

SURVEYOR

California

Winter 2008 Issue #153

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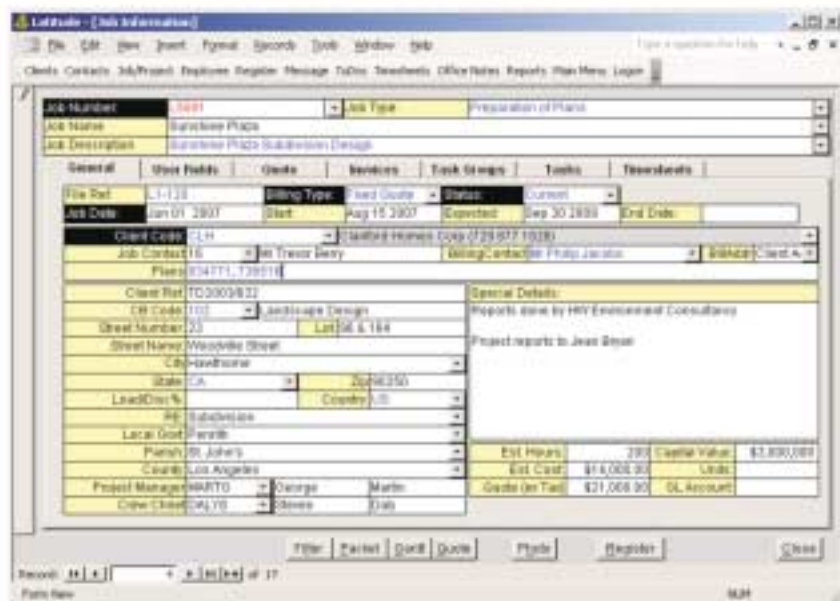
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The quarterly publication of the California Land Surveyors Association, Inc. and is published as a service to the land surveying profession of California. It is mailed to all Licensed Land Surveyors in the State of California as well as to all members of the California Land Surveyors Association, Inc. The California Surveyor is an open forum for all Surveyors, with an editorial policy predicated on the preamble to the Articles of Incorporation of the California Land Surveyors Association, Inc. and its stated aims and objectives, which read:

“Recognizing that the true merit of a profession is determined by the value of its services to society, the California Land Surveyors Association does hereby dedicate itself to the promotion and protection of the profession of land surveying as a social and economic influence vital to the welfare of society, community, and state.”

“The purpose of this organization is to promote the common good and welfare of its members in their activities in the profession of land surveying, to promote and maintain the highest possible standards of professional ethics and practices, to promote professional uniformity, to promote public faith and dependence in Land Surveyors and their work.”

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On The Cover:

Daren Hatch, Andregg Geomatics, operating a Trimble S6 total station in the MacArthur Maze.

From the Editor

When I think of high technology my ProMark2s come to mind. With my four GPS receivers I can do work that was previously impractical or impossible for a small shop like mine. They enable me to break sections down, close long, serpentine traverses, and extend control into remote locations. However, valuable as they are to me, they are a far cry from the cutting edge technologies featured in this issue of the *California Surveyor*.



Photo by: Auburn Photography

Many surveyors today rely on real time kinematic (RTK) GPS equipment to remain competitive. For them, Robert Reese's Tech Tips explains how spread spectrum radios can solve the problem of losing radio link between base station and rover during periods of on air chatter. Speaking of productivity on the move, Kevin Akin, Caltrans Office of Land Surveys, tells us about the emerging technology of mobile, ground-based laser scanners.

Photogrammetrists Devin Kelley and Thomas Loecherbach of HJW Geospatial, Inc., review aerial mapping technologies that integrate LiDAR, conventional film photography, digital frame camera imagery, and airborne GPS. And Andregg Geomatics explains how they put emerging technologies to good use during their pivotal work in the speedy repair of the MacArthur Maze freeway interchange.

The Professional Land Surveyor Examination

One of my goals as editor has been to feature information helpful to Professional Land Surveyor examination candidates. Also in this issue Ric Moore, Staff Land Surveyor, Board for Professional Engineers and Land Surveyors (BPELS), explains the California State-Specific portion of the Profession Land Surveyor examination development process. Together with Ric's article you'll find a list of exam-related resources available from the BPELS website. In particular, Ric asked me to remind candidates to prepare for success by reviewing Tips for Examinees at http://www.dca.ca.gov/pels/e_2007tips.htm. Bringing the right calculator to the exam is another key to success. For more on this topic, read Ted Kerber's NCEES Calculator Policy. Be sure to check both the NCEES and BPELS websites prior to exam day to make certain you have the most current information available. If you need study materials, consider purchasing the CLSA Exam Guide from CLSA's on-line store at www.californiasurveyors.org. The Guide is packed with information you will find useful long after you receive your license. Some students learn best in a classroom environment. For them, local CLSA chapters throughout the state sponsor examination preparation courses. These courses are typically taught by volunteers, each specializing in his or her field of expertise, and cover the breadth of professional practice in California. So there you have it; everything you ever wanted to know about the Professional Land Surveyor examination. Except the answers. All you have to do now is study.

As always, we hope you enjoy the magazine and we encourage you to submit articles. Thanks to everyone who helped make 2007 a successful year for the *California Surveyor*, and best wishes to all for a safe and happy 2008. ❖

John P. Wilusz, PLS, PE, is in private practice in Citrus Heights, CA

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President's Message



It's time to stop and smell the roses

Sometimes we get so wrapped up in dousing the flames of today's fires and worrying about tomorrow that we forget to reflect on the good things that we have achieved. As 2007 draws to a close, I thought it would be interesting to look back at what we have accomplished this year.....

CLSA was recognized as the "NSPS Affiliate of the Year". No small feat as we were judged on our membership, services, chapter activity, annual conference, public relations, education and professional development programs, legislative activities and student outreach. Congrats to all for being recognized as the top state surveying association in the Country!

Those of us who were lucky enough to attend the 2007 CLSA Conference in San Diego were treated with a very different conference setting than we have been used to in recent years. This year's conference had less of the distractions of previous years which, for me, offered a better setting to bond with my fellow surveyors. The weather was almost perfect and the resort was relaxing and beautiful. This was a joint conference with WFPS and together we put together an amazing group of presenters and seminars. Highlights included our first ever Education Foundation Golf Tournament and a scholarship auction that raised an unprecedented amount of money for surveying scholarships.

Speaking of scholarship auctions, what a year it has been for the Education Foundation. In 2007, over \$30,000 has been distributed through the state Education Foundation. On behalf of the many students whose lives were greatly affected by these scholarships, I want to thank the Chapters, companies and individuals who were involved in raising this huge sum of money. The Education Foundation has set a goal of more than doubling this amount within the next few years and I have no doubt that the members of CLSA will make that goal a reality.

Early 2007 marked the release of the "Exam Guide" for which much of the credit goes to Bob Hart and his team of hard workers. Those who took advantage of its wealth of information found this to be a key tool in preparing for and taking the LS exam. I have heard from several new LS's that this Guide made the difference in their success this year. This committee is working on additions and updates for the Guide which you will all see in the near future.

Our Legislative Committee is an unsung hero in CLSA. Though most of you don't see the efforts of what they are doing, know that throughout the year they are reviewing, advising on and creating countless bills that may have a direct affect on our profession. This is a very hard working committee that I don't think gets the thanks they deserve for the many hours required to keep up on our ever-changing environment. Next time you see Tom Taylor, be sure to thank him and his committee for their efforts.

The CLSA recruitment campaign took full stride in 2007. With the production of the video and resource materials completed, we were able to concentrate on getting the word out and meeting with the students. The response has been enormous not only throughout the state but around the nation and even overseas! The video has been a hit on YouTube.com and more than a dozen state and national associations have purchased the rights to use our video. Most importantly, the campaign has opened up the doors for surveyors throughout the state to meet with students and guidance counselors to explain the opportunities that our profession provides. This is an on-going campaign that relies on the efforts of the local chapters to be successful. Congrats to those chapters who have found success in this campaign.

In addition to the recruitment campaign, the Trig-star program has grown significantly over the past year. Several chapters have adopted the approach of gathering several schools to a central testing location and making a career day out of the event. This program has done a lot for surveying recruitment and public awareness. I hope the momentum we have with this program will spill over into the Scouting Merit Badge program and will continue to build popularity throughout the state.

This year we have seen a 10% rise in our membership numbers. Is it because my signature on the membership certificate may be a collectable someday? Not likely. Among the many other reasons to be a member, the quality and member pricing of our workshops make it an incentive to belong to CLSA. Look for a new series of workshops and seminars in 2008 and take advantage of the membership savings!

Finally, I am amazed by the quality of the media resources that this organization produces. Our web site is top notch and the CLSA News, E-news and Cal Surveyor rival any professional association publications on the market. I want to specifically recognize John Wilusz for his dedication in producing the Cal Surveyor. I have heard countless comments on how far this publication has come. I know that John will gladly accept your thanks in the form of article contributions! Way to go John.

It's amazing what a well organized and motivated group of volunteers can achieve when we all work together. I trust that you all recognize the value of your CLSA membership and will continue to support and be a part of CLSA's efforts in 2008.

It has been an honor to serve CLSA this year and I want to thank my fellow officers, the committees, board members, chapters, central office staff and individual CLSA members who have made all of these accomplishments possible. Stop and smell the roses now and then. It makes the challenges of today and tomorrow more achievable.

Sincerely,
Steve Shambeck
2007 CLSA State President

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[DEEDS]

[ASSESSOR MAPS]

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Caltrans Laser Scanning Research



The California Department of Transportation (Caltrans) conducts research and deployment that yields tangible products and process improvements to improve mobility across California. Caltrans Division of Research and Innovation (DRI) has developed a comprehensive program to research, develop, test, and evaluate transportation innovations. The Offices of Surveys and Photogrammetry joined the DRI customer driven research process in 2004. A Surveys Technical Advisory Panel was formed to suggest research, evaluate proposals from researchers, and deploy new technology. Caltrans surveyors statewide suggest topics for future research and are participating in field tests.

Survey and Photogrammetry related research projects are currently under way. California State University Fresno, <http://www.csufresno.edu/geomatics/>, has evaluated positioning GPS aerial photogrammetry using GPS Real Time Networks for positioning.

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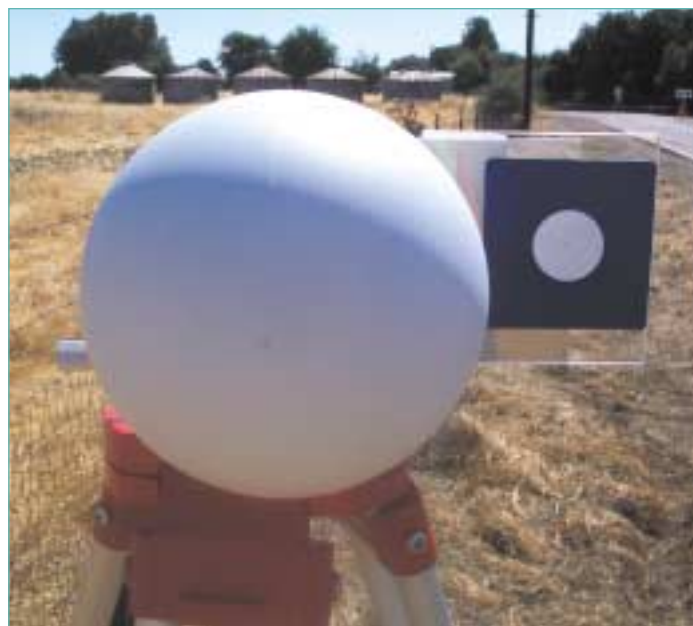
The Advanced Highway and Maintenance Construction Technology Center (AHMCT), <http://www.ahmct.ucdavis.edu/index.htm?pg=AboutAHMCT>, centered at the University of California at Davis, is developing specifications for using ground based laser scanners on Caltrans projects. Another research project has started to evaluate the emerging technology of mobile laser scanners. The mobile laser scanners are mounted on ordinary automobiles and driven at high-way speeds. This article describes the scanner research.

There have been several national research projects testing laser scanning, but not specifically on pavement or bridges. Two test sites were chosen that represent typical Caltrans projects: the Hutchinson Road overcrossing on Highway 113, in Yolo County, and a nearby abandoned section of Hutchinson Road. Several vendors including Leica Geosystems Inc., IntelliSum Inc., Optech Inc., and Trimble generously donated scanning equipment, training, and personnel to participate in the study. This project would not have been possible without their support.

Caltrans surveyors, with a Leica 1103 total station, established horizontal control. Vertical elevations were measured with a Topcon digital level and a Leica digital level. Elevations on control points were created to within +/- 2 mm.

