

What is Height Modernization?

Height Modernization (HM) is the establishment of accurate, reliable heights using GPS technology in conjunction with traditional leveling, gravity and remote sensing information.

In 1998, Congress directed the National Geodetic Survey (NGS) to conduct a national HM Study (http://www.nws.noaa.gov/PUBS_LIB/1998heightmodstudy.pdf). NGS, the nation's positioning agency has been subsequently directed by Congress to implement HM throughout the nation.

Height Modernization Program Objectives:

- Improve transportation systems by reducing design and construction costs.
- Accurate determination of floodplains.
- Study runoff amounts and effects.
- Improving agricultural yields.
- Manage coastal resources.

Achieving these objectives will require a consistent national geodetic reference framework. Presently, the National Spatial Reference System (NSRS) is that framework. The NSRS provides the following parameters for each geodetic control monument in the United States:

- Latitude and Longitude (Horizontal)
- Height (Elevation)
- Scale
- Gravity
- Orientation

The vertical component of the NSRS is currently lacking in both density and accuracy with many marks having been lost, destroyed or obliterated.

Why Height Modernization?

To Save Taxpayer Dollars By:

- Replacing labor intensive high cost leveling with new cost-efficient GPS.
- Reducing survey costs associated with floodplain determination and other mapping and GIS activities.
- Aiding in the environmentally friendly design and construction of roads and buildings.
- Aiding in the transportation of goods and people by auto, ship or plane.
- Determining high water marks Improving Flood Insurance Rate Maps (FIRM).



- Guides modern farm and construction equipment with GPS, and allows for tailored applications of fertilizers, herbicides, and pesticides placed on fields which allows for "Green" Agriculture.

- Will reduce the amount of waste and chemical runoff into Michigan's pristine waters.



To Save Lives by:



- Safely landing aircraft in low visibility conditions.



- Providing ships with safe under-keel and overhead clearance, to avoid dangerous collisions.



- Updating heights on Emergency Evacuation Routes.

Savings from Height Modernization

MDOT Cost Saving for Design Surveys.

(Use of RTK GPS for Elevations and mapping.)
(Does not include Construction and Machine Grading)

- 125 jobs/year, 3 mile avg. distance/job¹.
- 375 miles/year avg¹.
- 50% savings in leveling costs².
- 40% savings in control costs³.
- 30% savings in mapping costs³.
- 50% savings in photogrammetry³.

Savings per/year of \$800,000.

Total MDOT Savings once HMOD is fully implemented across the State:

MDOT Road Budget for next 5 years 6,628 Million⁴.
Will save 0.5% of total MDOT construction costs.

Savings of \$33,140,000 over 5 years.

CASE STUDY: MDOT 5 mile long Photogrammetric Control Project

- RTK survey with a localized GEOID consisting of 55 control points.
- Four RTK Rovers were utilized and all points were triple occupied with multiple observations per occupation.
- Project was completed in 4 days; including 1 day of downtime due to extreme solar flares.
- The same job would have taken 5 weeks using rapid static and conventional leveling techniques.
- Time Savings of 80% 4 person GPS crew including vehicles \$10000/week.

Savings of \$40,000.

Sources:

¹ MDOT PPMS SYSTEM.

² National Height Modernization Report to Congress 1998.

³ MDOT Test projects.

⁴ MDOT 5 year plan.

Benefits of Height Modernization

- Accurate horizontal and vertical positioning provides the basis for Intelligent Transportation Systems (highways, rail, air, water) and improves safety and efficiency. Dynamic water levels referenced to accurate land elevations, and integration of surface weather and water, benefit commerce and transportation, as well.
- Accurate survey control widely available, and easily accessible, reduces future survey costs, and improves geospatial related data accuracy such as in geographic information systems (GIS), remote sensing information, road and building construction, and evacuation route monitoring.
- GIS integrating, planting, and yield rates, results in well defined fertilizer and pesticide applications, saves resources, and reduces run-off; benefiting agricultural and environmental interests.
- In FEMA's National Flood Insurance Program, risk is measured by elevations. Hence, accuracy is critical to home and business owners, insurance companies, mortgage lenders, the real estate industry, and real estate development companies. HM improves flood insurance rate maps accuracy, allowing smarter planning, development, and risk management.
- Water resources (ground water vs. surface water) in areas susceptible to subsidence, deformation, or erosion, can be easily monitored and better managed.
- Precision agriculture applies GPS technology and management strategies to individual fields: to protect the environment, improve productivity, and save time and money. Terrain modeling derived from GPS/remote sensing data, results in more accurate field boundaries and slope (contour) management for land use.

How is Height Modernization Implemented?

Presently, the State of Michigan Department of Transportation (MDOT) has undertaken Height Modernization with the implementation of a pilot project as shown in red on the cover.

This work is being carried out under the direction of the MDOT Geodetic Surveys Unit, through consultants and in partnership with NGS and other governmental agencies.

MDOT's ultimate goal is to provide a 3D statewide network of reliable NSRS data utilizing the existing MDOT CORS GPS Stations.

For More Information Contact:

Andrew W. Semenchuk, P.S.
MSRN Administrator
Geodetic Surveys Unit
Michigan DOT
Van Wagoner Building
425 W. Ottawa
P.O. Box 30050
Lansing, MI 48909
Phone: 517-335-1923

Dave Rigney
National Geodetic Survey
Advisor to Michigan
Van Wagoner Building
425 W. Ottawa
P.O. Box 30050
Lansing, MI 48909
Phone: 517-335-1916

Brian Dollman-Jersey, P.S.
Supervising Land Surveyor
Geodetic Surveys Unit
Michigan DOT
Van Wagoner Building
425 W. Ottawa
P.O. Box 30050
Lansing, MI 48909
Phone: 517-373-0061

<http://www.ngs.noaa.gov/heightmod/index.shtml>

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Michigan Height Modernization Program

