

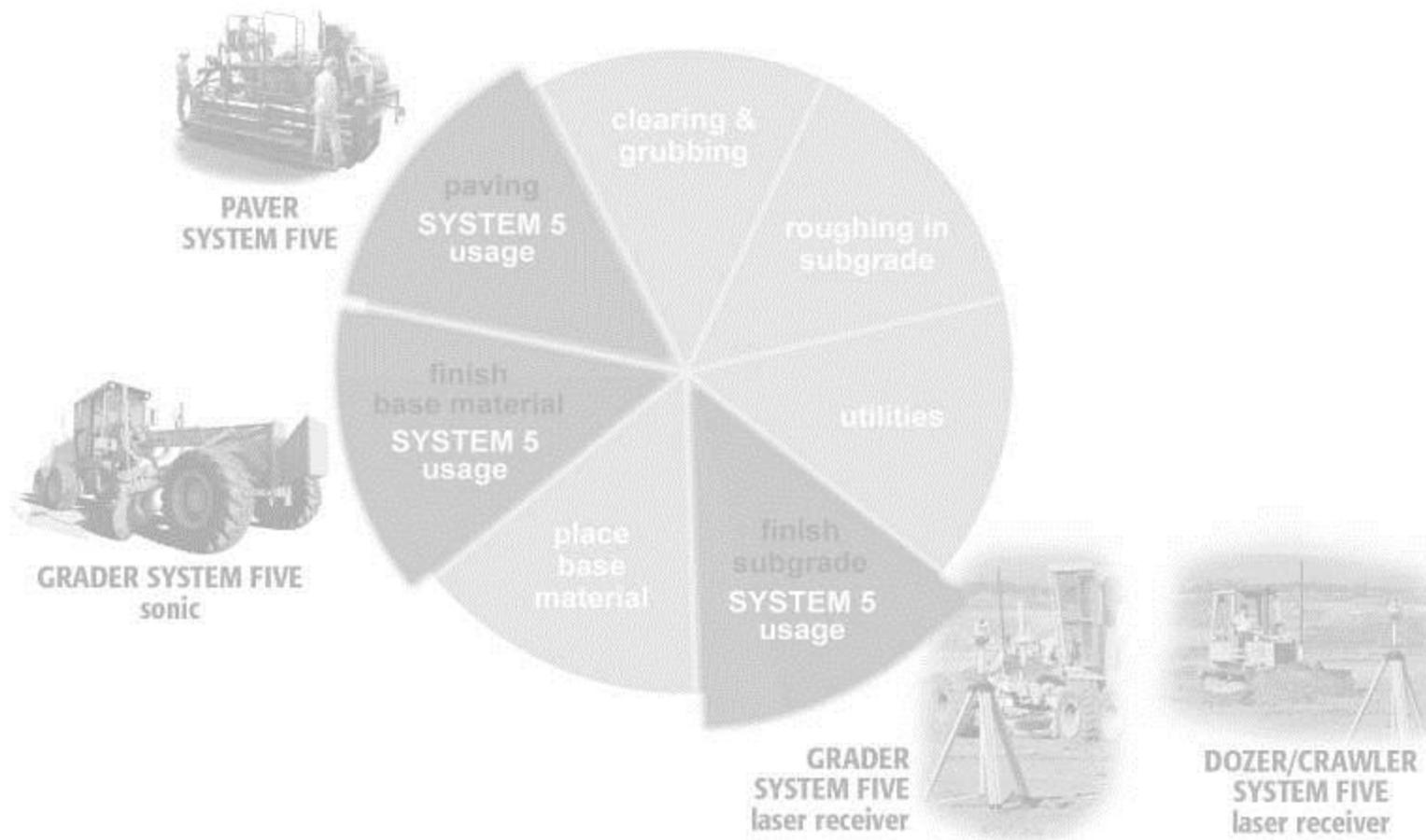
Automated Machine guidance systems

Jason Killpack

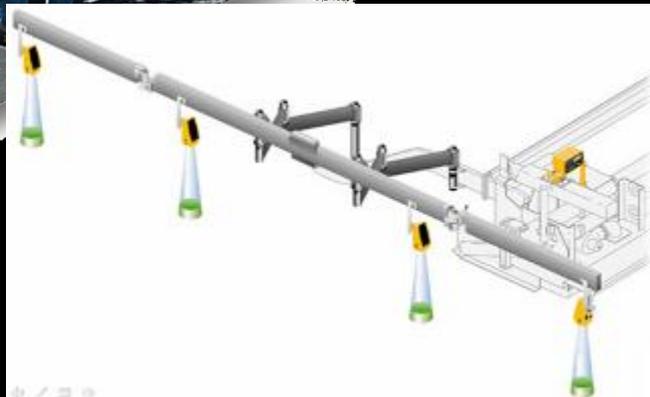
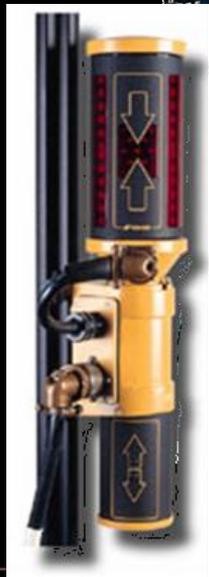
Topcon Positioning Systems



Construction Cycle 2D Controls



Traditional 2D Controls





ТОРСОН

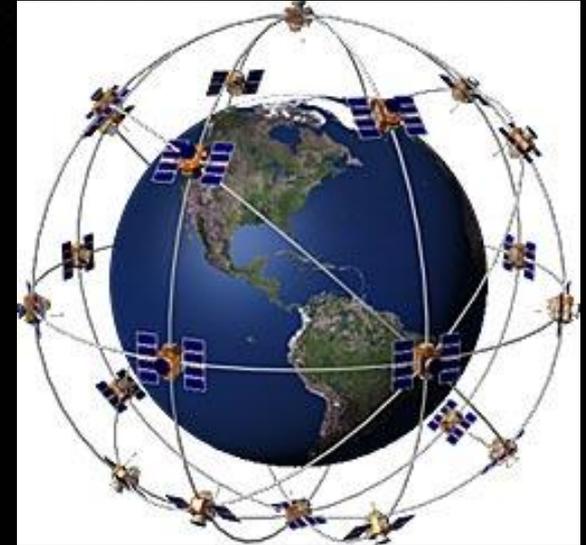
GPS as a Management Tool

- Machine Control
- Grade Management
- GIS
- Telematics



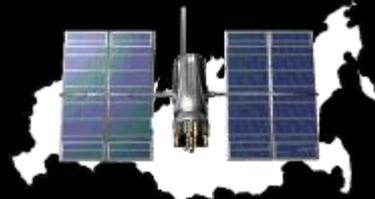
What is it?