Test fixtures were created by AHMCT to test various properties of the lasers. The fixtures were set on tripods at 25, 50, 75, and 100 meters and scanned at a high resolution.

Angular Precision- Sphere and flat scanner targets were mounted on a sliding carriage that allowed horizontal movement to be precisely controlled. The two targets were scanned and then moved a known distance. The targets were then scanned again. The modeled centers were then compared with the known movement of the carriage.



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Incidence Angle- A small cylinder was painted white, black, and grey was scanned. As the incidence angle of the laser beam with the cylinder increases there are fewer signals returned from the surface. The incidence angle will be related to a comparable zenith angle for indications of optimal ranges and instrument heights.



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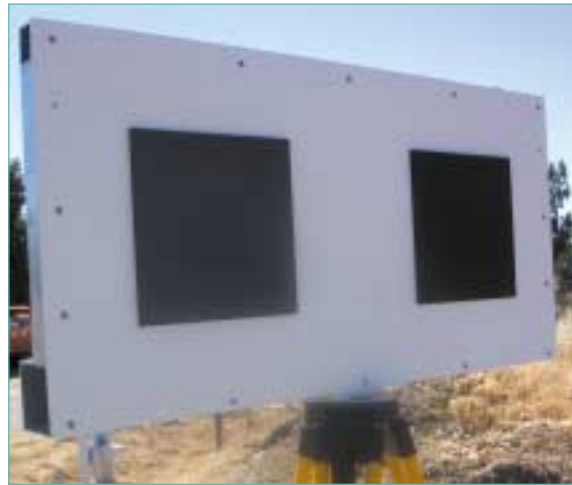
Resolution- A metal box (“The Box of Death”) with slots cut in the face measures the resolution. (In this case the resolution is defined as the ability to model the slotted face.) Scan points were created on the back and the front faces. There were points also created in the void between the front and back. The void points are a result of the scanner averaging a split signal.



Range Precision and Edge Effect- A precisely machined aluminum block demonstrates how well the laser can model a stepped surface at different distances.

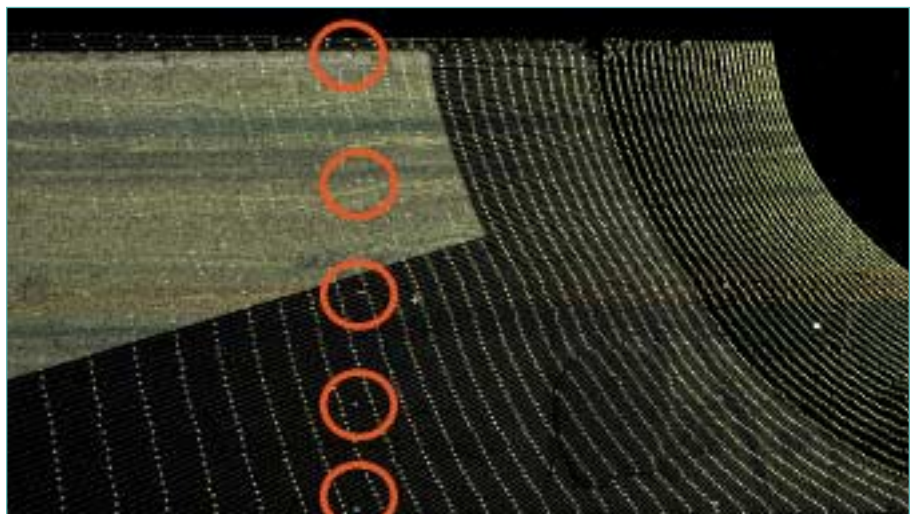


Range Precision- A large rectangle with gray and black squares mounted on the surface. The black and gray squares are 1/4 inch (7mm) inch thick. The back plate and the front plates will be modeled and the thickness compared with the known dimension.



Nails were placed in the asphalt of Old Hutchinson road and positioned with a total station measuring to a prism. Scans of the area produced points that were compared vertically with the nearest scan point. For comparison purposes the distance between the two sets of points was kept to within 0.1 meters. The results demonstrated the range at which scanners can meet Caltrans 7mm (0.02') elevation tolerance.

Caltrans also tested reflectorless total stations on this same course. The cross hairs of the total station were aimed at the nail and a reflectorless measurement taken. The results showed distances produced by reflectorless instruments were not as accurate as those measured to a prism. These results, and the experience of some Caltrans survey crews, demonstrate that caution should be used when measuring in reflectorless mode to surfaces at a large



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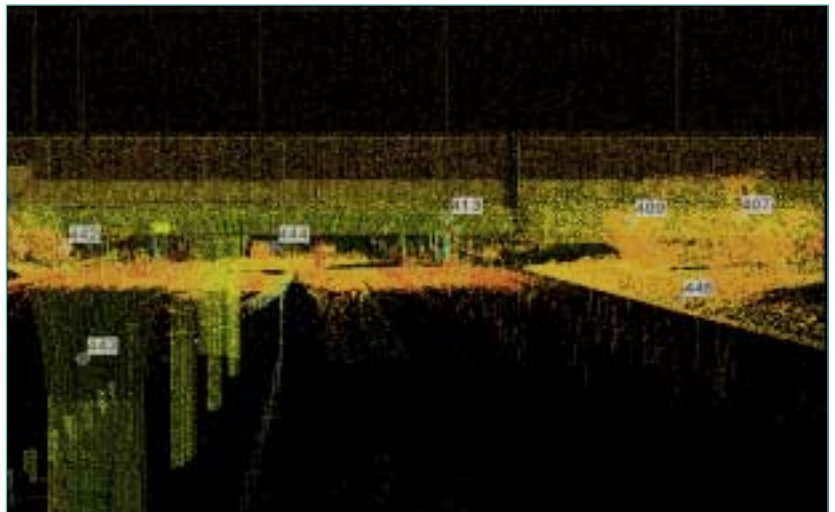
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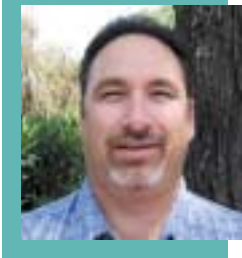
incidence angle. Manufacturers also recommend the reflectorless laser beam be calibrated to the cross hairs on a regular basis. The calibrations can have a large impact on the accuracy of reflectorless measurements.

Hutchinson Road overcrossing over Yolo Highway 113 was scanned from two sides. Selected points from the registered point cloud were exported to a data collector and measured with a stakeout routine. This comparison provided data on the accuracy of the registration process as well as the scanner.

Caltrans sees the potential to use laser scanning to model highways and structures. Laser scanning is a great tool, but like any technology, there are limitations. This research will help to successfully incorporate laser scanners into the transportation survey toolbox. The results from this research will be used to create laser scanner standards and specifications for the Caltrans Survey Manual. The final report is will be completed in 2007 and will be available on the AHMCT website. This research provides an invaluable resource for surveyors who wish to understand and market this technology. ❖



Kevin Akin, PLS, is a Senior Transportation Surveyor with the State of California, Department of Transportation, Office of Land Surveys.



BPELS Exam Development

Introduction

Every year in late summer, the Exam Development Committee is brought together to begin development of the State Specific Exam. This committee is usually comprised of five to six Subject Matter Experts (SME) with oversight from staff members of the Board for Professional Engineers and Land Surveyors (BPELS), a Board Member and employees of the exam administration vendor.

The SMEs are composed of California licensed Land Surveyors, in good standing, that have prior experience with the Exam Development Committee. Usually, a committee member must have experience Grading or Field Testing the exam before committing to the important task of formulating the exam. Any Land Surveyor interested in becoming involved with the process can contact BPELS and request to be included on the list.

The first order of business for the Committee is to become familiar with, and standardize on a very important concept pertinent to meaningful discussion of the Land Surveyors Exam in California, the concept of Minimal Competence.

Business and Professions Code, Section 8708 states:

8708. Licensure requirement

In order to safeguard property and public welfare, no person shall practice land surveying unless appropriately licensed or specifically exempted from licensure under this chapter; and only persons licensed under this chapter shall be entitled to take and use the titles licensed land surveyor; professional land surveyor; or land surveyor; or any combination of these words, phrases, or abbreviations thereof.

Business and Professions Code, Section 8710.1 states:

8710.1. Legislative Intent — Protection of the Public

Protection of the public shall be the highest priority for the Board for Professional Engineers and Land Surveyors in exercising its licensing, regulatory, and disciplinary functions. Whenever protection of the public is inconsistent with other interests sought to be promoted, the protection of the public shall be paramount.

Business and Professions Code, Section 8741.1 states:

8741.1. State law and board rules exam requirements

The California specific examination shall test the applicant's knowledge of the provisions of this chapter and the board's rules and regulations regulating the practice of professional land surveying in this state

Section 8742 further states:

8742. Education - experience requirements

(a) The educational qualifications and experience in land surveying, which an applicant for the second division examination shall possess, shall be not less than one of the following prescribed criteria:

(1) Graduation from a four-year curriculum with an emphasis in land surveying approved by the board or accredited by a national or regional accrediting agency recognized by the United States Office of Education at a postsecondary educational institution and two years of actual broad based progressive experience in land surveying, including one year of responsible field training and one year of responsible office training satisfactory to the board.

(2) Actual broad based progressive experience in land surveying for at least six years, including one year of responsible field training and one year of responsible office training satisfactory to the board.

(3) Registration as a civil engineer with two years of actual broad based progressive experience in land surveying satisfactory to the board.

(Note: Underlining emphasis in sections cited above, added by author.)


In reading these sections for licensure, one should realize that these requirements represent the minimum education and experience required to qualify to sit for the licensing exam. The Committee is tasked with developing an exam that targets the group of individuals that meets these qualifications. Developing a licensing exam that targets individuals with substantially more education and/or experience would violate the regulations and could possibly harm the growth of the profession.

Developing a licensing exam that targets individuals with less education and/or experience would again violate the regulations and could possibly harm the public consumers.

And the concept of Minimal Competency cannot be precisely implemented without understanding what potential licensees should be minimally competent in. On a regular basis, BPELS enlists the aid of an independent study based on an extensive questionnaire sent out to licensed land surveyors to develop an overview of the practice of land surveying in California.

The results of this study is the published Test Plan (http://www.dca.ca.gov/pels/e_ls_test-plan.pdf.) This Test

Continued on page 16



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BPELS Exam Development

Plan dictates the content of the exam and serves as the Guiding Principles to guide the development and evaluation of the exam content as it relates to a Minimally Competent Land Surveyor .

The following is a brief synopsis of the various meetings integral to the successful development of the Land Surveyors licensing exam.

1st Development Meeting

The goals of this meeting are to brief the committee on the overall purpose of the exam, while establishing the basic structure of the new exam, the problems, artwork, solution booklets and grading plans. Initial layout of the problems are defined by teams of committee members and regularly reviewed by the entire committee for comment and constructive criticism. While one or possibly two SMEs may create the initial structure of a given problem, each and every problem eventually forms as the result of collaborative development.

2nd Development Meeting

When the Committee returns to the 2nd development meeting, the exam administration vendor has created a Draft version of the exam as it was developed during the first meeting, and the committee fine tunes the exam structure and finalizes the content. All content is discussed in detail, and finalized with agreement from all committee members.

The committee reviews each problem and determines first, whether the problem fits the definition of Minimal Competence and second, whether the length of time is appropriate to complete the problem from the target group standpoint. From this, the exam problems may be revised to fit the goals of the exam.

Another important function at this second meeting, once the exam format and content are firmly established, is to determine the "task and knowledge" factors of each problem element in accordance with the Test Plan. The committee reviews each problem and ensures that the exam adheres to these mandatory guidelines. In some cases, the problems may be edited or modified to meet these demanding criteria.

At this point in the process, each and every element of the proposed exam has been independently reviewed by six - eight licensed professional land surveyors.

Field Test

At the "Field Test", generally six to eight licensed land surveyors are brought together to review the exam. These land surveyors are usually a mix of recently licensed individuals and former committee members. This integration is intended to supply a fresh perspective on the exam from two vital perspectives: individuals close to the target candidate and former development committee members, trained to provide constructive criticism of the exam content and structure.

The "field testers" solve the problems as though they were sit-

ting for the actual exam, within the actual proposed time limits. No discussion of the problems is permitted until each problem is solved. The "papers" are graded based on the grading plans, as currently developed. Once this has been accomplished, the discussion so vital to this stage of exam development begins.

The Committee Chairperson and Co-Chairperson query the field testers with respect to their thoughts on each problem. Criteria such as whether the wording was sufficient, or incomplete artwork, etc. is discussed with input from each Field Tester. They are also asked to help refine the problems so that the wording is more specific, more precise or clearer. Field testers are also encouraged to share their thoughts or possibilities of alternate solutions to the problems.

