U.S. Department of Transportation
Federal Highway Administration

ROAD BUSINESS

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Vol. 2 No. 1 Winter 1987

Above: From left to right are two of Madbury's selectmen, Jay Moriarity and Dick Houghton.

On the Road in New Hampshire

Madbury avoids being subject to substandard subdivisions

On Friday, January 9th of this year, Diane Hodgeson of the Madbury Town Hall made a call to the Technology Transfer Center. "We're looking for a second opinion on a road proposed for a new subdivision" she said. "Mostly, we want a quick evaluation of the design and to make sure that we're going to collect the right bond for the road."

Early the following week Diane and Selectman Dick Houghton brought the road plans to the T2 Center. Charlie Goodspeed, civil engineering professor at UNH and member of the T2 team, provided Madbury with a quick evaluation of a typical cross section of the road and a calculated cost per linear foot based on their road specifications. "This information will help us make a good decision at the up coming planning meeting", Dick said.

Dick Houghton's enthusiasm, positive attitude and sensible approach made us want to travel to Madbury and find out some of the things they were doing.

When I arrived at the Town Hall, Dick introduced me to Jay Moriarity, selectman and Madbury's resident road expert. I had a quick tour of the Town Hall, which Jay and Dick helped to design. "Just another example of Madbury's good sense", I thought. It was superbly laid out!

We started to talk about roads and planning boards. "One thing about a planning board," Dick said, "you can't go on the board for one year and expect to comprehend everything that's going on. Usually economics is the sole determining factor in a decision." What Dick was talking about was long term effects; as he puts it, "I want to make darn sure that a new development doesn't come back to haunt the town five to ten years down the road."

One of the ways Madbury stays on top of the booming developments that so many New Hampshire towns are experiencing is to assign a specific board member to each operation. Dick explains, "The assigned board member uses a check list to track the construction developments and to ensure that the town's interests are protected. By having one board member be the sole contact for a single subdivider or developer, there is a greater chance for avoiding any misunderstandings."

continued on p. 6

Timber Bridges

Timber offers real advantages to towns facing bridge replacements with limited funds

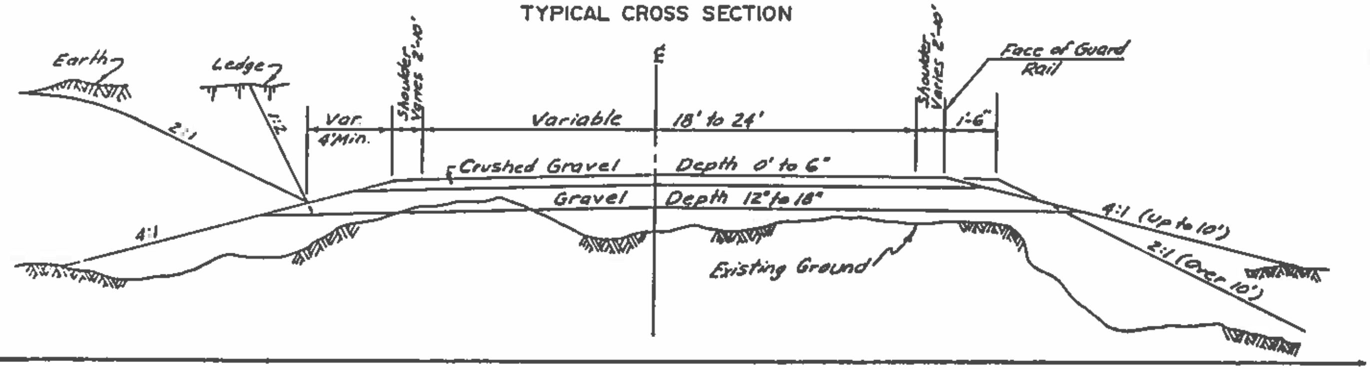
New Hampshire's efforts to upgrade its bridge stock could benefit from the use of modern, pressure-treated timber. While timber was once the most common bridge material, it has been largely replaced (at least in the minds of many bridge engineers) by concrete and steel. Timber, however, increasingly offers real advantages to towns facing bridge replacements with limited funds.

Timber offers many more advantages than its aesthetic qualities and renewable nature.

continued on p. 3

— ALSO IN THIS ISSUE —

TYPICAL CROSS SECTION



The above diagram shows a typical cross section of road based on minimum geometric and structural guides for local streets. (reprinted with permission from the New Hampshire Department of Transportation).