- Real time position anywhere on the earth
- Satellites orbit around the earth twice a day



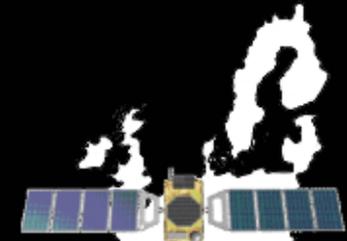
G1 Technology

24 Satellite Constellation



G2 Technology

Current Satellite Constellation: 20
Planned Constellation: 24

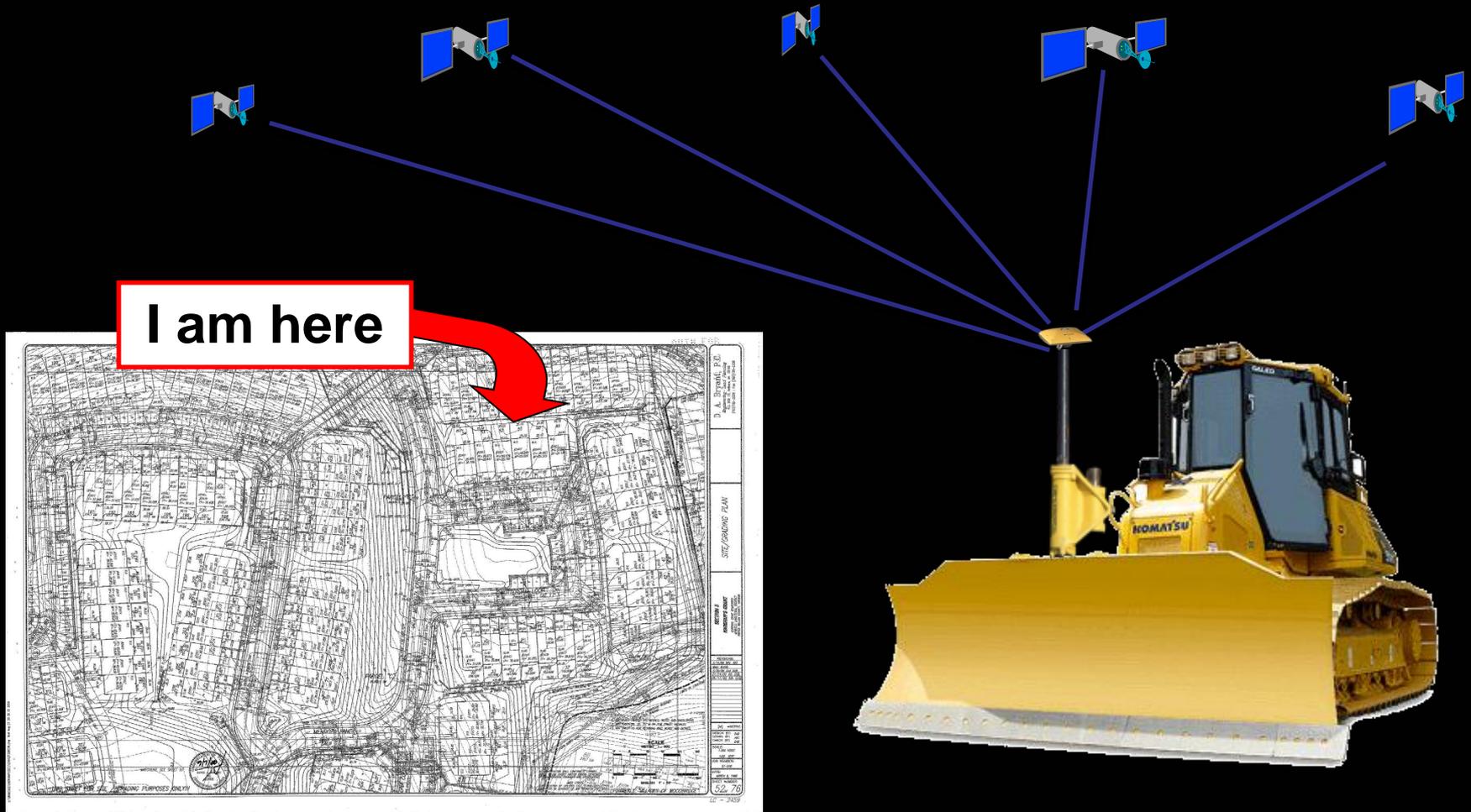


G3 Technology

Planned Constellation:
30 Satellites

How it works?

Machine Control Using GNSS determines ...