At this point in the process, each and every element of the proposed exam has been independently reviewed by twelve - fourteen licensed professional land surveyors.

Chair Review

Prior to the exam being finalized and sent to printing, the Chairperson and Co-Chairperson meet with the BPELS Staff Land Surveyor to review the final draft for a last minute review and evaluation.

Team Leader Meeting

Approximately one month after the State-Specific Exam is given, the development committee meets again. This time, the purpose of the meeting is to prepare for the grading of the exam.

Comments, submitted by candidates on exam day or subsequently delivered to BPELS staff, are presented to the committee members for thorough review and consideration. Possibilities of alternate solutions posed by the candidates are discussed and evaluated for validity and the grading plan may be altered to address the results of this committee evaluation.

As a group, committee members decide who will be the Team Leader for each of the problems. The Team Leader is responsible for guiding their respective team through the assigned exam problem in accordance with the developed Grading Plan during the Grading process.

A final function of this meeting is to determine the times necessary to grade the solutions and the number of graders required for each problem. This determines the number of California licensed land surveyors who will be asked to attend the exam grading session. Usually, the number of graders lies between 30 and 40 licensed land surveyors.

Exam Grading

Approximately, two months after the exam is given, the Exam Development Committee, BPELS staff members, employees of the exam administration vendor and the recruited graders meet to grade the current exam. The group is taken through an exercise

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BPELS Exam Development

and discussion on the characteristics regarding the Minimally Competent Land Surveyor, the purpose and practice of the exam and, most importantly, the grading procedure.

Each team is assigned one problem from the exam in which to completely grade in accordance with the grading plan and with the utmost integrity. The assigned Team Leader(s) will commence with a group overview of the problem as published and the developed grading plan. Any comments submitted by exam candidates following the administration of the exam are included in this discussion. Secondly, the group will be trained using examples of actual exam booklets. This rigorous training exercise is instrumental in establishing and verifying the consistent application of the minimally competent concept throughout the group and the entire process.

Any discussions that may need clarification or important to the consistency of the grading process across all of the grading teams will be presented to the original Development Committee as for opinion and direction.

Once the grading commences for the actual candidate booklets, each solution booklet is independently reviewed by a minimum of two trained Graders. If there is **any** element(s) from a

solution booklet graded inconsistent between the two trained Graders, it is mandatory for a third trained Grader to review the discrepant element(s) and determine the appropriate application in accordance with the accepted grading criteria.

While the Grading Teams are busy with their tasks, the exam administration vendor continuously monitors the statistical performance of the grading process and if a team, or any two Graders on a given team, is discrepant beyond the allowable tolerance, the process is immediately halted and the Team reviews the discrepancies. If necessary, the previously graded solution booklets can be re-graded to ensure a fair and impartial application of the process.

At this point in the process, each and every element of the exam has been independently reviewed by an average of twenty-two to twenty-four licensed professional land surveyors.

Standard Setting

During the Standard Setting meeting, a group of 6-8 Subject Matter Experts, comprised of California Licensed Land Surveyors, are lead through a process to determine the passing score that would be attained by an exam candidate who is minimally competent to practice Land Surveying safely in accordance with the State Rules and Regulations.

The procedure for establishing the passing score employs a standard that has been determined to be appropriate for licensing examinations. This standard addresses the question of whether the candidate knows enough about the subject, rather than does the candidate know more than a specified percentage of the other candidates who took the same exam. Employing a standard that relies on comparing candidates performance with each other ensures that some candidates will fail, regardless of how competent they are.

The procedure for establishing the passing score employs a standard that is independent of the actual test takers and is based on the level of competency demonstrated in comparison to the minimum established standards.

The experts familiarize themselves with the overall process and independently evaluate each and every element of the administered exam as it applies to the working definition of minimal competence. As a function of the process, the currently-administered exam and approved grading criteria is compared to other recent Land Surveyor examinations in terms of compliance with the Test Plan, entry level practice and actual California-related practice.

Once each element is evaluated, independently rated and discussed group wide, the final passing score is tabulated and reviewed holistically by the experts. This process is conducted without any knowledge of individual candidate scores.



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Subsequent to this meeting, a report of the process along with the passing score is submitted to the State Board Members, at the next regularly scheduled meeting for final approval. Once the score is approved, notification can then be sent out to the candidates.

At this point in the process, each and every element of the exam has been independently reviewed by an average of twenty-eight to thirty-two licensed professional land surveyors.

Appeals Grading

In accordance with Board Rules, any candidate that failed the exam and their score was within 15% of the approved passing score, can appeal and review their exam solutions within a specified period of time.

The original development committee (Grading Team Leaders) meets to begin the process. Initially, the committee reviews all of the submitted appeals inquiries and any comments raised by the Standard Setting Committee to determine the validity of each appeal in relation to the exam and the approved grading plan. This is an important step as the ramifications may affect all candidates with a score within 15% of the passing score, regardless of whether every candidate that could file an appeal, actually did. Then all solution booklets for problems appealed by the candidates are re-graded using the same procedures as used in the original grading session with the addition of any alternate solutions deemed valid by the Committee. On occasion when an alternate solution determined to be valid affects additional candidate scores, beyond the 15% range, all solution booklets for those candidates that have a passing score within the range of the those additional points, will be subject to re-grading. ❖

Resources for the Professional Land Surveyor Examination

The following references are available on the Board for Professional Engineers and Land Surveyors website at: http://www.dca.ca.gov/pels/e_refs.htm

- Examinee Instructions for the October 2007 PE & PLS Examinations
- General Information Regarding the New Format of the Professional Land Surveying Examination
- California State-Specific Professional Land Surveying examination: Test Plan
- California State-Specific Professional Land Surveying examination: Information for Examinees Booklet
- California State-Specific Professional Land Surveying examination: Sample Questions
- 2004 California State-Specific Professional Land Surveying Examination Actual Question
- 2005 California State-Specific Professional Land Surveying Examination
- National (6-hour) Professional Land Surveyor Test Plan/Examination Specifications
- National (6-hour) Professional Land Surveyor Study Materials

NCEES Calculator Policy

By: Ted Kerber, PLS

The National Council of Examiners for Engineering and Surveying (NCEES) has updated its calculator policy for the 2008 examinations. NCEES has created a list of the only calculators that will be allowed to be used for its examinations. The only calculators that will be allowed for use on any NCEES exam are the following:

Casio: All fx-115 models; any Casio calculator with fx-115 in its model name is allowed.

Texas Instruments: All TI-30X and TI-36X models are allowed; any Texas Instruments calculator must contain TI-30X or TI-36X in its model name.

Hewlett Packard: The HP 33s and HP 35s models are allowed. No other Hewlett Packard models are allowed.

These two HP models are programmable, and the HP33s have been used successfully on tests for the last few years. The HP 35s can do everything the 33s does and also has the capability to store coordinates through its indirect storage functions. You can include equations or expressions in your programming, use 100 built-in functions or store an equation then use it again and again to solve any variable, using HP Solve. The equations actually run like a program, prompting for each variable and calculating the unknown one. If you aren't sure about programming a new calculator, there are solutions books available (for both calculators). You can find more information by searching "NCEES+tests" on the web, or check with the calculator dealer. There's also the question of whether or not these calculators are tough enough for field use . . . It's a sturdy calculator in a solid case, has raised edges around the keypad to protect the keys and comes with a zippered hard carrying case. The calculator is held in the case with a well-placed elastic band, and HP did a great thing . . . the case has two elastic bands so you can mount the calculator for left-handed use.

Further information about the NCEES calculator policy may be obtained from the NCEES website at [HYPERLINK http://www.ncees.org/news/index.php?release_id=21](http://www.ncees.org/news/index.php?release_id=21)

Editor's note: Check the website again just before the exam to confirm your calculator is still on the approved list! ❖



By: Devin Kelley, Project Manager, ASPRS-Certified Photogrammetrist, and Thomas Loecherbach, PhD, Chief Photogrammetrist, ASPRS-Certified Photogrammetrist, HJW GeoSpatial, Inc., Oakland, CA

New Sensors, Deliverables and Strategies for Aerial Mapping Projects

New aerial mapping sensors and technologies offer enhancements to mapping end products and also impact a project's cost-effectiveness, quality and feasibility. Photogrammetric sensor data integration enables the photogrammetrist new opportunities to add redundancy to the mapping project, thereby reducing risks with enhanced capabilities for quality control and data verification. HJW GeoSpatial has spent years integrating airborne data from LiDAR, conventional film photography and digital frame camera imagery. Such data is heavily reliant on airborne GPS/IMU sensor data, with additional checks and control from surveyed ground control information. Airborne LiDAR data and digital camera photography offer new data types, products and capabilities that end-users should be aware of. Most importantly, these data sources should be utilized appropriately and properly characterized to their end-users, so that expectations of capabilities, accuracy specifications and delivery schedule can be met. HJW GeoSpatial's team of ASPRS-Certified Photogrammetrists and their clients are enthusiastic about the applications of these innovative, but proven technologies.

Airborne GPS/IMU

Airborne GPS/IMU is used to measure the position and orientation of the camera or LiDAR sensor platform during data acquisition. In the case of aerial photography, each time the shutter is opened, a GPS time event is recorded. After flight, the GPS/IMU and camera event information is post-processed with ground base station data to arrive at a trajectory solution which is established to a known accuracy. It is this position and orientation data which is at the heart of most photogrammetric operations. By utilizing the GPS/IMU as a constraint in aerial triangulation, or as the primary source of information for LiDAR point data, the photogrammetrist can keep the overhead for surveyed

ground control to a minimum, keeping project costs down. The GPS/IMU information can be used to add redundancy to the photogrammetric processing operations, playing a major role in blunder detection and quality control. In addition, when relying on GPS/IMU as the primary source of control for frame photography, significant opportunities present themselves; flights can extend long distances without ground control (over water bodies and inaccessible terrain), and corridor-style mapping projects see a dramatic reduction in surveyed control requirements. These characteristics have proven GPS/IMU as a valuable tool in projects with accuracy requirements for 1"= 100' scale, 2' contour mapping.

Airborne LiDAR Terrain Data

Airborne LiDAR data is acquired by an airborne laser range scanner that sends out laser range pulses at a very high rate, often detecting multiple returns for each outgoing pulse. During flight, airborne GPS/IMU is supported by ground base stations, which accommodate post-mission differential post-processing of the trajectory. The laser range data is processed with respect to the airborne GPS/IMU trajectory, which allows for the range data to become geo-referenced, as terrain points.

Most LiDAR sensors can record multiple returns for each outgoing pulse, which ultimately increases the probability of detecting bare-earth points in vegetated areas. Since the laser pulse is not finite in volume, and diverges to over 1' in diameter by the time it reaches ground level, the pulse can hit several objects on its way to the ground. Often, these objects are leaves or branches of trees and vegetation. The incoming returns from interference with these objects are recorded for each outgoing pulse. This information is useful in post-processing the dataset, by

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restricting “last-return” and “only return” signals to be designated as candidates for bare-earth, reducing the search space, and increasing probability of correctly identifying points on the ground. In post-processing, after reducing the search space in this way, the point cloud is analyzed to identify points in this sub-set that are most likely to be bare-earth. This geometric point classification approach usually selects seed points that have low relative elevations, and computationally, grows the bare-earth class from these points based on nearest neighbor analysis, user-defined thresholds and iterations relating to slope, and maximum/minimum horizontal and vertical distances. The end product will typically undergo manual QA/QC, using any ancillary data available, such as orthophotography, to guide the inspection and corrections.

Digital Frame Camera Data

Digital mapping cameras like the Microsoft/Vexcel Ultracam X collect imagery data with a larger dynamic range than conventional film photography, and can produce image data with a great dynamic range- in 12-bits per channel (instead of the conventional 8-bits per channel). The RGB color bands are collected simultaneously with the near-IR band, so both color and CIR imagery can be



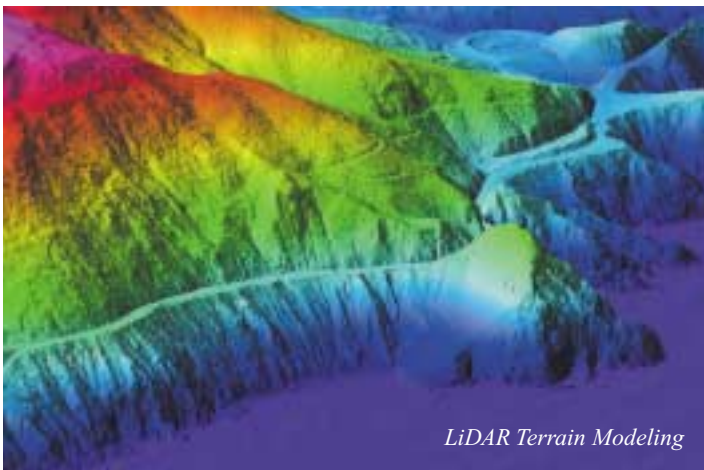
expected deliverables from a single flight mission. The imagery noise levels are dramatically lower than that of conventional scanned film, and color characteristics are

Continued on next page

much more straightforward to control. Also, without the overhead of film processing and scanning, digital photography taken with higher overlap (80% instead of 60%) is more cost feasible, allowing for photo geometry well suited for automated terrain extraction. The increased forward overlap combined with airborne GPS/IMU also offers greater redundancy in softcopy aerial triangulation. These characteristics are especially well-suited for the automatic generation of digital surface models, as well as both color and CIR orthophotography.

