I had wanted to write a paper for publication in *PCI Journal* on the development of the first prestressed double tee in the United States, but that will not happen. The alternate plan is that I wrote the following letter to the editor of the *Journal*: (It should appear in the Spring 2014 issue)

**Letter to the Editor of *PCI Journal***

January 19, 2014

Dear Rachel,

In May of 2010, I was honored to be the recipient of PCI’s most distinguished honor, the PCI Medal of Honor. In my remarks, I mentioned the achievements of previous recipients and credited Harry Edwards with the development of the first double tee in the United States. The full text of my speech is in the Fall 2010 issue of *PCI Journal*. I believe that I was influenced by Harry’s article that appeared in *Reflections on the Beginnings of Prestressed Concrete in America*, a special issue of *PCI Journal* to commemorate the 25th anniversary of PCI in 1979. That paper has a figure of a double tee with the caption “Dimensions of original double-tee.”

Sometime after that day, I was challenged on this and the purpose of this letter is to set the record straight.

I was wrong.

To confirm who actually did develop the first double tee, I reached out to people who I thought would know. These included, Norm Scott, PCI’s second Executive Secretary in Florida, Mac Taylor who hired Norm into the industry, Wally Prebis, former Executive Director of the Colorado Prestressed Concrete Association and Paul Zia who worked for Harry in the early 1950s.

The people who should be credited with this achievement are Jack and Leonard Perlmutter, owners of Prestressed Concrete of Colorado in Denver, Nat Sachter, the architect on the first building using double tees and George Hanson, a structural engineer in Denver.

Jack was so proud of this achievement that he had [image] inscribed on his tombstone.

The building was the Cold Storage Building for Beatrice Foods. That building is still in service today for a specialty steel supplier. The double tees are what we could call today a 6DT15; 6 feet wide and 15 inches deep. The span was about 24 feet.
This building was constructed in 1952. The first prestressed beds in Florida were used for flat slabs in 1953 and the first double tees in Florida were produced no earlier than 1953.

I confirmed all this in August last year when I met with Wally Prebis, Mike Altenberg and Leonard Perlmutter. Mike and Leonard were part of Prestressed Concrete of Colorado at that time.

With all that said, I must still give credit to Harry Edwards. While he did not literally develop the first double tee, he refined it and did a remarkable job promoting the industry during its early years. He also played a major role in the creation of the Prestressed Concrete Institute and served as its first Secretary-Treasurer.

If anyone reading this letter would like more information on my investigation, please email me at hwilden@roadrunner.com. Also, if anyone has information regarding the development and use of any other double tee, please send that to me as well. It may be used in a paper to be published in 2015 to commemorate the 60th anniversary of PCI Journal.

Thank you for this opportunity to set the record straight.

Helmuth Wilden, P.E., FPCI
Wilden Enterprises, Inc.
Hilton Head, SC

In preparation for people responding to my offer to provide more information, I prepared the following which is an edited version (many off topic remarks removed and added comments by me are noted in [ ] of a string of emails dating back to July 2010. I believe it will be self-explanatory. The conclusion mentioned in the letter to the editor will be somewhat obvious when you read this. Enjoy.

My June 2010 inquiry to several people went like this:

On May 30, 2010, I had the distinct honor of receiving PCI’s Medal of Honor. I gave a speech that morning at the breakfast during the fib/PCI symposium. In my speech, I cited the achievements of several previous Medal of Honor recipients including Harry Edwards. Here’s part of what I said: (The complete text is in the Fall 2010 issue of PCI Journal.)

Good morning!!

Thank you. I accept this award with a great deal of pride and even more humility.

Pride is self-evident.
Humility because my name is now alongside that of the 21 past recipients of this great honor that was first presented in 1972. The previous recipients have all done remarkable things for the benefit of our industry and I would like to cite a few:

**Harry Edwards** for playing a major role in the creation of PCI back in 1954 and serving as PCI’s first Secretary/Treasurer. **Do you know that he developed the first double-tee?** Where would we be without that?? And also for always seeing the importance of education. Was it he who said that the success of an industry is directly proportional to the energy devoted to its educational programs. That is as true today and tomorrow as it was in the early 50’.

I believe that my citing Harry Edwards with this achievement was influenced by Harry’s article that appeared in *Reflections on the Beginnings of Prestressed Concrete in America*, a special issue of *PCI Journal* to commemorate the 25th anniversary of PCI in 1979. That paper has the figure shown below.

![Fig 10. Dimensions of original double-tee.](image)

Well, it wasn’t too much later that I received some flak about citing Harry as the developer of the first prestressed double tee.

Then, for the past three plus years I have had an on again off again passion to get to the bottom of this. I consulted with several people who I thought might be able to set the record straight.