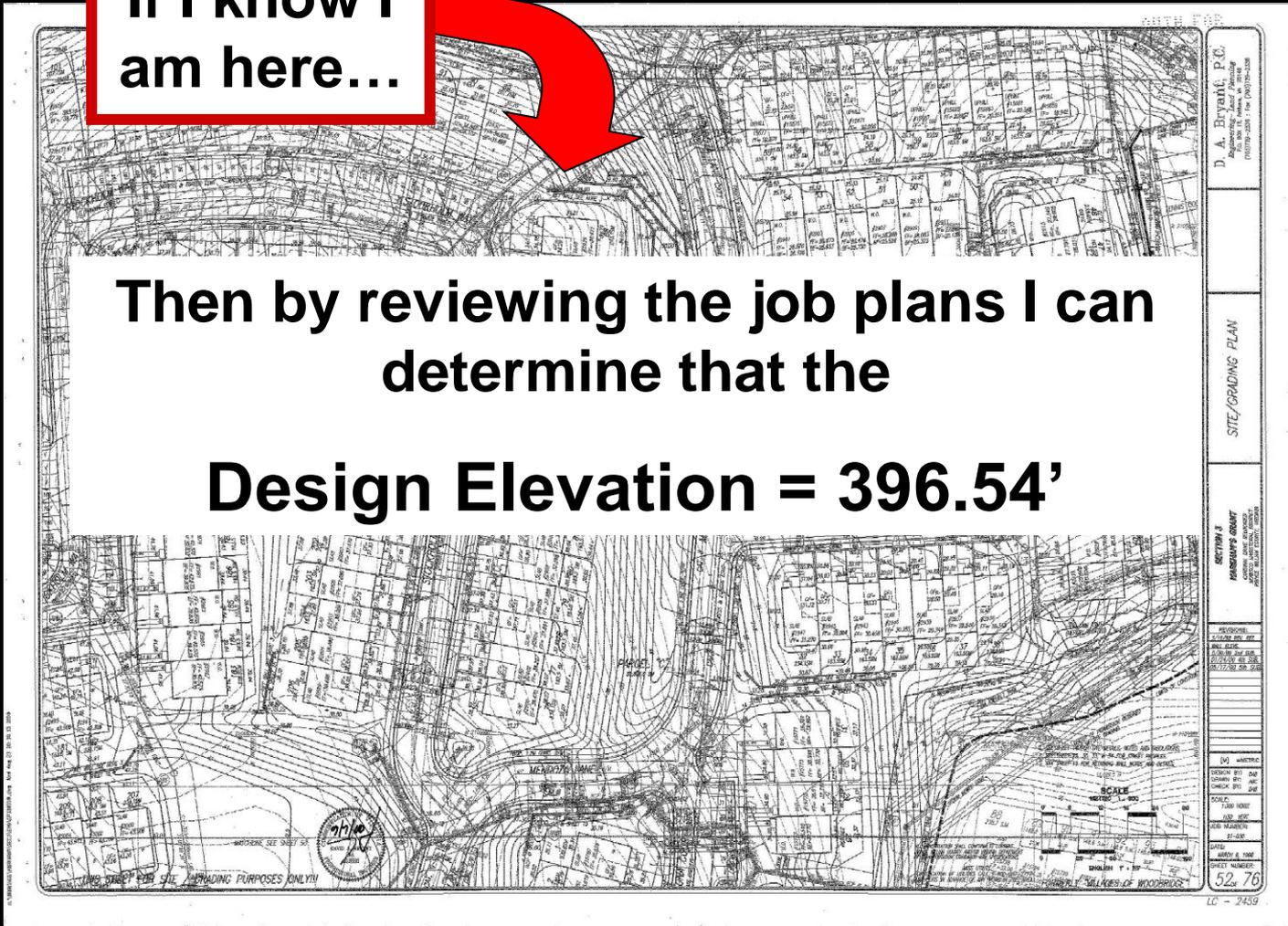


Machine Control Automation

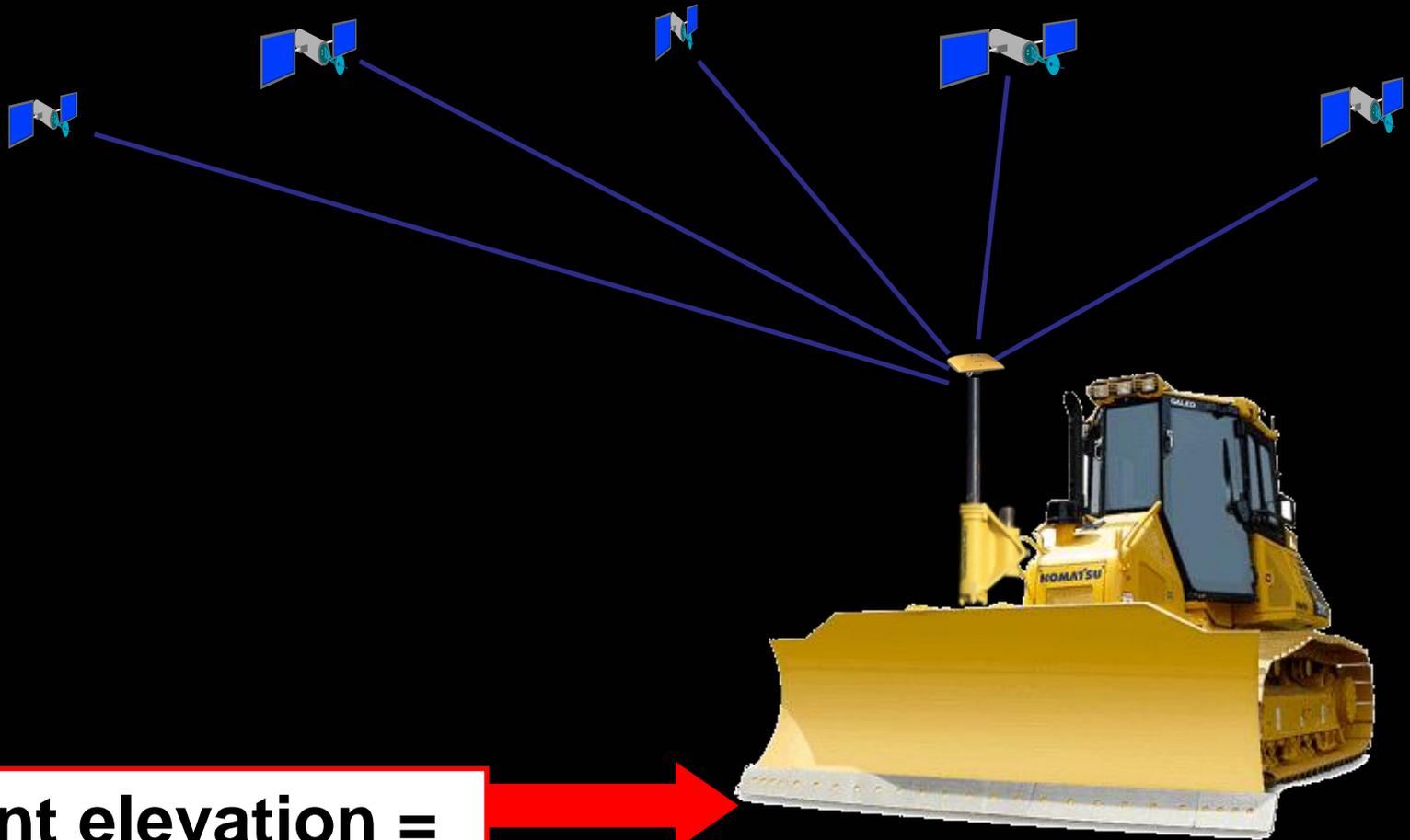
If I know I
am here...