New Technologies, Integration and Quality

Data integration and new technologies can facilitate enhanced accuracy and reliability. With the various sensors discussed above, some ways this is done is by:



- Constraining aerial triangulation of frame imagery with GPS/IMU data, in cases where surveyed ground control is not adequately provided.
- Incorporation of LiDAR point data into aerial triangulation as a vertical constraint in the photo aerial triangulation.
- The utilization of multiple ground base stations when computing the GPS/IMU trajectory can allow for redundancies that can guide the processing to use only the clean GPS data. This type of approach facilitates the computation of a trajectory with the highest accuracy the project design will allow.
- Increased overlap capabilities, low noise and high dynamic range associated with digital camera imagery, provides new types of redundancy and robustness in automated processing.

Data integration can facilitate enhanced quality control capabilities:

- Stereo photography can be used to visualize LiDAR point data to ensure that non bare-earth points have been removed from the terrain

dataset. Also, stereo visualization allows for manual confirmation that LiDAR point data are on the same vertical datum as the aerial photography.

- Aerial triangulation of frame photography constrained with airborne GPS/IMU allows for more robust blunder detection. Automated tie point measurement errors are more easily detected, as well as blunders or identification of discrepancies in surveyed ground control.
- Direct orientation of frame photography using GPS/IMU data allows for a preliminary orthophoto product to be generated quickly, so that image color balancing (in a geographic context) can begin early in the production phase, with the purpose of generating orthophoto products with properly balanced imagery.
- GPS/IMU trajectory processing for both frame photography and LiDAR missions can benefit from the utilization of multiple ground base stations. Combining these solutions allow for spatial comparisons which can identify blunders in antenna height, boresite parameters, or use of the wrong coordinates for ground base stations.
- Contours generated from LiDAR data can be compared against orthophotography and stereo imagery, and also edited in those environments. This way, terrain interpretation can be used to refine the otherwise automated determination of the bare-earth LiDAR point class.

New Technologies, Integration and End Products

Newer technologies and integration techniques facilitate the generation of end-products with new characteristics:



Continued on page 24

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- Stereo photography can be used to collect breaklines that are then merged with LiDAR point data, and used to generate contours. The terrain model benefits from the penetration capabilities and high point density of the LiDAR data, with the value of manually-measured breaklines that are placed by experienced photogrammetric technicians.
- LiDAR data provides a very effective terrain model to support orthophoto production. Stereo photography is often used to collect bridge platforms and breaklines, to strengthen the terrain model, later merged with LiDAR data for very precise orthophoto production.
- High overlap GPS/IMU-controlled digital frame camera imagery is an ideal scenario for automated terrain extraction for the generation of a digital surface model (DSM). This type of terrain dataset can also be used to support orthophoto production.
- Digital frame cameras can collect data better than 12-bit dynamic range, and produce output imagery with a 16-bit dynamic range. Additionally digital cameras provide imagery in RGB as well as near-IR bands. Compared to conventional film-based end products, this adds two new dimensions to the data- increased dynamic range and spectral range.

- LiDAR data has the unique capability of collecting terrain data through thick canopy in otherwise inaccessible areas or forested areas where GPS signals from ground surveys would be blocked. Also, it is possible to measure points on transmission lines, facilitating a new approach to mapping above ground features.

Changing Requirements for Data Providers and End Users

With these new options in data acquisition and processing, the data provider should be able to ask the right kind of questions in order to narrow down the best approach to designing a project that will meet both the specifications and budget. The data provider should also be able to acknowledge the pros and cons of each possible approach, to educate the client and facilitate well-founded decisions. Many components of project design are interrelated and act as limiting factors on accuracies. For example, orthophoto pixel size, planimetric accuracy, and contour mapping capabilities for a project should all be understood, so that even if not all are deliverables, the client knows what additional data can be extracted from the sensor data at a later date. These types of project design decisions have an incredible impact on costs, and therefore the data providers have to use their professional judgment to determine the right technology, design, and strategy for the job.

The end user must consider their own capabilities for utilizing the various forms of deliverables. With digital frame photography (specifically, from the Microsoft/Vexcel Ultracam X), image data can be delivered with accommodations for several new parameters, namely:

- The option to take delivery of 8-bit or 16-bit imagery. 16-bit imagery has the advantage of storing the full dynamic range of the imagery, and the disadvantage of required transformations to accommodate viewing hardware/software. The typical computer monitor only displays three channels (RGB) of 8-bit information. Viewing 16-bit imagery requires an intermediate histogram compression in this type of viewing environment. 16-bit imagery is most appropriate for end users intending to utilize image processing algorithms such as classification routines that operate best on the original reflectance values of the RGB or CIR.
- Unlike image processing and classification software, many off-the-shelf software packages cannot handle 4-band (red-green-blue-Near-IR) imagery directly. Also, computer monitors are limited to handling or displaying three bands (channels) of imagery. With RGB imagery as a standard deliverable, the near-IR image band must be handled in a separate way. One convention is to merge the color information and the near-IR data to generate CIR, or false color infrared imagery. Alternatively, the near-IR data can be delivered as a

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single-band (grayscale) image, still retaining its value while optimizing file size. One may argue that the two color bands in CIR imagery enhance the ability to interpret features in the imagery. The key decision for the end-user is how to take delivery of four bands of image data.

- Unlike film-based photography, digital photography gives the data provider much more control over the image histogram. Best practices are used to optimize the dynamic range of the exposure, and then later stretch the histogram after acquisition, to optimize image contrast and brightness. Subsequent image adjustments like dodging and balancing are often done to prepare imagery for orthophoto mosaicking. End-users wishing to use CIR (or the near-IR band) imagery may require that the image is not balanced, dodged or stretched significantly, in order to lessen the chance that those adjustments could affect the automated pixel-based operations and analysis that the end-user may wish to perform.

- End-users should also be aware that with digital frame cameras such as the Ultracam, the color and near-IR bands are collected separately from the panchromatic (black and white) imagery, and at a relatively lower resolution than the panchromatic. Pan-sharpening is part of the image construction. This technique has been well known for decades from satellite imagery and corresponds to the human visual system which has a much higher resolution in the panchromatic than in the color range. Given a camera calibration which permits a very precise, sub-pixel registration of all bands, the pan-sharpening process retains the apparent quality of the imagery.

The use of LiDAR data requires decisions about what deliverables are appropriate. Some important considerations are:

- The degree of point filtering. The LiDAR point cloud can be delivered in a state prior to bare-earth filtering, and encoded with return number. The data can later be filtered by the end-user or a third party. Alternatively, the data can be provided as filtered to bare-earth, as well as vegetation and buildings.
- There are many data formats that can store LiDAR data- the LAS format being the industry standard. This format stores a considerable amount of ancillary data that allows for sophisticated LiDAR processing software packages to manipulate the data in almost any way imaginable. A less-sophisticated data format would be ASCII point listings or comma-separated point files.
- Derived end-products would include DEMs, contours, or other terrain datasets which may or may not include breaklines. DEM posting, contour intervals,

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Easement Workshop <small>(Pre-Conference 8 hrs. - Feb. 25th)</small>	\$125	\$155	\$ _____
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Conference <small>(Includes Conference Registration, Monday & Tuesday Luncheon, Icebreaker Reception & Scholarship Auction)</small>	\$365	\$435	\$ _____
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Conference & Workshop <small>(Includes Easement Workshop, Conference Registration, Monday & Tuesday Luncheon, Icebreaker Reception & Scholarship Auction)</small>	\$475	\$575	\$ _____
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Spouse Registration <small>(includes tickets to Icebreaker Reception & Scholarship Auction)</small>	\$ 65		\$ _____
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MacArthur Maze Collapses ... Surveyors Respond



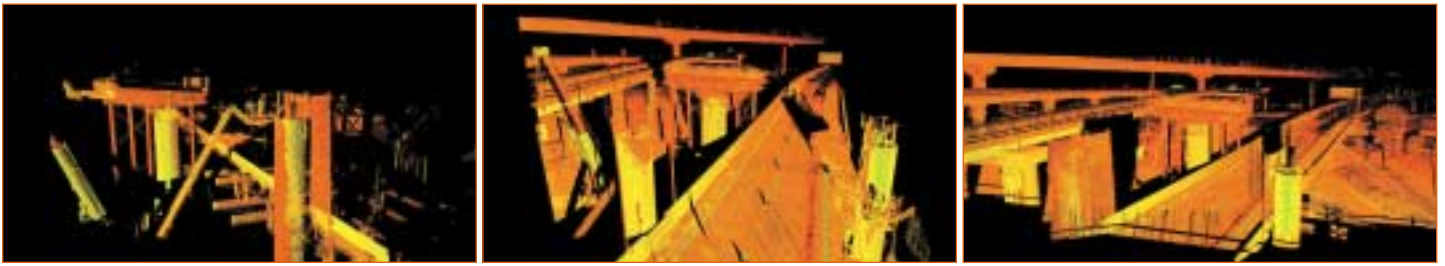
Satellite view of MacArthur Maze near Emeryville

Background

On Sunday, April 29, 2007 at approximately 3:40 am a gasoline tanker-truck accident occurred on the elevated section of westbound Interstate 80 (from Berkeley) at the connector with southbound Interstate 880 (to San Jose). The resulting fire caused the overhead section of eastbound Interstate 80 (from San Francisco) to collapse at the connector with eastbound Interstate 580 (to Oakland), closing two major arteries in the interchange.

The Governor issued an emergency declaration on the same day in order to begin immediate repair and replacement of the collapsed freeway. This declaration streamlined public contracting and permitting codes, and provided emergency funding to allow repair operations to begin immediately. The emergency declaration also authorized funding to provide free transit services in the Bay Area for Monday, April 30. "Some 35,000 cars travel the two-lane I-880 connector each day, and 45,000 cars use the I-580 connector, which is three lanes", said Caltrans Director Will Kempton.

Continued on next page



I-580 HDS Images

Project overview

C.C. Myers, Inc. won the contract to reconstruct the damaged interchange, and owner C.C. Myers personally selected Andregg Geomatics to provide surveying services. Within two hours of Mr. Myers' call, an Andregg team was on the ground to provide as-built survey measurements. With an accelerated schedule and tight steel fabrication tolerances, the work was more than critical; there would be no second chances. Andregg met the challenge with its most experienced surveyors using the most modern technology. Within twenty hours of the notice to proceed, the firm delivered as-built drawings for use in fabricating new steel girders for the repair of the freeway interchange.

Expertise and high-technology meet accelerated schedule

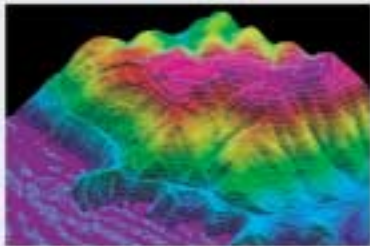
For the MacArthur Maze collapse, Andregg Geomatics deployed next generation technologies for an extraordinarily demanding project. The goal: get it fast...get it right...get it the first time. Two field crews surveyed what was left of the existing bridge using a Trimble S6 Direct Reflex Total Station and a Leica High-Definition Scanner (HDS 3000). A Leica NA 2002 digital level was also used for some of the vertical measurements. With this data, they computed the lengths for twelve new steel girders, girders that needed to be fabricated to extremely precise tolerances. The survey crews also laid-out the massive concrete beam that was installed to support the frame of the elevated roadway. Their work ensured that

Continued on next page

HJW geospatial

PACIFIC AERIAL SURVEYS

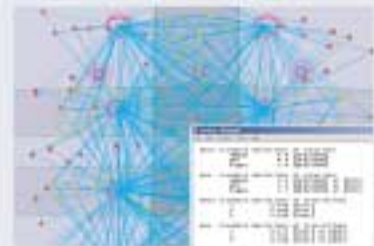
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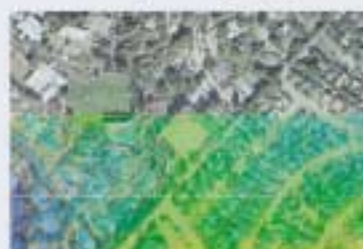
Orthophotography



QA/QC Oversight



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MacArthur Maze Collapses ... Surveyors Respond

the 243,750-pound beam, known as a bent cap, was properly positioned on top of existing columns.