Road Design Standards

Suggested minimum design standards for rural subdivision streets

Below are suggested minimum design standards to be followed in the absence of local subdivision controls. Every effort should be made to exceed these minimums whenever possible. The circumstance of topography and other physical factors may require an occasional exception to these standards; however, the selectmen should exercise reasonable judgment before granting such variations.

For a visual summary of the below minimum design standards the reader is referred to the above diagram of a typical cross section of road and the chart of minimum geometric and structural guides for local roads and streets on the bottom of this page.

1. General Street Plan: Approval of the general development street plan should be required before allowing construction of small integral phases of the plan.
2. Street Layout: Streets shall be laid out so as to intersect at right angles as nearly as possible and no street shall intersect another at less than 60 degrees. Streets shall be continuous and in alignment with existing streets as far as possible.
3. Dead-end Streets: Dead-end streets, designed to be so permanently, shall be longer than 1000 feet and shall be provided with a turn a round having an outside roadway diameter of at least 110 feet.
4. Street Names: All streets shall be named without duplication with other streets in town.
5. Right-of-Way: The minimum width of right-of-way shall be 50 feet. A greater width may be required for arterial and collector streets.
6. Highway Right-of-Way Bounds: Highway bounds, of a type approved by the Board of Selectmen, shall be installed at all intersections of streets, at all points of change in direction and at any other points the Board may deem necessary to designate the street lines.
7. Alignment: No streets shall be constructed with a curvature of less than a 230 foot radius.
8. Grades: Street grades, where feasible, shall not exceed 10 percent, nor shall any be less than 0.50 percent. Special care shall be taken to provide flat grades at all intersections.
9. Construction Supervision: Construction of the roadway drainage facilities must be done under the supervision of and with the approval of the Board of Selectmen.
10. Clearing: The entire area of each street shall be cleared of all stumps, brush, roots, boulders and like material, and all trees not intended for preservation.
11. Subgrade Preparation: All loam and other yielding material shall be removed from the roadway and replaced with suitable fill material. All boulders and ledge shall be removed to a uniform cross sectional depth of not less than 12 inches below the subgrade and replaced with gravel.
12. Drainage: Surface water shall be disposed of by means of culverts of sufficient capacity at water courses as determined by standard hydraulic design methods and by construction of a longitudinal storm drainage system whenever required to relieve water in the ditch sections. Construction to be in accordance with New Hampshire Standard Specifications, 1983, Section 603 and 604.
13. Gravel base: All streets shall be constructed with a minimum of 12 inches of gravel per New Hampshire Standard Specifications, 1983, Section 304.

continued on p. 3

The table below relates minimal structural guides for local roads and streets relative to average daily traffic (reprinted with permission from the New Hampshire Department of Transportation).

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION
MINIMUM GEOMETRIC & STRUCTURAL GUIDES FOR LOCAL ROADS AND STREETS

Ave. Daily Traffic (Veh./Day)	0-50	50-200	200-750	750-1500	1500 & over
Pavement Width (Feet)	18 min.	20	20	22	24
Shoulder Width (Feet)	2	2	4	4	8-10
Center of Road to Ditch Line	15	16	18	19-21	Varies
Pavement Type	Gravel	Asph. Sur. Treated	Hot Bituminous	Hot Bituminous	Hot Bituminous
Slope of Roadway	½" per Foot	⅜" per Foot	¼" per Foot	¼" per Foot	¼" per Foot
Base Course Depth - (Gravel)	12"	12"	12"	12"	18"
(Cr. Gravel)	-	-	4"	6"	6"

NOTES
1. Gravel Surface should be Paved where Steep Grades occur.
2. For Average Daily Traffic over 1000 Veh./Day Paved Shoulders should be considered.
3. Base Course Depths may need to be increased in areas of Poor Soils.

Design Standards. . .
continued from p. 2

14. Asphalt Surface: The asphalt surface may be a Bituminous Surface Treatment, Specification Section 410, or Hot Bituminous Pavement, Section 403, as required by the Selectmen. The minimum width should be 20 feet for up to 300 vehicles per day, 22 feet for 300 to 600 vehicles per day and 24 feet for over 600 vehicles. A 44-foot wide pavement may be required in areas where on-street parking is expected. Angle parking shall not be allowed.

15. Gravel Surface: In unusual cases of low traffic volumes where the Selectmen feel an asphalt surface is not required, the total usable roadway width shall be a minimum of 28 feet so that the ultimate design may be a 20 foot asphalt surface with 4 foot gravel shoulders.