Then by reviewing the job plans I can
determine that the

Design Elevation = 396.54'



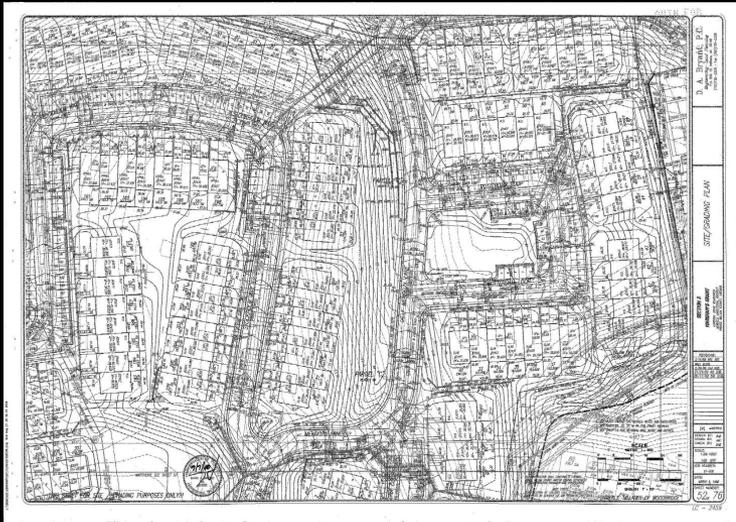
Machine Control Automation



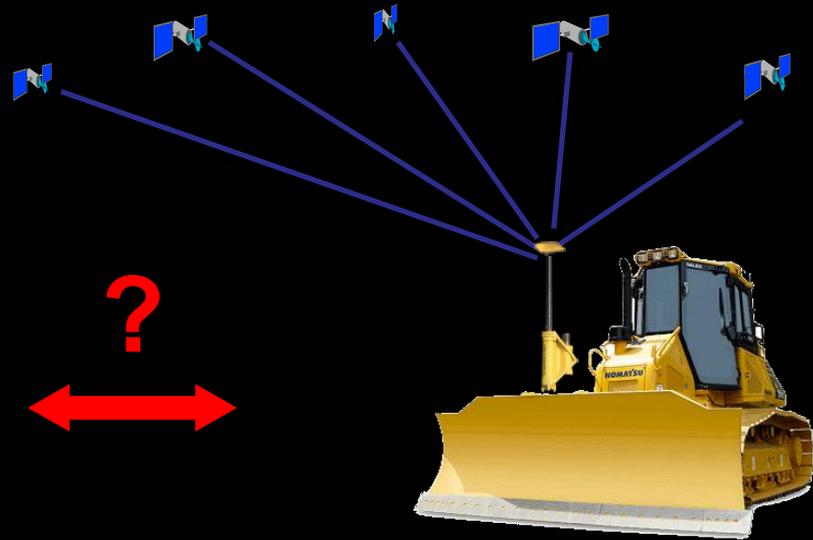
**Current elevation =
396.24'**

Machine Control Automation

How is GNSS Positioning linked to the job design plans?



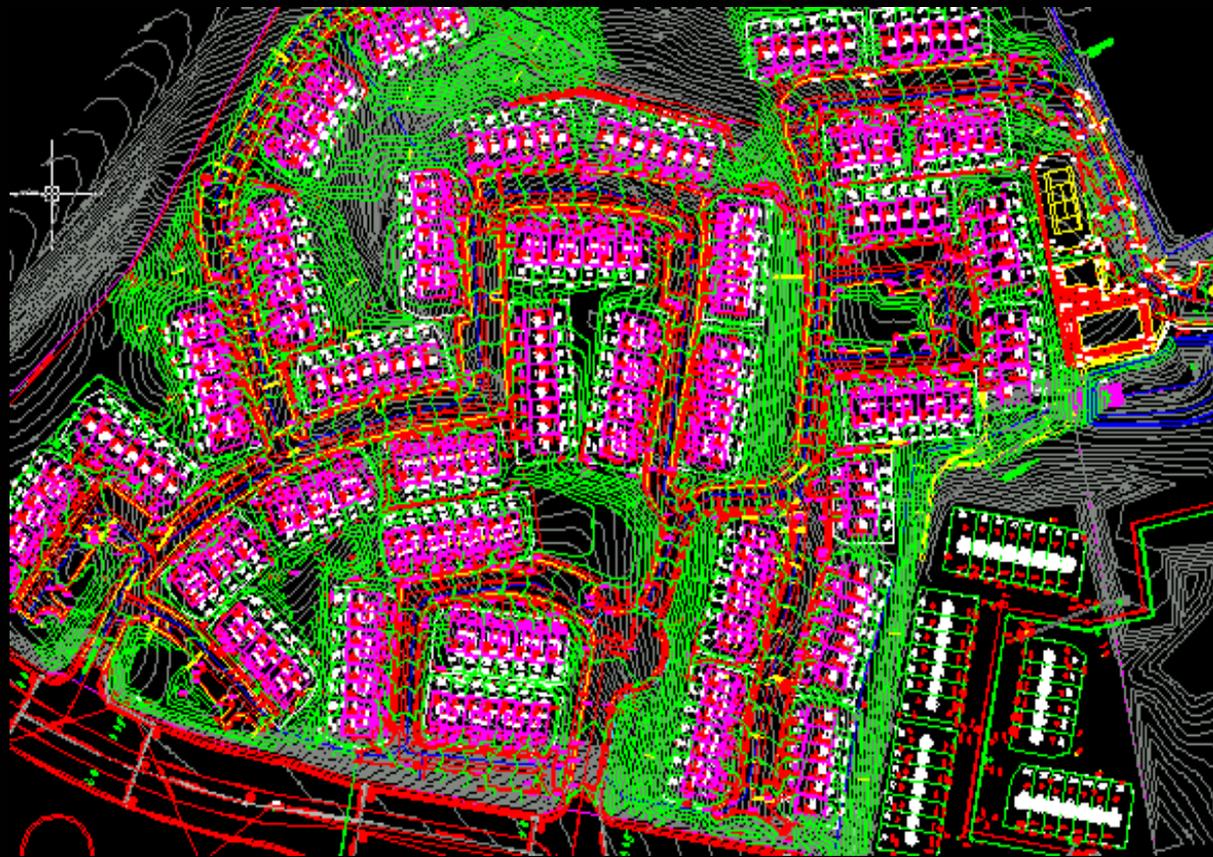
**Paper job plans and
conventional grading**