The twelve steel girders started arriving from fabricator Stinger Welding of Coolidge, Arizona, on Wednesday, May 16th. The girders, each 78 feet long, 4 feet high, and weighing 20,000 pounds, were used to support the concrete road deck. The location of the repair complicated matters further; it was where the bridge curved and the girders were therefore of varying lengths. Andregg did the field survey from 10:00 am until midnight on May 8th, continued in the office until 5:00 am, and delivered the results to the girder manufacturer on schedule at 6:00 am on May 9th. By Sunday, May 20th, all girders were installed and the deck formwork constructed. The 200 cubic yard concrete pour began at 4 p.m. that day; the deck cured in ninety-six hours.

Measure of success

Twenty-six days after the contractor's notice to proceed, Governor Schwarzenegger was at the site to proclaim: "I am happy to be here on the day that we have reopened the MacArthur Maze". The Governor went on to say "Twenty-six days ago, we suffered the worst damage to our transportation infrastructure since the Loma Prieta Earthquake. But by working together with the private sector and local and federal governments, we reopened the 880 interchange one week later, and now we have the rest of it done in time for Memorial Day weekend. I want to thank the people of Oakland and Bay Area motorists for their patience, Caltrans and their contractors for their hard work, and the federal government and our local partners for all their help in our repair efforts. I commend Caltrans and Director Will Kempton for their first class work, extraordinary effort and professionalism."

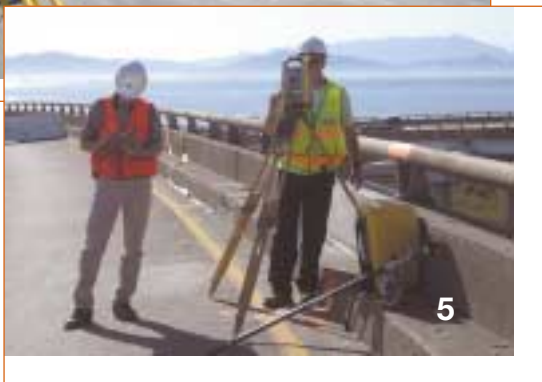
A combination of unique expertise, high-tech equipment, and good old-fashioned teamwork brought a successful result for an extraordinary job. The entire Andregg Geomatics organization feels privileged to have been able to participate in such a critical project, and expresses thanks to key team members:

Clinton C. Myers	C.C. Meyers, Inc.
Tom Holmberg, PLS	Andregg Geomatics
Ofelia P. Alcantara, P.E.	Caltrans

ANDREGG GEOMATICS is headquartered in Auburn, California and has been providing surveying and mapping for more than 60 years. The firm received a 2008 CELSOC Engineering Excellence Honor Award for its pivotal role in the repair of the MacArthur Maze interchange. ❖

Captions

1. Planning for success.
2. I-580 deck collapse.
3. Leica High-Definition Scanner (HDS 3000)
4. Trimble S6 Direct Reflex Total Station in foreground.
5. San Francisco Bay in background.



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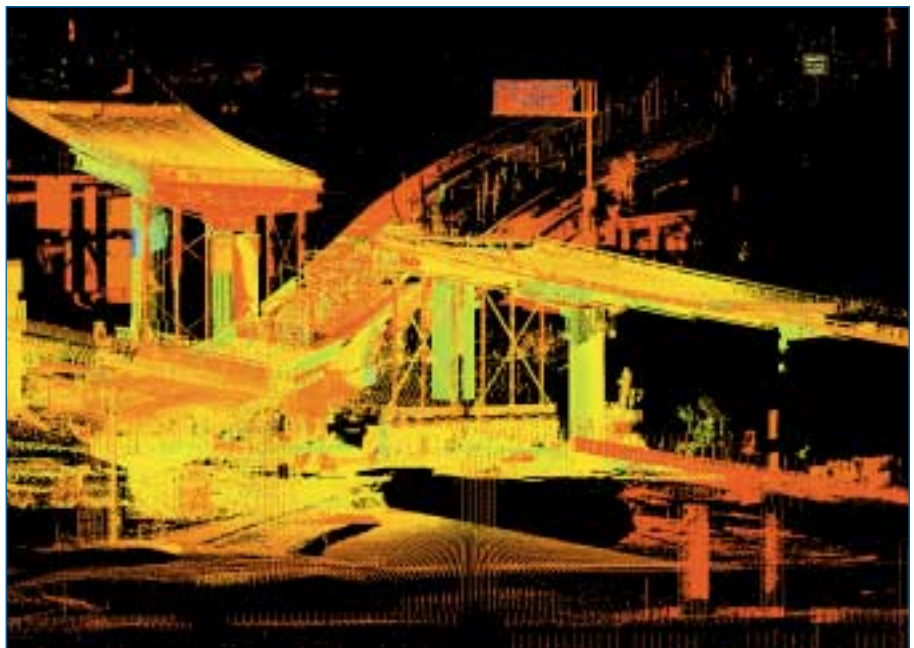


MacArthur Maze Collapse - CalTrans Office of Photogrammetry Responds

After the collapse of the freeway interchange, the Caltrans Office of Photogrammetry (OoP) initiated early morning telephone calls contacting aerial photography contractors. Radman Aerial Surveys (Sacramento, CA) and Cartwright Aerial Surveys (Sacramento, CA) were both very responsive, given the short notice and timing; each of these two firms would later play key roles in the project. Further calls resulted in HJW Geospatial Inc. (Oakland, CA) successfully completing the flight mission the same day as the accident. OoP staff met HJW's aerial photographer Sunday night to take delivery of the exposed film and delivered it to Radman Aerial Surveys on Monday morning to perform the film processing and produce edited prints. Both HJW and Radman use Kodak aerial film and chemistry. OoP staff delivered the edited prints to Caltrans District 4 in Oakland on Monday afternoon. Cartwright Aerial Surveys, Inc. created the Photo Index for this project.

Radman Aerial Surveys was tasked with capturing both vertical stereo photography and color oblique photos of the site after the concrete and steel debris had been cleared. This project has been an excellent example of public sector and private industry teamwork, and industry cooperation. The Office of Photogrammetry sincerely appreciates the efforts of all those who contributed to the success of this project. ❖

Lawrence "Larry" C. Dews, PLS, is the Aerial Photography Branch Chief for California Department of Transportation, Division of Engineering Services, Office of Photogrammetry.



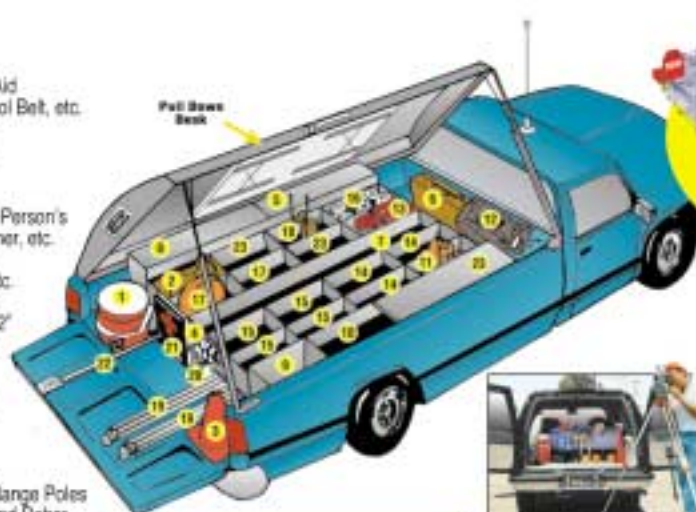
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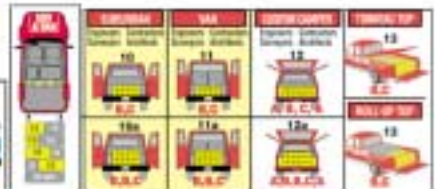
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By: Robert J. Reese, PLS

UHF RADIO ALTERNATIVE - SPREAD SPECTRUM RADIOS

Many of us surveyors using radio links for data transfer are familiar with UHF radios and their limitations. UHF radios are used for many types of data transfer, but in this article I am primarily concerned with the application of radio links to RTK GPS.

If you are using cell phones for data links from your own base stations, or from Continuously Operating Reference Stations (CORS), or are using correction signals from other proprietary subscription services, this article doesn't apply. But if you work in places that may not have cell coverage, or you need a local base for your rover control, the info below might help.

First, let's get my disclaimer out of the way. If I mention products or manufacturers by name, it is not an endorsement or a criticism. There are many other products and manufacturers of radios and data link equipment. I mention any products by name only because I have experience with them. In fact, all the radios I use operate very well. But they all have advantages that can be exploited for different field conditions. You'll have to do your own research on radio types and manufacturers that will work for you.

The UHF (Ultra-High Frequency) band of the radio spectrum covers several frequency ranges that are assigned by the Federal Communications Commission (FCC) to various user groups for different purposes (<http://www.jneuhaus.com/fccindex/spectrum.html>). The UHF frequencies used, generally, by the land surveying and geodetic control community in the US are between 460 MHz to 470 MHz. I refer to radios using these frequencies as UHF. Each of us who use UHF radios are required by law to obtain a license to use very specific frequencies, with a specific call sign. My base radio for RTK GPS work broadcasts my call sign in digital form on a regular interval to let any listeners know who it is that is transmitting the data. The positional corrections are transmitted from my base station at a one second interval (1 Hz) and give my rover GPS the corrections needed for navigation and location, in real time, down to sub-decimeter accuracies.

The UHF radios I use for base and rover radios are made by Pacific Crest Corporation (PacCrest) (<http://www.paccrst.com>). My base radio is a PDLHPB (Fig. 1) and my rover radio is a TM32, one of the older rover radio modems (Fig. 2). The TM32 is similar to their popular rover radio, model RFM96W (2watt). These radios are rugged and work well, and the technical support from Pacific Crest is first rate.



Fig 1 – PDLHPB 2/35 watt base radio - note external antenna cable and external battery (in camo pack). Data & power use same Lemo connector, antenna uses BNC connector.

Continued on page 34

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Fig 2 – TM32 2 watt rover radio - note data & power feed (from GPS receiver) and extension cable for small whip antenna.

THE PROBLEM – Too Much Traffic on the Radio Highway

The fourteen frequencies for which I am licensed range between 461.025 and 464.75 MHz. The *frequencies* can be assigned to any available channel on a given radio, but the frequencies remain the same. But therein lies the problem. Every other civilian user is licensed for the same frequencies and voice (vox) transmission has priority. Your radios must be set up to suspend transmission when vox communications are being made. That makes sense: voice comm could be emergency communications or other higher priority transmissions. However, during one of my jobs in a very busy part of southern California, near the intersections of two interstate highways, during the latter part of December, I encountered constant “chatter” on EVERY channel – mostly delivery drivers keying the microphone next to their AM radio speaker and re-broadcasting Christmas carols! (Silent Night it was not.) There was absolutely no way to get a decent, consistent link for RTK use. I tried changing frequencies, changing sensitivity, adding a “privacy code”, all to no avail. So I told my client I would pull off the job and return when I had the problem solved.

ONE SOLUTION – Get off the Highway

The solution: spread spectrum, frequency hopping, 900 MHz radios. Technically, these are UHF radios as well, but these radios are generally lower power output, low power consumption and don’t need an FCC license. So I did some quick research on the web and found radio pairs from about \$1200 to \$4000, a little more than I wanted to spend on a one-project solution. Then I talked to the folks at MaxStream, Inc. (<http://www.maxstream.net>), who had a 900 MHz spread spectrum (SS), frequency hopping, 1 watt output radio with a serial connection (RS232), their model DigiXtend, an RS-232 RF Modem. It has an omni-directional, low gain antenna that attaches directly to the radio itself (Fig. 3), and both radios can be configured easily for either base or rover. They can be powered from the GPS receiver through the DB9 serial port or from an external power supply. As well, they can be configured to be repeaters.

The frequency is the same as used by some cordless telephones and pagers and the frequency hopping means that packets of information are sent over constantly changing (hopping) frequencies. If one packet is “stepped on” (interfered with), error checking will retransmit the data on another frequency at an over-the-air-rate faster than the data baud rate for the GPS units. I was told by tech support that these radios would “solve my problem, just plug ‘em in”. They were right, and for less than \$300 per radio. After a quick overnight of two radios to my office, a test RTK trial (successful!) at my office, I returned to the project in southern California and completed the job.