16. Gravel Shoulders: A four foot gravel shoulder, equal to the base course depth, shall be constructed adjacent to all 20-, 22- and 24-foot asphalt surfaces.

17. Bridges: On stream crossings with a span of 10 feet or more, the structure shall be designed to HS-20 loading (AASHTO Specifications). The minimum roadway width shall be 24 feet.

18. Sidewalks: Sidewalks of two inch thick asphalt, on a four-inch gravel base, not less than 4 feet in width and no closer than 22 feet to the street center line shall be constructed on one or both sides of the street when in the opinion of the Board such sidewalks are necessary.

19. Erosion Control: Erosion shall be controlled by placing mulch or matting on all surfaces disturbed by construction of the roadway and on all other surfaces where there is danger of eroded material being carried to the roadway area.

20. Utilities: Utility poles should be kept close to the right-of-way line, in no case closer than the ditch line and always well back of a curb. Water and sewer mains should be constructed outside the surface area and preferably outside the ditch line.

21. Safety: Safety is an important factor on all roadway improvements. On development roads it may not be possible or practical to obtain obstacle-free roadsides but every effort should be made to provide clear areas within the maintenance limits. The use of flatter slopes, the use of guard rail where necessary, and the use of warning signs are other safety factors to be considered.

22. Minimum Standards: The use of more liberal values than these minimum standards is recommended. For additional guidance and design of local development roads and streets with high volumes of traffic, reference should be made to the American Association of State Highway and Transportation Officials, "A Policy on Geometric Design of Highways and Streets," 1984.

The above minimum standards were developed by the New Hampshire Department of Transportation and provided by Robert W. Greer, Administrator, Bureau of Municipal Highways ■

"Ware" Am I?

Computer Hardware and Software
by Dr. Dot

The last computer article discussed the widespread availability of computers and how they have become a major part of our everyday experiences. It is now time for us to meet this beast face to face and learn how to tame it.

There are two commonly used terms associated with computers; hardware and software. Hardware refers to the parts of the computer that you can touch and feel. The keyboard, printer, monitor and disk drives are examples of hardware. Software refers to any program or logic instructions (usually written on magnetic disks) that control the operation of the hardware. Word processing, spreadsheet, and pavement management programs are examples of software.

There are many types and brands of computers on the market. The best way to find out what's right for you is to determine your software needs and then to match the hardware to the specs dictated by the software.

How do you identify your software needs? Computers are basically used to handle tasks that are repetitious and burdensome in nature. The idea is to find activities that you do routinely or jobs that are too time-consuming and computerize them.

There are many different software packages available for the highway professional. Programs have been designed to handle such highway related tasks as pavement management, equipment maintenance, parts inventory, bridge ratings, budgeting, truck routing, and sign inventories.

Once your needs have been identified it's time to search for available software. Association journals, computer publications, your peers, and the Technology Transfer Center are major sources of information.

In the next Road Business article we'll take a closer look at some of the computer software packages now on the market.

Do you have any specific questions about computers? We would be glad to assist you in finding out the answer. Just call us on our toll free number (1-800-423-0060) or write to the following address:

Technology Transfer Center
University of New Hampshire
Department of Civil Engineering
Transportation Research and
Computation Group
Durham, NH 03824 ■

Timber Bridges. . .
continued from p. 1
Timber bridges are not damaged by freeze-thaw cycles, and are impervious to the action of deicing agents. Timber absorbs energy well, and can withstand severe short term overloads. Lightweight timber is more readily installed with smaller equipment than are steel and concrete. Timber's light weight also means that existing abutments can often be reused, sometimes even with an allowable load increase because of the structure's lighter imposed loading. Initial maintenance and life cycle costs are often smaller with timber bridges than with steel and concrete spans.

Timber bridges do, of course, have certain shortcomings. Wood, an organic material, is subject to damage from fire, insects, fungus (rot), and accidental impact. However, modern pressure treatment with preservatives can prevent most of these problems indefinitely. Timber bridges often have deeper sections than would their steel or concrete counterparts. This can mean a decreased hydraulic opening. Finally, procuring the larger timber members is for many a new experience, and may involve delays and supplier searches.

A recent search of the Federal Highway Administration's National Bridge Inventory[1] revealed some interesting data on existing timber bridges. There are more than 65,000 timber bridges in the country, not including those spans shorter than 20 feet, the Forest Service's 8,000+ timber bridges, or the railroads' 1,500 miles of timber bridges and trestles. The great majority of these bridges are owned by local governments and are subject to fewer than 100 vehicles a day. Most are 40 feet long. Impressively, the majority of the timber bridges are not only open, but carry no load posting at all. Analysis of the age and estimated remaining service life is more than fifty years. This figure speaks particularly well of timber bridges durability when one considers that many of the inventoried timber spans predated modern pressure treatment procedures.