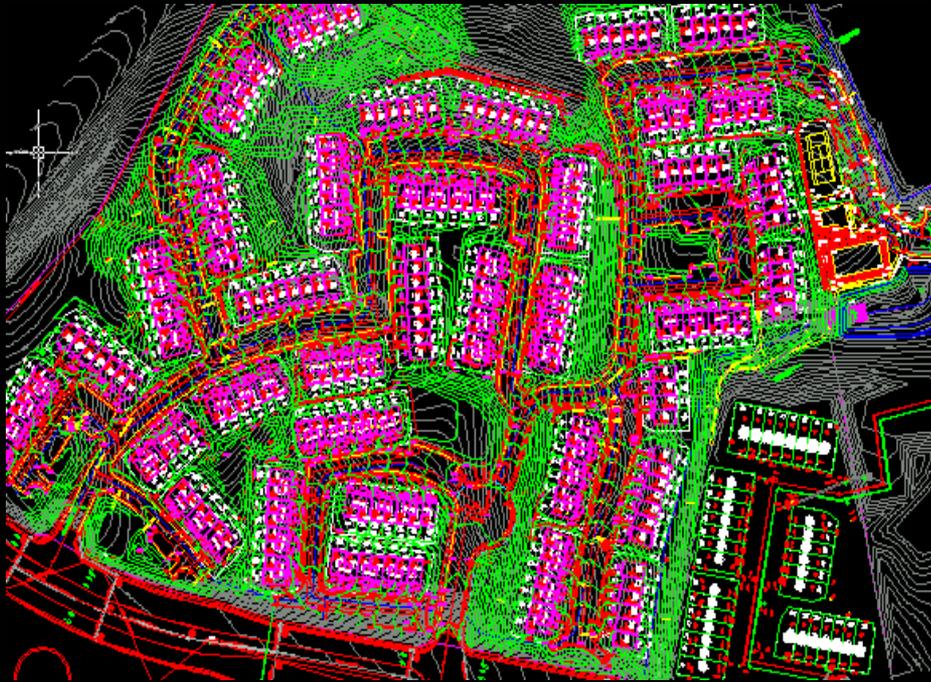
GNSS Positioning

Machine Control Automation

... Convert into a 3D model



Machine Control Automation



...then transfer them into the control Box

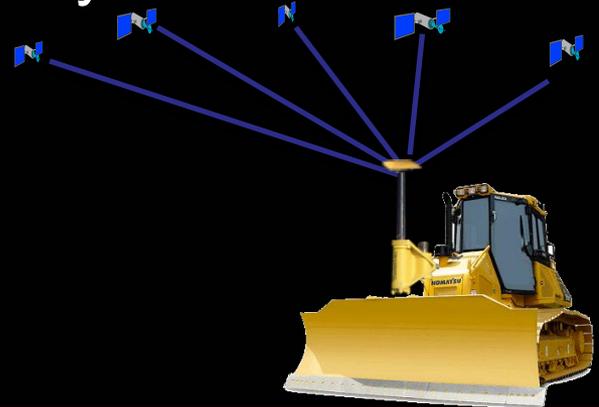
Machine Control Automation

Job file says the Design elevation = 396.54'



Control box determines
Cut or Fill:

GNSS says the current elevation = 396.84'

