187
setting, hwy construction 201
Bottom dumps
aggregate 320

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aggregate base 314
asphalt 364
Bucket, forked 404
trapezoid 248, 394
with thumb 351-352
Bucket, manhole bottom 445
Chapter questions, answer sheet 499-500
Check valve, in water main 401
Checking grade
highway excavation 208
pipe laying 404
subdivision excavation 166
using a ruler 302
using an eye level 288
with straightedge & hand level 288
Chip machine 388
Chip seal 388-389, 492
self-propelled spreader 388
Chlorinating a main 398
Choker 492
cutting 210
highway 320
Clamp bucket 128
Clay subgrade, compaction 279
Clay pipe, sewer 408
Cleanup, roadwork 229
Cobble
erosion control 170
ripping and excavating 150
trenching in 404
Cold mix asphalt 125
Color coding, contour plan 20
Color-coded tape 400
Commercial site excavation 183-186
Communication, staff and crew 128
increasing productivity 127-128
Compaction 271-282
aggregate base, highway 32
embankment standards 376
equipment 150-152, 279
highway 260
highway fill, slope 312
highway subgrade 214
lime base 340
moisture density curve 273-274
narrow fill 237
narrow road strip 228-229
overrolling 290
parking lot 194
pavement testing 387
rocky fill 150-152
selecting equipment 281-282
sewer pipe trench 410
sidewalk and curb 328
soil types 271
standards 276
street and walk subgrade 174-177
street subgrade 298
subdivision street subgrade 176
subgrade soil mixture 277
subgrade standards 277
tamping 381
testing subgrade 277-278
testing subgrade trim 179
under road requirements 176
water, importance of 271-272
Compaction test
back scatter test 387
moisture density curve 273-274
nuclear testing 274-276
sand cone test 272-276
Compaction wheel, hoe 127, 247
Compactors
laser controlled 101
operating tips 487-487
pad-drum roller 226
pad-drum vibratory roller 176
planning excavation 135, 138
plate tamper 381
pneumatic tired roller 379, 489
riding high 299
rocky fill 150-151
rollers 314, 387
subdivision excavation 160

C
CAD, from aerial photo 52
Calcium hypochlorite tablets 398
Camera in pipe 411
Carbide trenched teeth 126
Cast iron pipe
sewer 408
water main 396
Cast-in-place drain pipe 424-429
braicing 425-427
curing 424-428
finishing 428-429
curing 428-429
curing 428-429
bracing 425-427
water main 396
Concrete
Concrete curb machine
casting curb for 290
cast-in-place 425-428
trenching through 126
Concrete curb machine
casting curb for 290
slip-form 117-118
Concrete drain pipe 417-418, 420
concrete wall 425-428
Concrete manhole
curing test 430-435
mix, manhole bottom 445
pouring 448-449
Concrete paving
casting 120
setting 446
pouring roadways 119-120
pouring sidewalk & curb 329-330
slip-form paver 119-120
spreader machine 120
Cone, traffic control 129
Construction, changes in 5
Construction fabric
paving machine 120
underdrains 460
Construction signs & barricades 199
Contour line
elevations 28-30
establishing 29
reading 29
Contour plan 83
bench mark 87
closed loop lines 85-86
color coding 29
computing slope 85
contour intervals 84-85
engineer's scale 86
existing grade 90
marking cuts and fills 87-89
new grade 90
reading 84
staking grade 86-87
sawas 86
using GPS for grade 87
Contractor, unsuitable material 253
Control box, equipment 101-102
Conveyor,
paving machine 120, 356-357
Copper pipe 399
Core sample, asphalt 381
Corners
setting for curb machine 62
staking 287
tamping asphalt 381
Correction stop valve 399
Correcting grade, string line 58-59
Corrugated metal pipe
aluminum 423
culvert 469
downdrain 462-463
steel (CSP) 38, 423
Cost overruns 128
Coulplings
drain pipe 423-424
pipe joint 396
sewer pipe 409
Cracks, resurfacing pavement 122
Crew
cast-in-place drain pipe 425-427
communication with 127-128
laying drain pipe 418
meeting with 161
parking lot 194
paving 364-365
safety 129, 220-221
sewer pipe 408
working in field 438-440
Cross drain 256
Cross section 21

C
Cadmium 52
Cadmium hydrosulfite tablets 398
Camera in pipe 411
Carbide trenched teeth 126