When people think of timber bridges, they often conjure up an image of a picturesque covered bridge. Actually, the vast majority of the nation's (and the state's) timber bridges are simple girder/deck spans. The girders can be solid-sawn or glulam timber, steel or even concrete. Most timber decks are laminated planks on edge, running transverse to the bridge axis and main members. The planks used to be simply spiked to each other (nail-laminated), but are now almost always laminated with glue (glulam) into panels. The glulam panels tend to develop better load sharing and reduced reflective cracking in the asphaltic overlays. New timber decks are readily available and can be installed by most town road crews.

continued on p. 4

Why Did It Happen To Me?

by Harvey Kuester

It is a human trait for anyone who has had an accident to ask, "Why did it happen to me?" There are probably two reasons an individual will ask such a question: (1) to feel sorry for himself and to get sympathy from others, or (2) to objectively analyze what happened and try to determine what could have been done differently to prevent the accident.

There is nothing wrong with either reason. We all need sympathy and reassurance, but when we stop at that point, there is a tendency to place the blame on another person or to charge it to fate. Objectively analyzing the factors which lead up to the accident is more rewarding in the long run because it can help us to avoid getting into another accident.

If the accident was vehicular, we might ask ourselves some of the following questions:

- Was the vehicle or equipment I was operating in good mechanical and physical condition?
- Was I practicing good defensive driving techniques?
- Did I react to the situation in the best possible manner?
- Was I wearing the safety belts which were provided?

On the other hand we might ask ourselves the following questions if it was a non-vehicular accident:

- Was I wearing the proper personal protective equipment?
- Was I using the right tools for the work I was doing?
- Was I wearing the proper attire for the work I was engaged in?
- Was I following the accepted safe standards for the work I was performing?

When we ask ourselves these questions, we are performing our own accident investigation.

While we can all benefit from accident investigation, all of us will agree that preventing an accident is the best approach. Job training, protective equipment, teamwork, a cooperative attitude, and open discussion of the safety aspects of our work at safety meetings are some of the accident prevention tools which are available.

Accident prevention then, is the key to avoiding accidents. If we keep this in mind during the course of our work and other daily activities, we can substantially reduce the need for both sympathy and accident analysis. We can instead say, "it doesn't have to happen to me." In addition, we can be proud of our ability to perform work safely and efficiently within our work environment.

The above article appeared in the Vermont Local Roads News, Issue 19, February 1987. ■

Timber Bridges. . .
continued from p. 3

A relatively new, and very simple, timber bridge layout is becoming increasingly popular. The so-called longitudinal deck bridge dispenses with the spanning girders, and supports the load solely with the deck itself. Clear spans of up to 48 feet have been achieved, even carrying heavy logging trucks. There are several ways to interconnect the separate spanning deck components. Four foot wide glulam panels can be held together by a simple transverse beam suspended under the deck. This joining member will get all the deck panels to resist the applied loads, not just those under the tires. Some companies simply supply large (8x14, for example) members and bolt them together on the site.

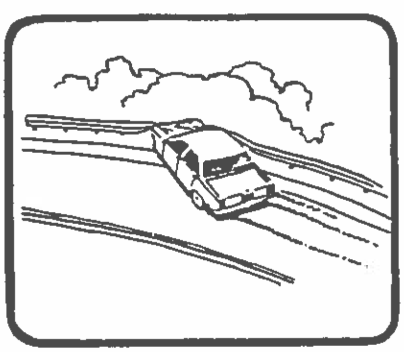
The Canadians are having much success with a "post-tensioned" timber deck system, wherein the deck planks are squeezed together with high strength steel through-rods[2]. This clamping force means that all the deck members deflect together, sharing and distributing the wheel point loadings. The post-tensioning rods have been used in retrofits on loosened nail-laminated decks, replacement decks in rehabilitation jobs, and in completely new bridge construction.

An increasing number of locally built bridges are using modern treated timber in the principal structural elements. If your steel and concrete bridges have not been enduring the rigors of the New Hampshire winters and de-icing agents as well as you might hope, a closer look at the timber alternative could be a money saver for you.