But these radios do have limitations. The SS radios are strictly line of sight. My project was a survey of a 370-acre lake, most of which was visible from one control point, so line of sight was not a problem. But if I went out of sight only slightly, the radio link was lost. I needed to set up an additional control point to “see” the remaining portions of the lake. Fortunately, these radios have repeater capabilities, just like UHF radios, and one can be set where it can “see” the base and the rover in order to relay (repeat) the radio signals. The PacCrest radios, however, seem to “saturate” an area better, so the radio link can be received much longer when there are line of sight obstructions. Also, since the SS radios are only 1 watt output, antenna cables can eat away at power, so the antenna really needs to be attached directly to the radio. The power and data feed can use the same serial cable, although you can use an external power source as well.

Fig 3 (next page) – MaxStream Spread Spectrum 1 watt radio, same for base or rover. Note small omni directional antenna attached to the radio and the standard serial cable used for power and data feed. Radio is attached with hook & loop strips to a mounting bracket clamped to a prism pole.

Some advantages and disadvantages I have experienced with the two systems (460 MHz and 900 MHz) are summarized below. I continue to use either system, depending on field conditions, and both have suited my purposes quite well.

Continued on next page



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Fig 3



Continued from previous page

	<u>PDL35W</u>	<u>RFM96W/TM32</u>	<u>XTend SS</u>
output ¹	2/35watt	2watt	1watt
range ²	5-7 mi	1-2 mi	40mi
area saturation ³	very good	good	poor to none
weight (no battery)	3 lb	< 1 lb	< 1 lb
transmit/receive	both	both	both
repeater ability ⁴	yes	yes	yes
interference ⁵	possible	possible	less likely
connections ⁶	proprietary (Lemo)	proprietary (Lemo)	serial DB9pin or barrel
power	9-16v	9-16v	5-13v
power source	external	from GPS unit	external or from GPS
antenna connector	BNC (common)	BNC (common)	RPSMA (exotic)
tech support	excellent	excellent	excellent

¹ optimal output - depends on MANY variables (antennas, cables, etc.)

² optimal - manufacturer spec, HIGHLY dependant on MANY variables

³ ability to cover areas out of line of sight - my opinion based only on my experience

⁴ ability to act as repeater in data link chain

⁵ susceptibility to others on same frequency - dependent on area and local radio "traffic"

⁶ onboard connector for data or power supply ❖

Q&A SMA Expert



Question:

I currently am submitting applications for various kinds of subdivision maps, but am concerned about how long the current economic downturn will last and want to protect my projects against changes in the law. How long do vested rights last when using the various vesting subdivision maps under the Subdivision Map Act?

Answer:

This is an excellent, and timely, question! In this issue's column, we discuss the Subdivision Map Act or "Map Act" (Gov. Code §§ 66410 et seq.), and how vested rights can be secured through Vesting Tentative Maps, Vesting Parcel Maps, and Vesting Final Maps (collectively referred to hereinafter as a "Vesting Map"). (Gov. Code § 66498.1(a).)

Under the Map Act, approval of a Vesting Map confers a vested right to proceed with the development in substantial compliance with the ordinances, policies, and standards that were in effect at the time the Vesting Map application was completed (Gov. Code §§ 66498.1(b), 66474.2(a)), which is a date much earlier in the process than project approval.

The "life" of the vested rights protections secured under the Map Act are limited in duration and can be summarized as three distinct periods of time:

- 1.** The "life" given by the Map Act when the Vesting Map is in "tentative" status (through initial life and extension life); plus
- 2.** The life of the vested rights once the Vesting Map is recorded (as a Final Map or Parcel Map); plus
- 3.** The life of a building permit, if the building permit is issued while the vested rights are alive under #2 above.

Each of these periods of time is described in greater detail next.

1. The Life Given the Tentative Vesting Map

If the Vesting Map is treated as a "tentative map" (either as a tentative map or tentative parcel map), then the life of the vested right is the same as the life of the tentative map itself. Within that life, the tentative map must become a recordable map or both the map and the vested rights lapse (die), and the process starts all over again: a new tentative map application must be submitted, processed and approved. Keeping a tentative map alive is therefore a critical issue. The life can be broken into two categories: "Initial Life" and "Extension Life." The Initial Life is very short – 24 months, which can be extended by local ordinance for up to 12 months more (max of 36 months total). (Gov. Code § 66452.6(a)(1).)

Fortunately, under the Map Act, a subdivider can seek "extensions" to the Initial Life of a tentative map. We call this a tentative map's "Extension Life." These extensions are not mutually exclusive; a subdivider may secure multiple extensions of time under the various extension provisions. (Gov. Code § 66452.6(a)(1).) Extensions are available through the terms of a development agreement (which can extend the tentative map's life for the life of the development agreement), the existence of a "development moratorium" (for up to five years), litigation involving the approval of the map, discretionary extensions granted by the City for up to five years (an additional advantage to a Vesting Map over a regular (non-vesting) tentative map is that it is more difficult for a local agency to deny a discretionary extension; see Gov. Code § 66498.1.), "special" legislative extensions not applicable here, and, finally, through the use of multiple phased Final Maps.

The use of phased Final Maps is key to extending the life of the tentative map. Generally, a subdivider will secure a tentative Vesting Map covering all the property to be subdivided, and then will seek a single Final Map covering the entirety of the area contained in that tentative map. However, in certain circumstances, the Map Act not only allows the filing of a Final Map on only a portion of the area

Continued on next page

Q&A SMA Expert

encompassed by the tentative Vesting Map, but the filing of that Final Map also extends the life, and hence the vested rights, of the remaining portion of the Vesting Map still in tentative (not yet recorded) status. This process is generally referred to as filing "multiple" or "phased" Final Maps.

Each filing of a Final Map extends the life and vested rights of the remaining portion of the tentative Vesting Map by 36 months. However, these extensions may not extend the vested rights and life of the tentative Vesting Map more than 10 years total (including the Map's Initial Life). Of course, this extension approach may be done in tandem with other extensions.

2. The Life of the Vested Rights Once the Vesting Map is Recorded.

The life of the vested rights for the property included in the Final Map itself is very short: a minimum of one year, a maximum of two years, decided by local ordinance, with a single 1-year extension available. (Gov. Code § 66498.5.) Within that time frame, (unless extended as described below) a subdivider must secure all permits the development within that Final Map area will need, or the vested right will lapse and that development will be subject to the new laws then in place.

Practitioners should note that the vested rights of a Vesting Parcel Map normally have a life equal to the life of a Vesting Final Map – 1 to 2 years, with a 1-year extension. However, under Map Act section 66428(c), when a Parcel Map is otherwise required under the Map Act (for example, 4 or fewer parcels are being created), the subdivider can nonetheless apply instead for a tentative map, thereby maximizing the time of the map's vested rights (under #1 above). This is a very effective, but little known, strategy where the subdivider is creating four or fewer parcels but wants to maximize the map's vested rights.

3. The Life of a Building Permit

Finally, if a building permit for the project is granted before the expiration of the life given the vested rights once the map is recorded (e.g., Final Maps under #2 above), the life of those vested rights under the Final Map are retained and automatically extended for the life of the building permit itself (and any extensions of the building permit). (Gov. Code § 66452.6(h).) ❖

About the Author

Michael Patrick Durkee, a partner in the Walnut Creek office of Allen Matkins, represents developers, public agencies and interest groups in all aspects of land use law. Mike is the principal author of *Map Act Navigator* (1997-2008), and co-author of *Ballot Box Navigator* (Solano Press 2003), and *Land-Use Initiatives and Referenda in California* (Solano Press 1990, 1991). 415.273.7455 mdurkee@allenmatkins.com

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New Sensors, Deliverables and Strategies for Aerial Mapping Projects

and completeness (or nature) of breaklines add additional dimensions to these end product specifications. Also, because of the high density of LiDAR point data, contours may appear noisy, and the end-user may ask that the data provider modify the contour generation process to smooth them out for easier interpretation.

Conclusion

New technologies offer opportunities to optimize the use of remotely-sensed data and minimize the overhead for survey fieldwork, which is focused on base-station support and conventional ground control and checkpoint surveys. These technologies have been shown to facilitate the mapping of areas at higher resolutions and accuracies than were previously possible, and with added redundancies that can lower risks. Use and integration of these technologies with one another, and with conventional photogrammetry should be done by experts who understand how to work with and use the data in appropriate ways. HJW GeoSpatial has the advantage of a 57-year history of understanding the requirements and expectations of the surveying and engineering communities, as well as agencies mostly interested in high-resolution orthoimagery. The professionals delivering large-scale highly-accurate mapping products for many years are the same people putting

the new technologies to the test and taking advantage of their benefits.

***Devin Kelley** is a project manager at HJW GeoSpatial, a full-service aerial mapping company headquartered in Oakland, CA. Devin has played a major role in incorporating the new technologies of LiDAR and digital photography into the company's service offerings. HJW has recently purchased the newest digital aerial mapping camera, the Microsoft/Vexcel Ultracam X, which is sure to redefine the expectations of end-users and mapping professionals. Devin is an ASPRS-Certified Photogrammetrist, with a background in aerial triangulation, and he holds a M.S. in Photogrammetry, and a B.S. in GIS, both from The Ohio State University.*

***Thomas Loecherbach** is HJW GeoSpatial's Chief Photogrammetrist, an ASPRS-Certified Photogrammetrist, and holds a Ph.D. in Photogrammetry from the University of Bonn, Germany, as well as a M.S. in Geodesy, from the same University. He has worked in the field of photogrammetry for the past 22 years, starting as a graduate student and later as an assistant researcher and teacher at the Institute for Photogrammetry in Bonn. Thomas has been with HJW for 12 years. ❖*