Cast iron pipe
sewer 408
water main 396
Cast-in-place drain pipe 424-429
braicing 425-427
curing 424-428
finishing 428-429
manholes 428
pouring 425
trenching 424
Casting, manhole 454-456
Catch point 8, 492
Caterpillar equipment
Cat 12 grader 138
Cat 14 grader 138
Cat 16 grader 138
Cat 225 track hoe 404
Cat 325 hoe 351
Cat 651 scraper 134
Cat 815 compactor 138, 410
Cat 825 compactor 134
Cat D6 dozer 137
Cat D10 dozer 134, 281
Cat D11 dozer 134
paddle wheel scraper 137
paver 360
profiler 122
reclaimer 125
rubber-tired roller 360
Cement, treatment
sand base 343
toxic dust 343
unsuitable material 263-264
using reclaimers 126
Cemented cobbles, trenching 405
Centerline (CL) 14, 24
definition 34, 492
grade and line 320
Centerline grade
checking 331-332
computing 300-301
subdivision street 298
Channel excavation 241-250
damming channel 243
diversion pipe 244-246
diversion trench 243-244
drainage 241-250
selecting equipment 156
stepped lots 169
streets 169
use experienced crews 155-156
Excavating unsuitable soil 253-267
around utility lines 264-265
bridging 257
cement treatment 263
equipment 254
fill 257, 259
filter fabric 260
time treatment 262-263
Excavation abbreviations 497-498
equipment balance 133-137
equipment planning 134-135, 138
haul or stockpile 139-140
length of haul 134
length of haul 134
methods 138-139
planning 133
Existing grade 8
contour plan 90
Extra work
charging for 253
soft trench bottom 408
unsuitable soil 195, 341, 253
Extruded curb 185, 193
placing 361
pouring 318-319
Eye level
accuracy 56
checking grade 56, 288
grade setter’s 53-55
setting up 55
with swedes 56
F
Fabric
asphalt paving 383-384
construction 460
paving 122
Face-of-curb (FC) 24
Fall, sewer service 409
Feathering asphalt 384-385
Fencing, temporary 130, 245
Fiberglass rod, for corners 62
Fill
contour areas 29
dumped from above 237
marking crows feet 72
mixing, unsuitable soils 250-260
narrow embankment 233-237
replacing unsuitable soils 257
rock 150-151
shoulder 211-212
stakes 7, 11-12, 205-206
Fill slope
compacting 212
correct profile 238
grating 205-206
Fills and cuts
contour plan 57-59
cut stakes 7, 10
ditch 9
fill stakes 11
marking crows feet 72
setting boots 75
stakes, reading 7-16
Filter bag, erosion control 173
Filter fabric
pipe trench 407
unsuitable soils 258, 260-262
Final trim
aggregate road base 331-332
highway 214
Finding cut or fill,
with movable tape 68
Fine, pollution penalty 173
Fine trimming
compaction test 179
curb grade 177-178
equipment 299
painting notch line 178
parking lot 194
rural road grade 226
setting hubs 300
sidewalk grade 177
subgrade 299
using grading with sonar 178
with string line 178
Fines, aggregate 315, 317
Finished grade (FG) 17, 493
floor 184
highway 214-215
lot pad, subdivision 163
parking lots 194-195
profile, subdivision 163
road base, trimming 325
shoulder 211
string line 62
Finishing manhole bottom 445
Fire hydrant blow off (FHBO) 33
Flagman
highway construction 324
rural roadwork 228
Flow line (FL) 32-33, 38
Flexible drum, traffic control 129
Flexible rubber, traffic control 129
Float switch, pump 244-245
Flow line (FL) 32-33, 38
curb grade 32
direction 34
division trench 244
gate, pipe trenching 100
Fluorescent paint, grade setting 53
Foreman, communication 128-129
Forms
curb, undercut for 291
manhole, 446
Formula, aggregate quantities 312
Grade
Ga (GA), pipe 25
Generator, pump 245
Giving line, grade setter 166
Global positioning system (GPS) 104-114
Glue-down curb 185
GOMACO Corporation
Concrete machine 118
paver 120
texture/cure machine 121
GPS
aggregate base grade 325
cave excavation 242
components 105
description 104-105
equipment controlled with 110
grading 87, 104-114
machine control 112-113
parking lot grading 94
rover 105-106
rover, setting grade 87
satellite antennas 112
satellite locations 107
satellite receiver 105
saving stake locations 109
screen descriptions 110-111
set up 105
setting grade with 52
utility tie out 108, 222
Grade
calculating lip-of-curb 292-293