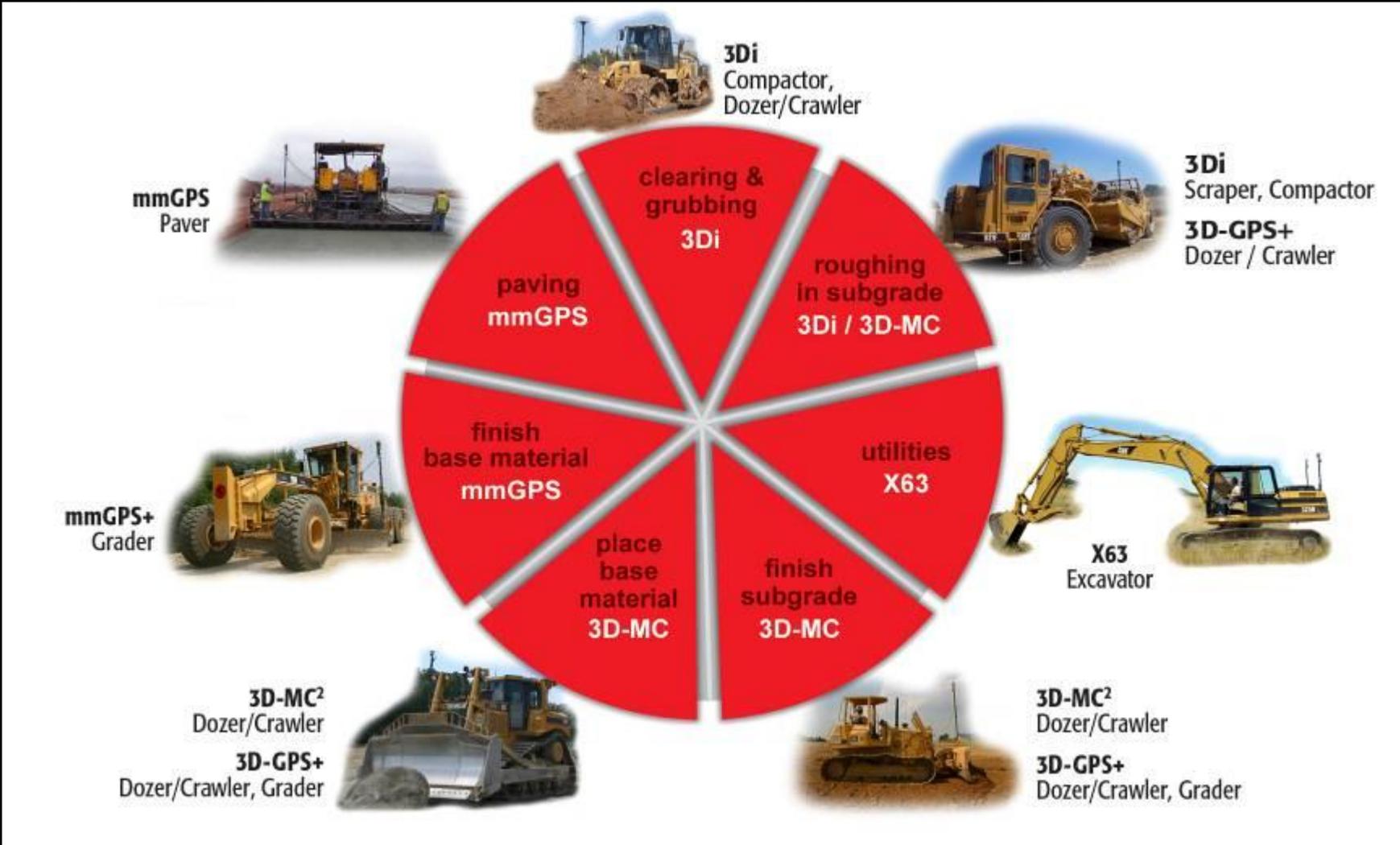


$$396.84'$$

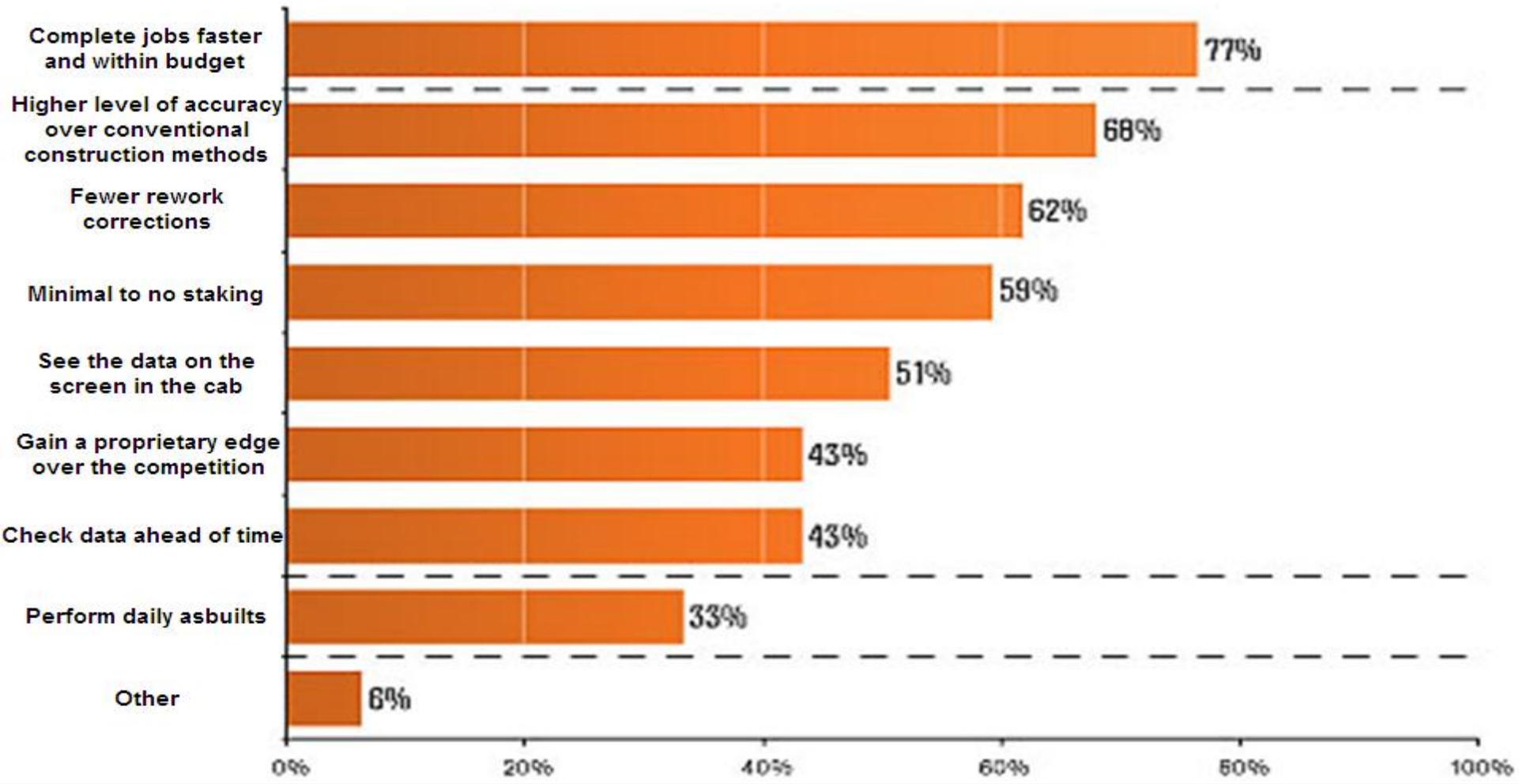
$$- \underline{396.54'}$$

$$= 0.30' \text{ Cut}$$

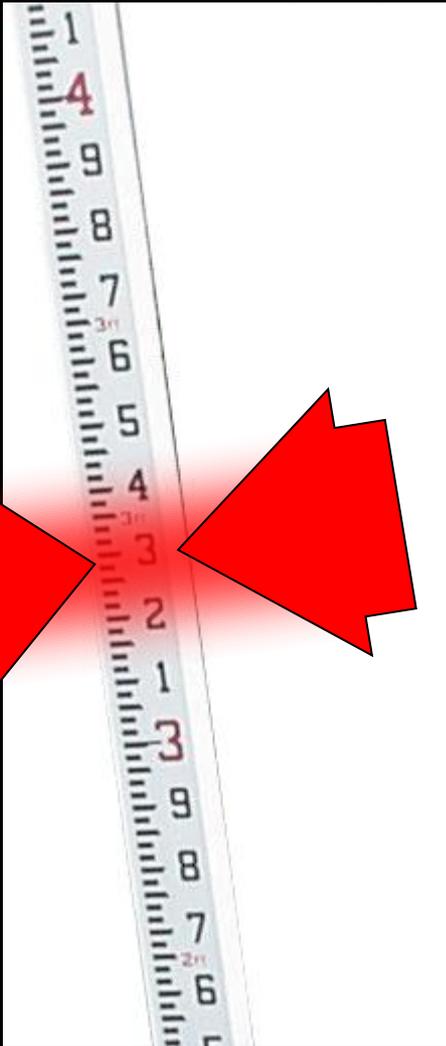
Construction Cycle 3D Controls



Greatest Benefits of Machine Control Technology



Satellite Positioning Weakness:



Vertical Accuracy:

+/- 0.1 ft

Improved Vertical Accuracy



Local Positioning Systems



Laser Enhanced Systems

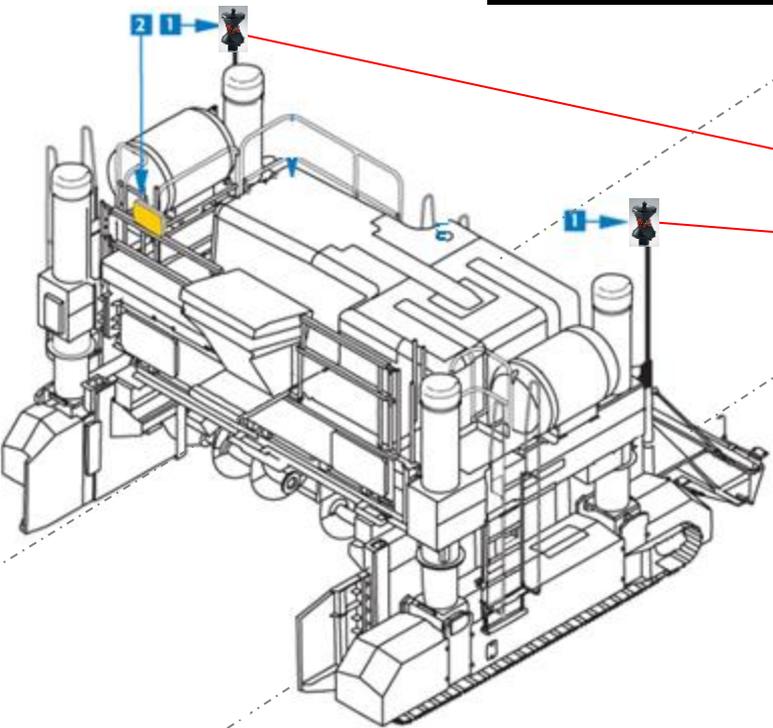
LPS Technology

- Total Station tracks prism to provide position information
- Ideal for low visibility GPS applications