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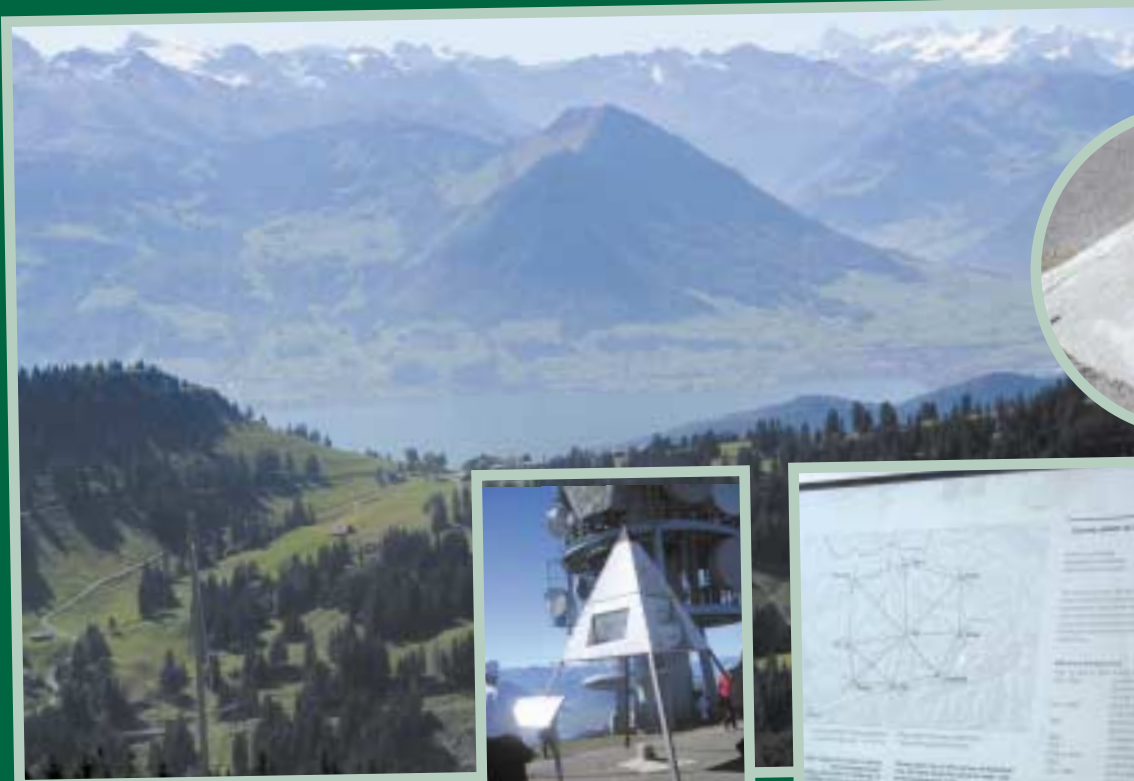
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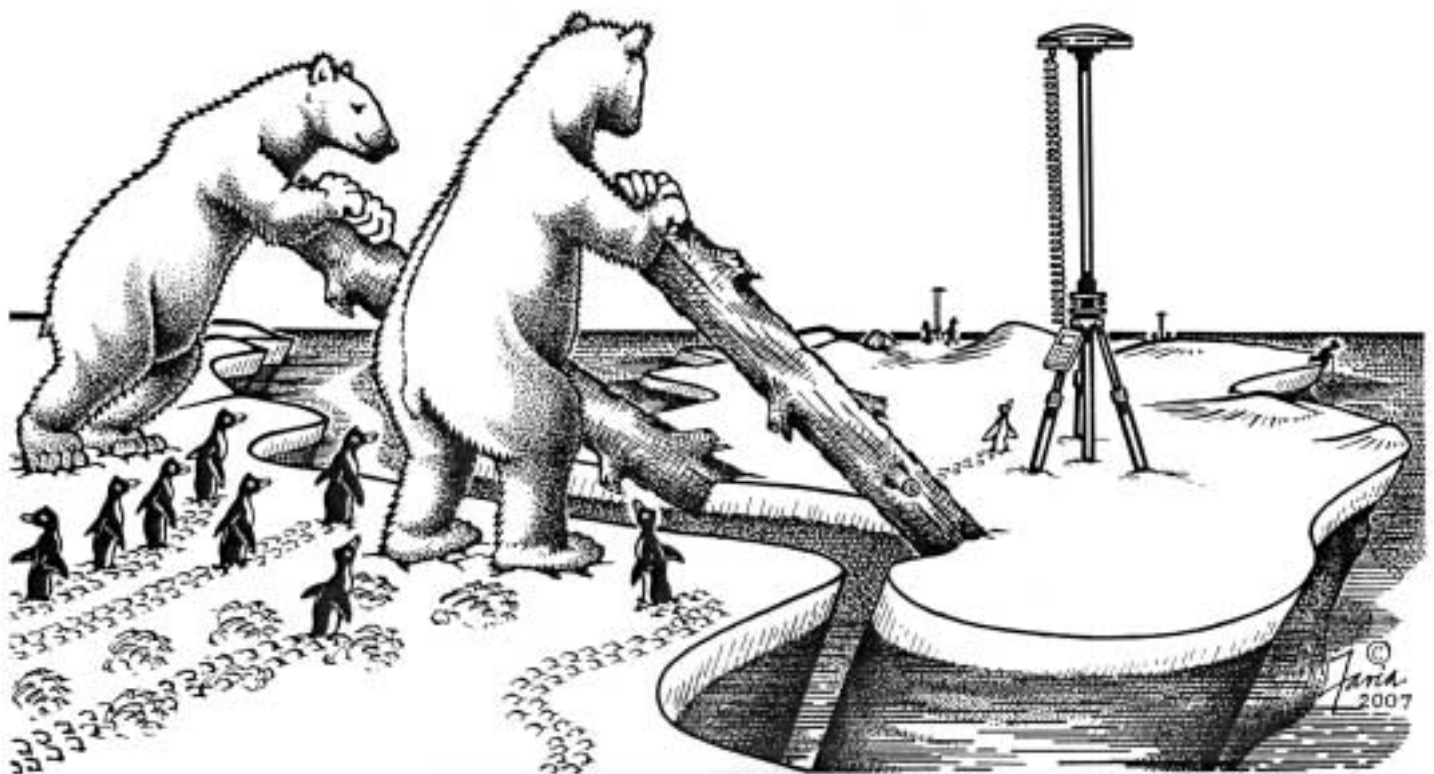
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Postcards



Submitted by Phil Danskin, PLS

These photos were taken by Pat Whitfield while on vacation in Switzerland.



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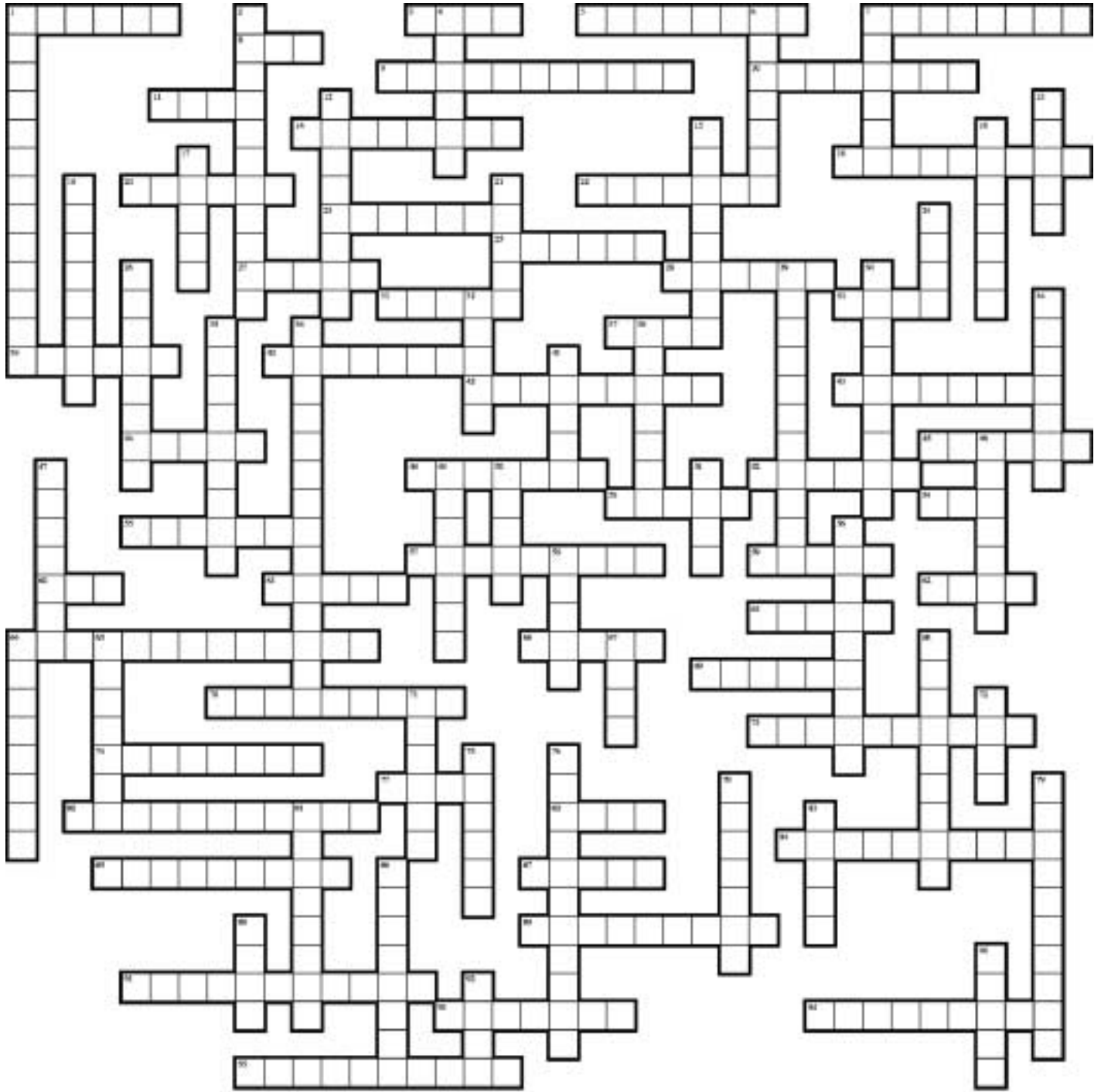




Crossword Puzzle

By: Ian Wilson, PLS

CLSA Crossword Puzzle #6



Ian Wilson, PLS is the president of Ian Wilson Land Surveying, Inc., in Temecula, CA. His practice specializes exclusively in boundary and topo surveys. He has worked in both private and public sectors for small firms in California and Caltrans, respectively. As well as being a licensed land surveyor, he and his wife, Laura, are newly certified SCUBA divers. They are looking forward to "getting wet" on future trips along coastal California and around the world.

Across

1. GAP
3. PERCH
5. EXEMPTION FROM EXISTING ZONING LAWS
7. EXACT VALUE
8. HOW MANY MICE WERE HIDDEN IN NINO'S CARTOON IN THE LAST ISSUE OF CAL SURVEYOR (PAGE 42)
9. NON-USE OF PUBLIC ROADS; TYPE OF ISSUE
10. NEARNESS TO TRUTH
11. UT1 TIME
14. DELIBERATE TRANSMISSION OF FAKE GPS SIGNALS
18. ADMISSIBLE EVIDENCE
20. SPANISH GRANT UNDER 1,000 ACRES
22. MISTAKE
23. ASTRONOMIC CORRECTION
25. DEFINITE BOUNDARY MARKERS
27. OBSERVED VALUE MINUS COMPUTED VALUE
28. INTERSECTION OF PLUMB LINE AND CELESTIAL SPHERE; FROM THE ARABIC "SAMAT"
31. RADIO DETECTION AND RANGING
33. 1/4 ACRE
37. A REFERENCE IN A DESCRIPTION
39. GRADUATED ROD
40. HYDROSTATIC WELL HEAD; BEER ELF
42. THE RIGHT TO EXCLUDE OR PREVENT OTHERS FROM USING OR ENTERING PROPERTY
43. NORTH-SOUTH LINE
44. OPPOSITE; FROM ARABIC
45. MATHEMATICAL INTERSECTION
48. PERSONAL PROPERTY
52. SHORT RANGE RADIO NAVIGATION
53. FOUR POLES
54. PERCH
55. A COLLECTION OF POINTS OF THE SAME ELEVATION
57. NEARNESS TO EACH OTHER
59. THIRTY NINE POINT THREE SEVEN INCHES
60. SURVEY CONNECTION
61. TIER OF TOWNSHIPS
62. DIAGRAM TO SCALE
63. HALF A HIDE OR 60 ACRES
64. LOCATION BY DIRECTION FOR A BASE LINE
66. POSSESS ONLY MAGNITUDE
69. SIX FEET
70. PIPE EXTENDING ABOVE HYDRAULIC GRADE
73. MEASURES ONE'S INCLINATIONS
74. OUTSIDE
77. 160 SQUARE RODS
80. FANCY MAP MAKING
82. ONE STEP
84. OLD FASHIONED SET UP ON LINE (TWO WORDS)
85. DISCLOSURE OF PERTINENT FACTS
87. LONG RANGE RADIO NAVIGATION
89. OUT-OF-COURT TESTIMONY MADE UNDER OATH
91. WHERE WAS THE W.M.D. HIDDEN IN NINO'S CARTOON IN THE LAST ISSUE OF CAL SURVEYOR (PAGE 42)
93. NAME APPLIED TO A NATURAL OR CULTURAL FEATURE
94. GRADUAL ACQUISITION OF LAND DUE TO RECEDED WATERS
95. CENTER OF MASS OF A SYSTEM OF MASSES

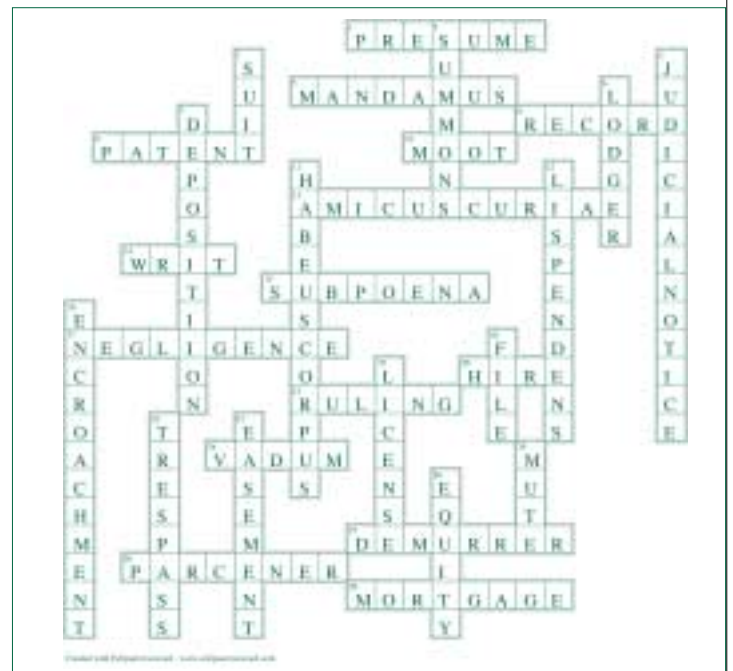
Down

1. THAT WHICH CAN BE INHERITED
2. GROUND-BASED TRANSMITTERS THAT MIMIC A GPS SATELLITE
4. BROWN TRACING ON SPECIAL PAPER
6. ALTITUDE RATIO
7. TWO STEPS BUT NOT TOO STEP
12. FURTHEST POINT FROM THE SUN
13. TYPE OF COMPASS STAFF
15. STELLAR!
16. PEPENDICULAR TO RADIAL
17. SHORE