centerline, calculating 300-301
changes 192
changes, highway 201
channel excavation 243-244
control, profiler 121-125
control, sonar 366
curb flow line 32
cutting 57
existing 8
final 8
finish 17
for sewer project 79-80
lath location 78
manhole bottom 446
setting 52-53
setting bank plugs 304-306
setting with swedes 317
slope, finished 24
stakes, apartment and industrial pad 95
stakes, curb 285-287
stakes, rural road 221
stakes, sewer project 79
top of manhole 453
Grade checking 56
pipe laying 104
subdivision excavation 166
subgrades 302
with eye level 55
Grade indicator, movable tape 67-69
Grade rings, manhole 453
Grade rod, laser level 98
Grade setter
abbreviations 497-498
calculating curb rise 90
centerline, calculating 300-301
checking centerline grade 331-332
covering curbs for level 303
equipment 53-55
giving line 166
job description 52
Grade setting
cuts and fills 76
equipment 53-55
finish aggregate grade 325
highway base grade and line 320
highway grade stakes 202-204
marking fine trim 300
offsetting island stakes 191
offsetting survey stakes 174
optional stakes 77
safety 53
setting swedes, parking lot 317
staking subdivision 163
with contour plan 83-90
Grader
advantages of GPS 113
articulation system 473-474
asphalt paving 354
channel excavation 249
circle shift and yoke 472-473
cave excavation planning 138
final trim, highway 214
laser controlled 103
mould board slide 469
mould board tilt 469-471
operating on slopes 207-208
operating tips 468-473
sonar and slope control 175
spreading aggregate 322
subdivision trim grading 175-176
trimming sidewalk and curb 327
trimming street subgrade 298-299
turning points 474
wheel tilt 468
wing 322
Grading
aggregate base 322-323
apartment and industrial pad 95
balancing the site 192
commercial building pads 187-189
curb 289-290
curb and sidewalk 285-294
cut slope 207
equipment, trench trim 175-176
fill slope 206
highway 199-215
length of division 38
parking lot curbs 193-194
parking lots 94, 190-191
plan 26-30
rocky slopes 117
rural road, aggregate base 227
street subgrade 298
subdivision fine trim 177
subdivision rough trim 174-176
trimming curb and sidewalk 291
using curb shoe 293-294
using GPS 104-114
using sonar and slope control 56
Grading equipment
douser, tips 474-475
hoe with grading bucket 247
GPS guided 5-6
laser controlled 5
skip loader, grading box 484-485
sonar and slope control 5
tractor with drag box 373
Grading plan 21, 83
subdivision, reading 26-30
Gravel 320
pipe bedding 402
Grid pattern, parking lot 94
Grinder, asphalt 348-349
Grainer, 350
Grindings, reusing 349
Grizzly 124
Guinea hopper 73, 493
Guinea 493
Ground elevation, contour 28-30
Ground improvement system 104-114
GPS
headwall detail 36
HDPE pipe 423
High density polyethylene pipe
(HDPE) 423
High point 32
Highway construction 324
rural roadwork 228
Highway base grade and line 320
Highway construction 324
rural roadwork 228
Horizontal control, sonar and slope control 5
Hot asphalt 354, 364
Hand grade, asphalt mat 369
Headwall detail 36
Hand level, checking grade 288
Hand grade, asphalt mat 369
Hand, checking grade 288
Hand tamping 381, 388
Hard ground, trenching 405-407
equipment 407
Hardpan, subgrade compaction 280
Haul distance, subdivision 164
Haul road, excavation planning 135
HDPE pipe 423
Headwall detail 36
High density polyethylene pipe
(HDPE) 423
High point 32

But similar Craftsman Book Co. titles here: www.Craftsman-Book.com
Highway construction
aggregate base, placing 320
arrow boards 290
asphalt paving 369
detour signs 200
dikes, placing 215
drainage 460-463
grading aggregate base 322
grading and excavation 199-216
Hinge point (HP) 9, 13, 24
Hubs 493
backhoe vs. track hoe 482
channel excavation 243-244
finish subgrade 306-307
Hopper
gravel-filled 407
paving machine 356-357
Hub拉斯 483
channel excavation 243-244
Finish subgrade 306-307
parking lot 317
setting 56
setting for fine trim 300
surveyor, subdivision 163
Hydraulic shoring 433-438
jacks 435
planks, setting 437