Local Positioning System set up

- (2) 360 prism
- Control box
- Radio communications



TS #4
(MC)



TS #5
(MC)



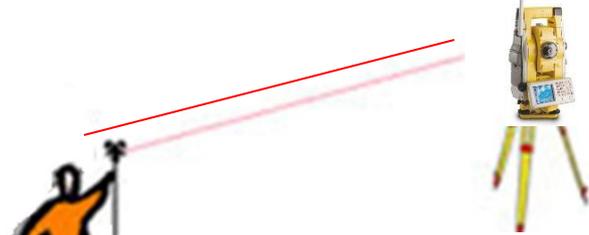
TS #1
(MC)



TS #2
(MC)



TS #3
(Grade
Checking)





mmGPS Video



Laser Augmented GPS

- Multiple user RTK advantages with laser precision
- Large elevation working range
- More versatile than robotic machine control



mmGPS Paving



- Run any combination: mmGPS, sonic or cross slope
- Same GPS components used for grading



mmGPS Paving



mmGPS Asphalt



Joint match with Sonic



Check grade at the same time

mmGPS Paving



Joint match with ski when paving multiple lifts for improved rideability



Additional mmGPS Machines

- Profilers
- Trimmers



- Using a 3D design verses stringline.
 - ✓ Eliminates staking-out
 - ✓ Avoids inaccurate stringline placement

NO stringline...

Significantly reduces material & labor costs

Saves time...prior to paving & during

No damaged string line to reset

Complete multiple lanes/passes without resetting string line

Ability to work in narrow work corridors



Improved machine productivity.

Machines and trucks can move around site without stringline logistics
String line sensors do not have to be reset in between passes

Increased safety.

Trip hazards



Maximizing Production

- New technologies increases speed at which grading work can be performed



John Deere 764



Topcon 3D-MC²

3D-MC² High Speed Steep Slopes



“IC” Intelligent Compaction

Asphalt IC Rollers

Ammann/Case



Dynapac



Caterpillar



Bomag America



Sakai America



Intelligent Compaction?

- “A system of hardware, software and analysis equipment installed on a roller that work together to improve the compaction process and to provide innovative tools for compaction acceptance”

Rollers/Compactors

Major benefits of Intelligent Compaction

- Improved Density
 - Increased Productivity
 - Reduction of Highway Repair Costs
 - Continuous Record of Material Stiffness Values
 - Identification of Non-Compactable Areas
 - Improved Depth of Compaction
-

IC for Soils

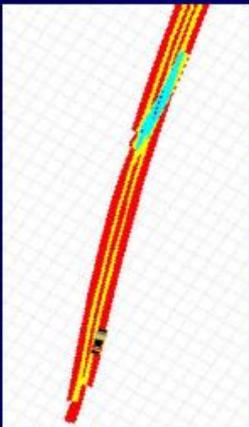
- Improve uniformity of compaction and provide assurance of adequate compaction.
 - Permits identification of “soft spots” or even non-compactable areas prior to placing pavement.
-

IC for HMA Pavement

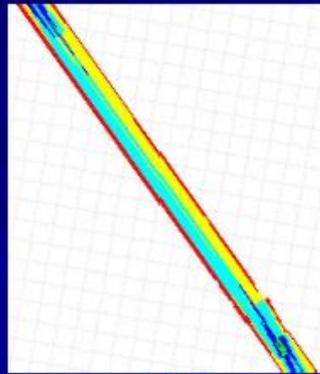
- Ensure uniformity and efficiency of compaction, and ensure compaction under proper conditions (mat temperatures).
- Improve Efficiency (fewer passes)
- Generally used to track roller passes and mat temperatures using GPS system
- Stiffness/Support can also be mapped

GPS Mapping

Tracking Rolling Patterns

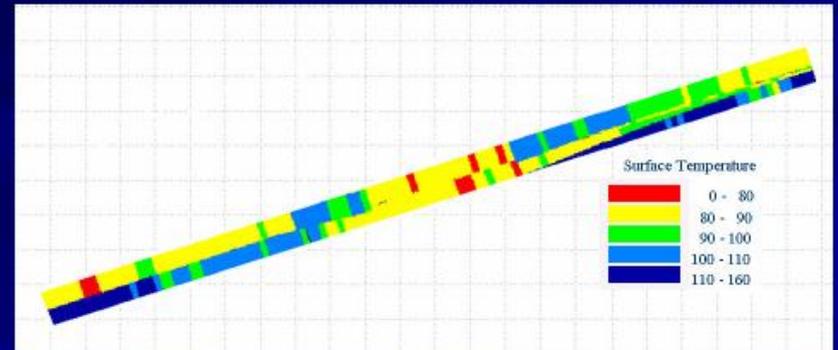


Before



After

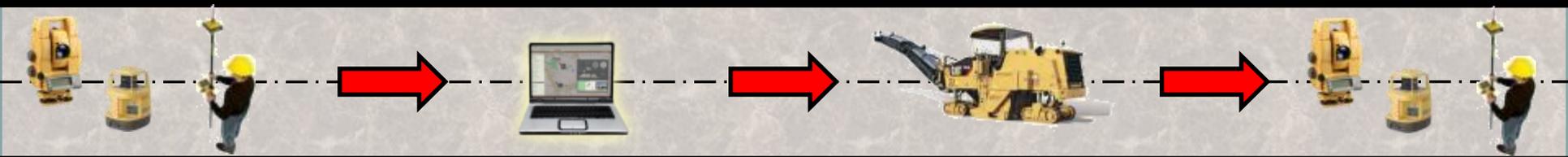
Tracking Surface Temp



(Courtesy of Saltel)

Machine Control in the Future

Mainline Paving Project Timeline...