References

1. Brungraber, Gutkowski, Kindya, McWilliams, "Timber Bridges: Part of the Solution for Rural America," submitted to TRB Steering Committee for presentation at 4th Low Volume Road Conference.
2. Csagoly, Taylor, "A Structural Wood System for Highway Bridges," IABSE Proceedings p-35/80, November, 1980.

The preceeding article, by R.L. Brungraber, Assistant Professor at the University of Connecticut and Chairman of the ASCE Committee on Timber Bridges, was modified and reprinted with permission from Technology Transfer, Vol. 4, No. 4, Fall 1986. ■



Did You Know?

What is of interest to your peers and colleagues

In the Fall of '86 The Technology Transfer Center sent out an interest survey to Road Agents, Public Works Directors, Town Managers and Selectmen. We would like to thank you for your responses and share the results with you.

To start with, about 65% of New Hampshire's roads are paved. Certainly, some towns have more gravel roads than others so this number should only be thought of as a general overall figure.

50% of the estimated road condition ratings that we received fell in the fair to poor categories. 33% of the respondents estimated roads to be in good condition, 16% in very good condition and only 1% in excellent condition.

We also asked our survey respondents which areas of Public Works were of greatest interest. The following top 10 subjects were selected: (1) pavement maintenance, (2) construction of roads, (3) design of roads, (4) snow & ice control, (5) solid waste disposal, (6) materials & aggregates, (7) bridges, (8) equipment management, (9) administration and regulations; and (10) highway safety.

Four areas were found to be posing the most difficult problems for our towns: (1) maintenance—not including winter maintenance; (2) rapid expansion and increased traffic; (3) personnel; and (4) road design and construction. Three areas were singled out as areas reflecting success: (1) maintenance—not including winter maintenance; (2) personnel; and (3) finance.

It's good to know that our towns have been attacking some of the more difficult problems and arriving at working solutions. ■

The 7 Year Winter

From the editor

You may have noticed the date of our last newsletter. Instead of reading Fall 1980 it should have read Fall 1986. Of course, there are those who don't believe this was a typographical error. I've been told it was more like a prediction or a warning. "Certainly," they said, "we've had about seven years of snow!"

Thank you for the vote of confidence, but at least we could have spelled Canaan correctly.■

GENERAL COMMENTS:

CHANGE OR ADDITION OF TITLE AND/OR ADDRESS:

Please fill in *old* address:

Please fill in *new* address:

INFORMATION REQUEST *(Please use this space for any general questions or comments you may have. Remember to include your Telephone Number)*

PLEASE! PUT YOUR RETURN ADDRESS IN THE UPPER LEFT HAND CORNER OF THE REVERSE SIDE OF THIS PAGE. FOLD, STAPLE AND MAIL.

FROM: ______________________

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University of New Hampshire
Technology Transfer Center
Civil Engineering Department
Kingsbury Hall
Durham, NH 03824

DOTTED LINE

CUT ON

Fold on this line, staple and mail

REQUEST FOR PUBLICATIONS OR OTHER RESOURCE MATERIALS

Publications available from the T2C for free distribution or loan are listed in various issues of *ROAD BUSINESS*. Please indicate the titles you want, put your name and address in the upper left hand corner above, fold and mail.

!!FREE!!

Railroad—Highway Grade Crossing Handbook

This handbook provides general information, including the physical and operational devices recommended for use at crossings and procedures for analyzing the traffic hazards present at crossings. Also included are statistical data on the 200,000± crossings currently in active use. (FHWA)

!!FREE!!

A Basic Asphalt Emulsion Manual

This manual outlines the basic types of paving asphalts, the chemistry of asphalt emulsions, and their storage and handling. It goes into uses of asphalt emulsions including selection considerations, aggregate applications, aggregate mixes, and recycling. (FHWA)

!!FREE!!

Pavement Patching Guidelines

"How-to-do-it" recommendations are presented for constructing patches during cold weather (emergency basis), cold weather (routine basis), and warm weather (routine basis). (FHWA)

!!FREE!!

Improving Guardrail Installations on Local Roads and Streets

This pamphlet is intended as a general guide to effective, low cost methods of enhancing highway safety with guardrails. Technical information such as hardware standards, warrants for selecting guardrail, typical layouts, and cost-effective analysis can be found in the material listed in the reference index. The guidelines and recommendations included in this pamphlet reflect actual needs and opportunities for safety improvements on many local roads and streets. (FHWA)

!!FREE!!