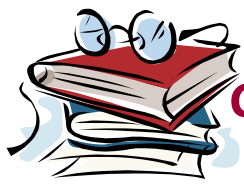
19. TYPE OF TITLE TO REAL PROPERTY THAT IS FREE OF ENCUMBRANCES AND OBLIGATIONS
21. UNIT OF MAGNETIC FLUX
24. MODULATION RATE
26. EVIDENCE BACKED BY DOCUMENTS
29. WHERE THE CLOUDS ROAM
30. WATER BARRIER FOR CONSTRUCTION
32. TYPE OF LEVEL
34. AUXILLIARY SCALE USED TO AMPLIFY ACCURACY
35. RENDER PARALLE
36. POSITIONAL CONVERSION PROCESS
38. ARC OF HORIZON; FROM ARABIC AL SUMUT "THE WAY"
41. MARK ON A TREE
46. 57°17'44.8"
47. ADJOINER; NOT AMARGARINE
49. EVIDENCE NOT BASED ON PERSONAL KNOWLEDGE
50. PARCEL OF LAND
51. WATER BORNE SEDIMENT
56. FIRST HAND AUTHENTICATION OF A FACT
58. LAND NEXT TO A STREAM ON A MAP
64. 36 SQUARE MILES
65. SUN DECLINATION DIAGRAM
67. 1/25 OF A ROD
68. TABLE OF LOCATIONS OF SPACE OBJECTS
71. ALLUVIAL DEPOSIT
72. FROM THE ARABIC WORD, SIFR, MEANING NOTHING
75. MAGNITUDE AND DIRECTION
76. MAN MADE STRUCTURE
78. 1/36 OF A TOWNSHIP
79. TYPE OF EXPERT WHOSE WORK IS NOT USUALLY DISCOVERABLE
81. DISPLACEMENT DUE TO SEPARATION BY DISTANCE
83. LASER RANGING
86. SOMETHING THAT FURNISHES PROOF
88. CONVEYANCE DOCUMENT
90. ROCK MOUND
92. TREE TRUNK

Key to CLSA puzzle #5

(Surveyor Issue # 152)



If you have an idea for a puzzle theme or a clue you would like to include in an upcoming puzzle, email to crossword@californiasurveyors.org



The FABRIC of AMERICA

by Andro Linklater

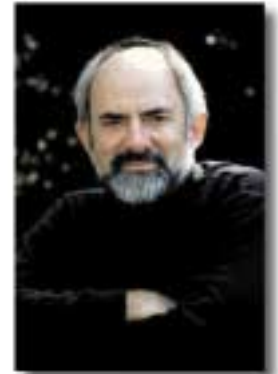
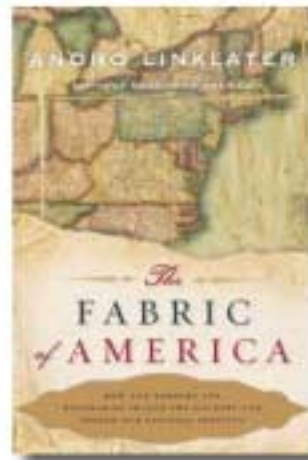
This is Linklater's second book dealing with the historical aspects of surveying. It's a subject that he clearly knows well and just as clearly feels a passion for. The central theme of the book is described in the subtitle – "How our borders and boundaries shaped the country and forged our national identity".

The book takes as its focus the life and works of Andrew Ellicott, an early American surveyor of outstanding repute. Ellicott as we see, developed highly accurate astronomic surveying methods and ran state boundaries in New York, Pennsylvania, Maryland, Virginia, the Carolinas and Mississippi. He extended the line started by Mason and Dixon, established part of the line between the U.S. and Canada, and surveyed the new nation's southern boundary with Spain when Spain still held the Floridas. In later life he taught mathematics and navigation theory at West Point and trained a generation of military topographic engineers that in turn, ran out more of our national and state boundaries.

The biographical aspects of Ellicott's life and his accomplishments alone make for great reading, but following Ellicott functions mostly as a jumping off point for numerous digressions into other aspects of our history. Every few pages contains a 'gee-I didn't know that' or 'gosh – I never thought about it that way' moment. I had to reread a couple sections because I so thoroughly enjoyed the particular passages that I wanted to absorb every word.

The chapter dealing with Ellicott's survey of our boundary with Spain delves into the political intrigues of the day, describing how one of our highest ranking generals, James Wilkinson, was secretly on the Spanish payroll. Wilkinson was essentially a double agent, paid by the Spanish to keep the U.S. troops at a distance and not to enforce the recently signed Treaty of San Lorenzo, which established the boundary in question. Ellicott discovered conclusive evidence of this treachery during his time in Mississippi yet continued his survey. I had never read about this previously and was fascinated by the self-interest of Wilkinson and later in the book by Jefferson's role in protecting him.

I was really taken in by the description of Ellicott's role in laying out the nation's capitol and all the intrigues and scams being run by various speculators while he was trying to complete his task. That these speculators were chosen and encouraged by none other than Thomas Jefferson and President Washington was something that my bonehead history courses never explored. And, credit is often given to Pierre L'Enfant for con-



Andro Linklater, Author

ceiving the layout of Washington DC but the fact is, he never really had much more than a crude sketch, devoid of dimensions, and it was from this that Ellicott had to layout his city. And lay it out he did indeed.

But I digress - much as the author does throughout the book. Upon reflection I'd say that Linklater's digressions are really like running random lines out but each time he comes back on the true line to the central theme of the book - that our identity and our freedom comes from our unique (in history) ability to own our own land and that in turn came from measuring, demarcating, and parceling the land as our frontiers crept ever outward. And along with that development of our individual identity, the author points out again and again that as our frontiers expanded and our surveys demarcated more lands, so too did the powers of the federal government expand leading it toward its present identity.

Linklater spends a lot of time discussing the dichotomy of the free states and the slave states and notes the perhaps obvious but nevertheless underemphasized physical boundaries that separated them. The Mason Dixon line and after the Missouri Compromise, the 36°30' parallel were boundaries that separated more than just states. When discussing the cursed parallel, Linklater quotes an aging Thomas Jefferson who said, "A geographical line, coinciding with a marked principle, moral and political, once conceived and held up to the angry passions of men, will never be obliterated; and every new irritation will mark it deeper and deeper." The author visits the bizarre contradictions of slavery in the genera-

Continued on next page

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Continued from previous page

tion before the civil war, during the civil war and after the war during the reconstruction years and continually contrasts the fact that land ownership and title gave us our identity with the fact that so few could step up and claim that identity. That is until the big boundary running down the middle of our country was diminished in importance through the struggle of war.

This is a well written and very interesting book that comes at our history from a new angle, at least to me. Any surveyor would enjoy reading *The Fabric of America* because it serves to emphasize how important our work was and by extension how important it still is in the development of this nation. I would also recommend this book for any non-surveyor who just has an interest in some of what lies just beyond the pages of *History 101*.

Carl C.de Baca, PLS, is the owner of Alidade, Inc., Elko, NV, and is a past editor of the *California Surveyor*.

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The *California Surveyor* is a quarterly magazine written and edited specifically for land surveying professionals. Quarterly, it provides in-depth articles on issues affecting the profession as well as current events, and general interest articles. Our readers are members and non-members of CLSA. They are Land Surveyors in private practice and public employees, Land-Surveyors-in-Training, employees of title companies and other related industry professionals.

FINDING THE MINDSET

Personal experience is probably your best source of article ideas. As a Land Surveyor, you have encountered problems, made mistakes and found solutions that can be shared with your colleagues. Have you worked on a unique project you would like to share with the profession? Do you have a fresh approach to an old problem or a cost-effective solution to a new one? Examine back issues of *The California Surveyor* to get a feel for the kinds of articles that are published and the way they are written. Visit the California Surveyor page on the CLSA website at www.californiasurveyors.org/files/calsurv.html. Before you write the article, feel free to write or call the editor to discuss your ideas.

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All articles submitted will be reviewed by the editor. We may accept your article outright, accept it for a staff rewrite, or accept it contingent on your revision. Your writing style is your own, and we make every attempt to preserve it as we prepare your article for publication. But we will try to make the copy as substantive and clear as possible. If your article is substantially revised, we will email you the edited version, and you will have approximately one week to review it and make any additional changes.

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Generally, articles should be between 500 and 4,800 words. Articles must be submitted digitally. Pictures must be sent as individual files at least 300 dpi. Please include a head-and-shoulders photo and a brief bio of author. **Articles cannot promote a product, service, or company.**

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TOPIC IDEAS

Project Narratives

Personal accounts of interesting land surveying/geomatics projects including the people, equipment and field procedures involved, together with tips for success that may benefit other surveyors.

CLSA

Reports from committees and local chapters regarding Trigstar and the Boy Scout Merit Badge, joint activities with ACSM and NSPS, and service work (such as baselines and PLS examination review classes).

Education

Reports from land surveying/geomatics curriculums in California including school location, program administrator, classes and degrees offered, status of enrollment, and job placement of graduates.

Boundary Resolution and Mapping

Research opportunities available at public agencies, certifications and ALTA surveys, gaps and overlaps, easements, using survey narratives and notes on record maps, and applying PLSS methods.

GPS and Geodetic Surveying

Using emerging technologies, fundamentals of datums for practical applications, defining geoids and ellipsoids, finding geodetic data on the web, interpreting published data sheets, and project planning.

GIS

The surveyor's roles and responsibilities regarding GIS, the acquisition, use and dissemination of geographic information, and opportunities for networking with the GIS community.

Photogrammetry and Remote Sensing

Principles, practical applications and limitations, descriptions of equipment and procedures, evaluating data quality, finding sources for existing coverage, and graphic examples of mapping products.

Business Management

Strategies for diversifying a private practice, identifying nontraditional opportunities, suggestions for crafting contract language that satisfies clients, minimizes surprises, and limits liability.

Article Submission Deadlines:

February 1st • May 1st
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The goal of the California Land Surveyors Association is to promote and enhance the profession of surveying, to promote the common good and welfare of its members, to promote and maintain the highest possible standards of professional ethics and practice, and to elevate the public's understanding of our profession. CLSA represents all Land Surveyors, whether they are employees or proprietors, whether in the public or private sector.

Representation

LOCAL: Your local chapter represents you in local issues. Through your chapter representative to the State Board of Directors, the individual member can direct the course CLSA will take. **STATE:** The Surveyor is represented at the state level through an active legislative program, legislative advocate, and liaison with the State Board of Registration. **REGIONAL:** CLSA is an active member of the Western Federation of Professional Surveyors. This Federation is composed of associations throughout the western United States and addresses regional issues. **NATIONAL:** Through institutional affiliation with the National Society of Professional Surveyors and the American Congress on Surveying and Mapping, CLSA is represented at the national level.

Educational Opportunities

CLSA presents annual conferences which provide technical and business programs, as well as exhibits of the latest in surveying and computing technology. Seminars and workshops are presented to assist in continuing education. CLSA publishes the California Surveyor magazine and the CLSA NEWS to keep the membership abreast of changing legislation, legal opinions, and other items which affect our profession.

Business and Professional Services

CLSA provides a fully staffed central office which is available to answer questions or to provide up-to-date referrals concerning legislation, educational opportunities, job opportunities, or other issues concerning our membership. Professional liability insurance programs are available to members.

JOIN CLSA TODAY!

- **CORPORATE MEMBER** *\$159.00 + Entrance Fee. Shall have a valid CA Professional Land Surveyor or Photogrammetric license.
- **CE CORPORATE MEMBER** *\$159.00 + Entrance Fee. Any California registered Civil Engineer who is authorized to practice land surveying pursuant to Article 3, Section 8731 of the PLS Act and must be actively practicing land surveying and show sufficient proof thereof. CE Corporate membership must be approved by the Board of Directors.
- **AFFILIATE MEMBER** *\$79.50 + Entrance Fee. Any person who, in their profession or vocation, relies upon the fundamentals of land surveying.
- **ASSOCIATE MEMBER GRADE** *\$79.50 + Entrance Fee. Any person who holds a valid certificate as a Land Surveyor-in-Training.
- **OUT-OF-STATE CORPORATE MEMBER GRADE** *\$79.50 + Entrance Fee. Any person who resides in a state other than CA, who is a member of the other state's Association, and meets the requirements of Corporate Member.
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