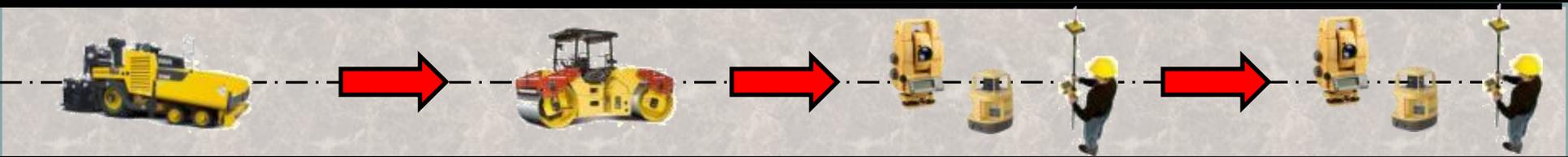


Asbuilt
Measure Existing

Analysis
Design phase

Trim / Mill
Constant Depth

Inspection
Confirm milling



Paving
Multiple Lifts

Rolling
Optimum Density

Inspection
Confirm paving

Asbuilt
Measure Finished

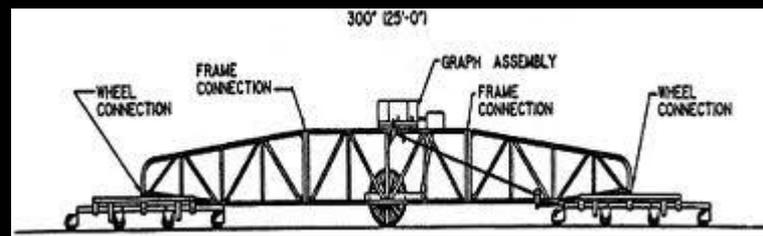
RTP-300

- Replacement of Manual Profilograph

- Profile road while driving

- Create identical reports

- Increase productivity without lane closures



RTP-300

•System Setup:

- Modular & Portable components
- 30 minute first time setup; including calibrations
- Adjustable hardware for lateral and vertical positioning of sensors
- All data collection started / stopped from cab of vehicle





**Phase #1 –
Measure Existing**

— Existing Road
— Designed Road



**Phase #2 –
Analysis / Design
New**



**Phase #3 –
Trim / Mill / Pave for Smoothness**

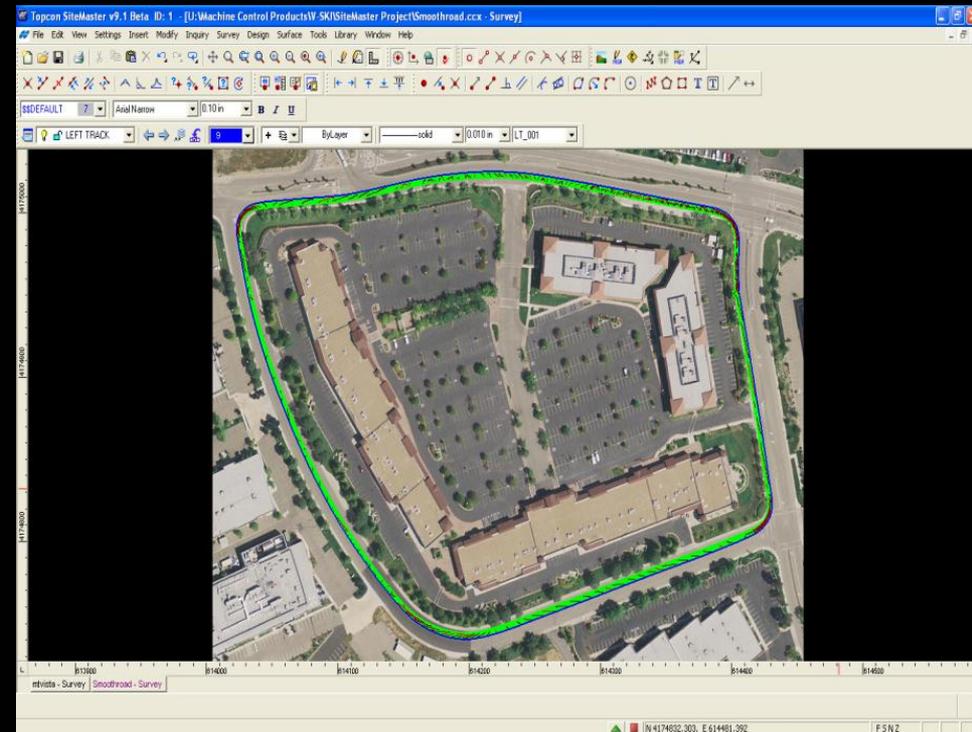


**Phase #4 –
Inspect Trimming / Milling
Surface**

RTP-300

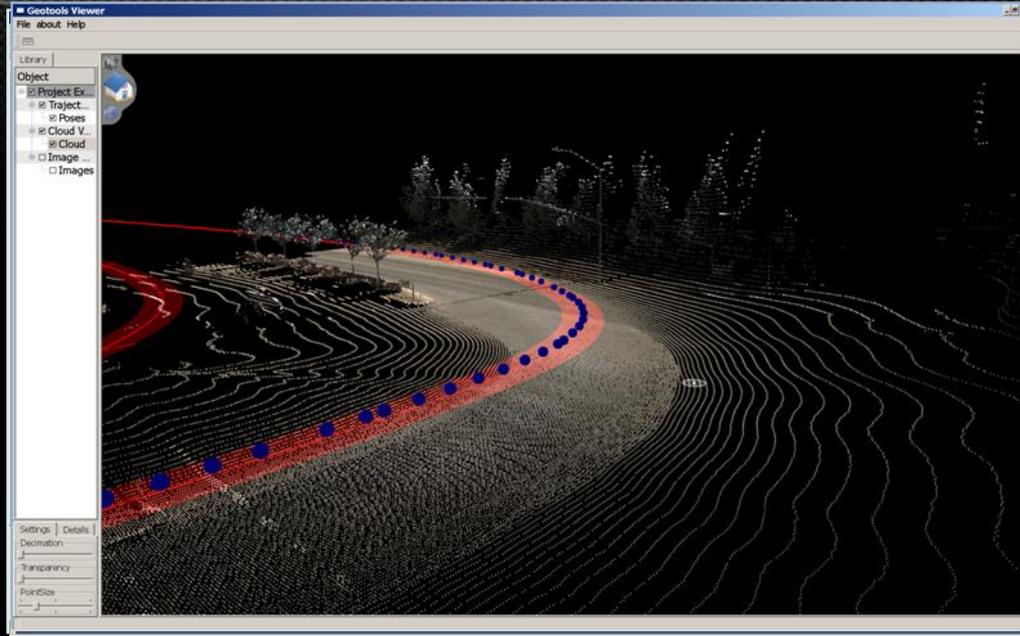
• RTP-300 Data into SiteMaster:

- P,N,E,Z,D point data input
- Volume calculations
- Road / Surface Design Modifications
- Overhead Image overlay
- Data Export to 3DMC / P3D



IPS2

Real time surface mapping



Overlay digital picture





Thank You!