Manual on Countermeasures for Sign Vandalism

This manual describes measures for reducing sign vandalism and the costs associated with the repair and replacement of vandalized signs. Guidelines are also presented for planning, implementing, and evaluating antivandalism programs. (FHWA)

!!FREE!!

Guide to Safety Features for Local Roads and Streets

This guide deals with construction and maintenance practices that will lead to increased safety on local roads and streets. The purpose of this guide is to provide local transportation agencies with important information related to highway safety features. This guide is intended for use on roads and streets in rural and small urban areas. The uses and functions for each of several safety features are discussed. Examples of both good and poor practices are given. (FHWA)

Available Publications

Unless otherwise stated, all FREE publications can be ordered through the New Hampshire Technology Transfer Center by sending in the attached order form or by calling us toll free at 800-423-0060.

!!SPECIAL!!

New Hampshire Roads & Highways Manual

This excellent New Hampshire Municipal Association (NHMA) publication is written for New Hampshire town officials responsible for road construction and maintenance. It is designed to acquaint officials with issues such as development, finance, liability, and regulation, which are so often associated with roads. "Road law" is important.

This is a reference for every town. Problems often start before a road exists and can endure long after it has been constructed. The manual begins by explaining the New Hampshire Highway classification system and goes on to cover such topics as the establishment of public highways, the reduction of municipal responsibility for a road, regulation and maintenance, highway aid, road development (with a special section on subdivisions), and ends with some good tips on developing a road policy.

NHMA has already distributed this manual to most of New Hampshire's municipalities. If your town has not received a copy, or if you would like to acquire additional copies, you can place an order with the New Hampshire Municipal Association by calling toll free 800-852-3358, or by writing to NHMA, PO Box 617, Concord, NH 03301. The cost is worthwhile investment at $20.00 for NHMA members and $35.00 for non-members (pre-payment for non-members is required).

!!FREE!!

Culvert Inspection Manual

Many small bridges under the bridge rehabilitation and replacement program are currently being replaced with multiple barrel culverts, box culverts, or long span culverts. This has not only increased the use of culverts but has led to larger installations. The failure of such a facility would be both costly and hazardous. (FHWA)

!!FREE!!

The Engineer's Pothole Repair Guide

Cold Regions Technical Digest, No 84-1, March 1984, Corps of Engineers, Cold Regions Research and Engineering Laboratory, details the proper procedures for repairing potholes. Intended for highway engineers, superintendents, and maintenance managers.

!!FREE!!

Comparison of three Compactors used in Pothole Repair

This Special Report 84-31, November 1984, Corps of Engineers, Cold Regions Research and Engineering Laboratory, is a summary of the results of a compaction study using recycled hot mix asphalt concrete in pothole repair. This report is for those who want to repair potholes with high quality materials without paying premium prices.

—APWA—

Paying for Transportation at the Local Level: 17 Strategies

Contains strategies and guidelines for raising local transportation funds. 1984, 28pp. Order from: APWA, 1313 East 60th Street, Chicago, IL 60637. Cost: $5.00.

—APWA—

How to Create Standard Specifications

This pamphlet outlines the steps required for local committees to establish specifications that both town and contractors can work with. Order from: APWA, 1313 East 60th Street, Chicago, IL 60637. Cost: $5.00.

On The Road. . .
continued from p. 1

Madbury has a good approach to new subdivisions and we asked them for a copy of their checklist.

Below is a reprint of the Madbury Planning Board residential subdivision checklist:

Subdivider ______________________

Location ______________________

1. Pre Application Review ____________
2. Site Inspection ____________
3. Board Comments to Subdivider (letter)

   ____
4. Application
   a) Agenda request for ______ meeting received ____________
   b) Applications received (3 copies)

      ____
   c) Fees
      1. Filing 1 @ ____ = ____
      2. Abutters ___ @ ____ = ____
      3. Lots ___ @ ____ = ____
      TOTAL = ____
   d) Abutters notices mailed ____
   e) Considered at meeting on ____
5. Preliminary Layout
   a) 3 Copies represented
   b) Identification
      1. Subdivision name ____
      2. Subdivider ____
      3. Designer ____
      4. Engineer ____
      5. Date ____
      6. North Direction ____
      7. Scale ____
      8. Location ____
      9. Abutters (of rec.) ____
      10. Easements ____
      11. Buildings ____
      12. Water/Leach field ____
      13. Topography/contours ____
      14. Minimum size ____
      15. Frontage ____
      16. Setback ____
      17. Soils ____
      18. Fill/dredge/excavate ____
      19. Test pits ____
      20. Percolation tests ____
      21. Driveway ____
      22. Boundary Monuments ____
6. Review with Subdivider
   a) Verbal ________
   b) Board Recommendations (letter) ________
7. State Approvals
   a) Leach field and septic system ________
   b) Water supply ________
   c) Driveway (entry onto state highway) ________
8. Public Hearings
   a) Town Notices ________
   b) Abutter/Subdivider Notices ________
   c) Newspaper notices ________
   d) Evaluation ________
9. Final Plat
   a) Submitted to Board ________
   b) Changes completed ________
   c) Mylar presented and complete ________
   d) 3 Copies of completed plan ________
10. Final Approval and Signature ________
11. Recording of Mylar ________ ■