pressure tank 435
removal 437-438
setting in trench 434-436
sheeting between planks 437
using quick coupler 434-435
wide trenches 436-437
Hysoreost, erosion control 170-171
Industrial pad, grading 95
Information stake 14, 493
double line 6-7
Inspector, unsuitable material 253
Instruction sheets, plan 38
Intermediate grade stakes 86-87
Island
curb 26
parking lot 184-185, 190
parking around 373
Joint tape, manhole 453
Joint
tape, manhole 453
Joints
manhole barrel 451
paving 362
K
K-rail
highway construction 199
pinned 46
pouring 118
highway construction 199
pouring 118
K-rail
safety 482
ripper tooth 127
rams 127
Quick-coupler bucket 247
pavement removal 350
packs 127
paving machine 356-357
ramps 127
ripping tooth 127
rubber tired 222-230
safety 482
slotted bucket 106-407
tapered bucket 243
thrust bucket 351-352
track 482
trapezoid bucket 248
trenching 99, 403
Hooks and slings, pipe 402-403
Hopper
gravel-filled 407
paving machine 356-357
Hub拉斯 483
channel excavation 243-244
Finish subgrade 306-307
parking lot 317
L
Ladders, in trench 438
Lane delineators 142
Laser controlled equipment
ramps 127
Laser receiver
control box 101-102
equipment mounted 101-103
pole mounted 100
signal 67-68
target arm and mast 101
Lateral pipes, manhole 444
Laying pipe
cast-in-place concrete 424-428
drain 419-423
sewer 408-416
water 395-401
Leaks, pipe
mains and joints 415
testing for 411-416
Left of road centerline (LT) 39
Length of haul, grading 30
Level beam, laser level 65, 70
Lifts
compacting, lime treatment 342
planning passes 362
Lime mixing machine 338
Lime treatment
compaction 340
moisture testing 341
reclaimers 338
spreading 339-340
subgrade 337
unsuitable soil 262-263, 341-342
using reclaimers 346
Line
and then 3, 10, 13
contour 29, 84
level 46
Light of way 24
Lining, channel 249
Lip-of-curb (LP) 25
calculating grade 292-293
loading capacity, road 272
Loaders
automatic neutral gear 484
operating tips 483-484
self-levelling bucket 483
skip 354
track 351
Loading
rock 149
time, scraper 137
Loading dock, excavating 190
Locators wire, pipe 399
wire box 399-400
Loose gravel, trenching in 403-404
Loosening 443-444
Loot 385
Lot pads
slope undercut 168
trimming 170
Low point (LP) 32
M
Mailboxes, moving 222
Manhole (MH) 32
common sizes 443
grade 453
gate rings 453
joints 453
manhole 444
paving around 455-456
platform 458
Pole 458
Rain (R)M 33
setting barrels 450-454
setting casting 445-456
shields 438-440
shoring 438-440
symbol 34, 36
vacuum test 453-454
with sump 447-448
Manhole bottom
inner wall forms 447
poured 445-445
precast 446-447
smooth water flow 443-444
with sump 447-448
Marking cuts and fills 87-89
Mast, laser target 101
Material concrete 120
asphalt 368-369
Match line 221
Maximum soil density 274, 276
Measure, engineer's 8
Measuring 90-degree angle 89-90
Mechanical coupling pipe 466
Medium, drainage outlet 462
Metal trough, downspout 463
Filled asphalt 121
Mix, asphalt 365-366
Models, survey for GPS 106
Moisture density curve 273-274, 276
Motor grader 493-494
Motor grader 468-473
articulation system 473-474
circle shift and yoke 472-473
mould board slide 469
mould board tilt 469-471
turning points 474
wheel tilt 468
Mould board
back 471
extending 472-473
forward 471
slide 469
tilt 469-471
N
Narrow embankments 233-237
bench cuts 235
dumping from above 237
equipment access 234
hauling on narrow fill 236
slope cuts 235
New grade, contour plan 90
90-degree angle, forming 89-90
No-joint concrete machine 425
No-joint concrete pipe 424-429
bracing 425-427
casting 428-429
finishing 428-429
grouting voids 429
manholes 428
pouring 425
trenching 424
Noses, island 191
tamping 381
Notch line, painting 178
Nuclear density test
back scatter test 274
compaction 274-276
Nylon string line 58
Office buildings, excavating 185-190
Offset
back-of-curb 285
calculating 17
curb 318-319
reference stake 13
stake 77
stakes, parking lot island 191
string line 59
Oil, asphalt 365-366
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