Avoid A Bridge Catastrophy

A checklist is offered for assessing potential bridge liability
by Charlie Goodspeed

Are you a government official responsible for posting bridge load limits? Are you reluctant to install signs advising motorists of load restrictions for fear that acknowledging the deficiency, but not correcting it, makes you liable in case of an accident? Nothing could be further from the truth. The best defense is posting the limits and maintaining a prioritized list of corrections to be made as funding becomes available.

What makes a bridge structurally deficient or functionally obsolete? Structural deficiency results when the bridge deck, the superstructure, or the substructure has weakened or deteriorated to the point that the bridge is inadequate to support all types of traffic. Functionally obsolete bridges are those that are structurally sound but are no longer adequate to serve today's traffic. These are the bridges that are too narrow, poorly aligned with the roadway, or have insufficient load-carrying capacity.

Is it unreasonable to expect someone who is not an engineer to assess the potential liability of a bridge? No! There are many signs that can be observed before a catastrophic disaster occurs.

Structural Deficiency: Can the bridge support all possible types of traffic? We can assume the bridge was properly designed for today's traffic unless it is more than 50 years old. To determine the existence and extent of deterioration of any of the three main components — deck, superstructure and substructure — check the following:

Deck: A bridge deck supports the wearing surface and typically made of concrete, wood or steel grating.

Material	Signs of Deterioration
Concrete	Cracks, loose or deteriorated concrete to a depth where the steel reinforcing is visible.
Wood	Splits, checks and rot to the extent that one can push a sharp pocket knife blade into the deteriorated wood to a depth 1/4 of the member depth.
Grating	Rusted sections or bent sections to the extent that the remaining material looks smaller than the original.

Superstructure: The bridge superstructure is the portion of the bridge that spans between the supports. The superstructure beams support the bridge deck.

Material	Signs of Deterioration
Concrete	Concrete cracking or spauling to the extent that the reinforcing is visible. Rust stains that originate in the beam. Beam deflections that are visible to the eye.
Steel	Rusted members where the corrosion visible reduces the steel thickness. Rusted rivets, bolts and welds to the extent that corroded material is separating from the item.

Substructure: The portion of the bridge supporting the superstructure. Sections of the substructure are underground; however, the visible portion supporting the beams can be inspected from underneath the bridge.

Material	Signs of Deterioration
Concrete	Most bridges have concrete substructures. Concrete cracking and spauling should be checked for corrosion and alignment. All abutment components should be checked for vertical alignment and settlement.

Functionally Obsolete: Bridges typically become obsolete when the approach roads have been upgraded by either widening or realignment.

If any of the above signs of deterioration are observed, a qualified bridge engineer should be notified and a complete bridge evaluation done. A state inspector can be arranged for by making a written request to Mr. Robert Greer, Bureau of Municipal Highways, John O. Morton Building, Concord, New Hampshire. ■

The Ingenuity Of "Yankee" Highway Engineers

Portable temporary bridges used in NH

Numerous bridges in every state are reaching the end of their designed life at a faster rate than funds become available to provide satisfactory replacements. In New Hampshire, the use of portable, temporary bridges to provide an immediate emergency replacement has been put to advantage to help solve a small part of the problem.

In order to appreciate the magnitude of the task of maintaining bridges on a statewide system, one has only to look at the state's computerized bridge inventory. The following statistics will serve as an indication of the problem in New Hampshire.

- Under the federal aid system, the state is responsible for all bridges over 20 feet in length: 1,230 in New Hampshire.
- Of these 1,230 bridges, over 300 were constructed prior to 1935.
- Under the various state systems, there are over 2,400 bridges—those over 10 feet in length—for which the state has maintenance responsibility.
- Local municipalities are responsible for 1,329 bridges not included in any state system. When necessary state services can be engaged.
- There are 1,108 eligible bridges on New Hampshire's selection list for the Highway Bridge Replacement and Rehabilitation Program. Of these, 25 on the state highway system and 25 on the local system are in critical need of attention with a sufficiency rating of ten or less.

The term "Portable Temporary Bridges" is used in this article to mean both the famous "Bailey Bridge" of World War II and a more contemporary version called the "Acrow Panel" bridge. Let's take a look at the differences between these two and the uses to which they have been put.

The primary difference in use between these two designs is that Bailey bridges are for single lane use while Acrow panel bridges can accommodate two lanes.

The New Hampshire Department of Transportation first purchased Bailey bridge components from the U.S. War Assets Administration in 1946. Subsequent purchases were made in 1966, 1968, and 1979. Since the original purchase, 62 installations have been made using new or previously-used components.

Erection costs per installation for Bailey bridges vary from $2,000 to $10,000 on the average. Variables involved in the cost include condition of existing abutments, height of ramp needed, length of bridge, and staging area available. The most expensive installation was in Danbury and exceeded $30,000. The Bailey bridge was used for a temporary detour while deck components of the existing bridge were replaced. Abutment types vary from gabions, pile cut-offs, stone fill or even existing abutments when available.

The Acrow panel bridge was first used in 1973. It was used by a contractor as a temporary bridge and was rented and returned to the supplier. New Hampshire first purchased Acrow panel parts through a federal aid project in 1979 and has made several similar purchases since then. Usually, the purchase of Acrow parts for a particular project will involve a commitment by the state to use the bridge on a subsequent federal aid project prior to being salvaged and inventoried by the state. While Acrow panel bridges to date have been placed by contractors, state forces inventory, inspect and maintain the various components. Purchase costs are not available as all purchases have been handled by the contractor on federal aid or other construction contracts. This is also true of erection costs as all installations to date have been done by contractors. Erection and launching components are the same as those used for Bailey bridges and are available through the New Hampshire Department of Transportation.

For more information, or a copy of The Use of Portable Temporary Bridges in New Hampshire — A Special Maintenance Report, you can contact the Technology Transfer Center by mailing the attached order form or calling 1-800-423-0060.

The above article was edited and reprinted with permission from V.F. Schimmoller, Division Administrator, Federal Highway Administration, Region One, and includes excerpts from J.E. Gergler's maintenance report of September, 1986. ■

Tips For Reducing Tort Liability

A "tort" isn't something grandma used to make

Tort is a legal term, defined as any private or civil wrong by act or omission, not including breach of contract. While torts are not always crimes punishable by law, they can be crimes. In a time of increasing insurance premiums and lawsuits, local agencies need to know how to protect themselves from tort liability. Listed below are thirteen practical tips for reducing tort liability.

(1) Define duties, responsibilities and authority of your staff.

(2) Understand and perform duties satisfactorily.

(3) Use competent professionals to assist in decision making.

(4) Establish adequate records systems to provide facts about existing conditions. These systems should include traffic accident records and procedures for identifying high-accident locations, and inventory procedures which will provide reasonably current information about the physical features and conditions of existing transportation facilities and traffic control devices.

(5) Establish and maintain a system of regular inspection. These inspections should cover the physical conditions of facilities and traffic control devices. Check traffic signs and signals at least twice a year both day and night; check traffic markings as needed, particularly in winter and early spring; check temporary traffic control device(s) on a daily basis; and establish a chain of command for inspections so that defects can be reported and promptly corrected.

(6) Develop and maintain a procedure for handling complaints and reports. Designate one person to receive all such reports and to take appropriate action. Effective handling of complaints has legal and public relations benefits.

(7) Be sure all maintenance records are complete and current. Well kept records can provide information about the character of a repair including what the trouble was, repairs made, and materials used.

(8) Make sure the designs of facilities or traffic control devices are consistent with currently adopted policies, guidelines, standards, and manual specifications.

(9) Adopt standards of performance in the areas of design, construction, operations, and maintenance.

(10) Establish good procedures for deciding what improvements should be made and when this would include the cost effectiveness of alternatives.

(11) Review the design and operation of new facilities or traffic control changes. Inspect both active and completed projects.

(12) Impress all employees with the importance of reasonable care in doing their jobs.

(13) Foolishly cutting necessary expenditures in order to appear fiscally responsible to the taxpayer inevitably leads to careless and negligent work.

If you would like to receive more information about Tort Liability or Highway Safety, please contact the Technology Transfer Center at 1-800-423-0060.

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