What I learned is noted in the following chronological order of a string of emails.
Helm to Wally Prebis, former Executive Director of the Colorado Prestressed Concrete Association: 6/13/10

Wally,
I am doing a little research into the history of the industry and discovered that there might be some dispute about who developed the double tee. Many believe it was Harry Edwards in Florida in the early 1950s. Then Irwin Speyer opened the door that it might have been someone in Colorado. I then read the article written by George Hanson that appeared in the 1979 special issue of the PCI Journal called Reflections on the Beginnings of Prestressed Concrete in America. On page 171 of that issue, it indicates that “Prestressed Concrete of Colorado developed and introduced the double-tee slab which it marketed under the copyright name Twin Tee.” It goes on to mention an architect named Nat Sachter.

What can you tell me about all this? Can you also let me know who of those early Colorado pioneers in the industry is still alive? The Permutters? Mike Altenberg? George Hanson? Nat Sachter? Anybody else you can add to the list?

This is not urgent so, please reply when you have time to do so.

Thank you,
Helm

From Wally Prebis: 6/14/10:

Helm,

HISTORY:

There is very little I can add to what you already know about the history of the double tee. And please be sure of this: Harry Edwards did not develop the double tee. Nat Sachter, working for Prestress Concrete of Colorado, did the engineering, and George Hanson picked up on the product while working for consulting structural engineering firm Orley Phillips. George went on to design several structures in Colorado and the double tee started to catch on. The first structure built was Beatrice Foods Cold Storage Warehouse, located on 48th and Washington in Denver. All of the above occurred in 1952, and the Permutters copyrighted a logo with TT on it shortly after. Other chief names involved were Roebling Wire and later CF&I (Colorado Fuel and Iron). In 1953 Harry Edwards visited Denver, specifically to sit down with George Hanson. The two got together with Roebling and Kent Preston, their Chief Engineer, who shared all that had been developed to date with Edwards. Harry then returned to Florida where he entered the Prestress industry making double tees. Again, Harry came about a year after all this had been developed in Colorado. Below is a page from CONCRETE PRODUCTS (not sure of which issue) that documents some of what we are talking about. Finally, I’m going to enclose two pictures of Jack Perlmutter’s grave. I think you will find these interesting. Hope all this helps!

Wally
REPRESENTATIVE INDUSTRY AND INSTITUTE HIGHLIGHTS

Oct 1, 2004 12:00 PM

1944 — First technical committee on prestressed concrete organized, ACI-ASCE Joint Committee 323

1949 — Concrete Products of America, Pottstown, Pa., installs first pretensioning bed for bridge beams

1950 — Walnut Lane Bridge completed in Philadelphia

1951 — First U.S. prestressed concrete conference at MIT

1952 — Prestressed Concrete of Colorado builds first pretensioning bed

— Perlmuter, Altenberg and Sachter develop and patent the Twin-Tee (double-tee)

1953 — Henry Nagy introduces Spancrete-branded hollowcore slabs

1954 — Institute charters in Tampa, Fla., chartered.

1956 — Development of AASHTO (later AASHTO) standard I-beams (Types I, II, III, IV)

1958 — PCI Standards for Prestressed Concrete Plants published

1959 — PCI moves from Boca Raton, Fla., to Chicago

1963 — ACI 318 Building Code recognizes prestressed
JACK PERLMUTTER
[1920 – 1997]

Working for more than 40 years in the precast/prestressed concrete industry, Jack helped develop one of the first designs for the double-tee and he led his family’s business efforts in creating the first prestressed concrete plant in Colorado and one of the first in the United States. He served on PCI’s Board of Directors for two years.
George Hanson

Picture of Nat Sachter was unavailable
Helm to Norm Scott 7/5/10:

Hello Norm,

I think you may be able to help me resolve a mystery.

During my speech when I received PCI’s Medal of Honor, I gave credit to Harry Edwards for creating the double-tee. Someone commented later that this was not correct so I did some research without a real conclusion. If indeed I was wrong, I want to correct my error even if it’s just to myself.

In Harry’s Reflections article (attached), [Part 3 of Reflections on the Beginnings of Prestressed Concrete in America] it indicates that he did develop the double-tee in the section about the Author. If he did this shortly after he started LEAP in 1950 as noted on the next page, then perhaps he did.

On the other hand, George Hanson’s Reflections article (attached) indicates that a Nat Sachter “conceived the idea…” in 1952.

Then I asked Wally Prebis and he replied rather strongly that Harry did not develop the double-tee. I have attached his response to my inquiry that I sent him in which he says “…..And please be sure of this: Harry Edwards did not develop the double tee. Nat Sachter, working for Prestress Concrete of Colorado, did the engineering, and George Hanson picked up on the product while working for consulting structural engineering firm Orley Phillips. George went on to design several structures in Colorado and the double tee started to catch on. The first structure built was Beatrice Foods Cold Storage Warehouse, located on 48th and Washington in Denver. All of the above occurred in 1952, and the Perlmutters copywrited a logo with TT on it….”

I have the feeling that Harry may have visited the Perlmutters in Colorado and taken the idea back to Florida where he made it more commercialized.

Now I know that you were not involved in the industry as early as 1950, but since you were with PCI in the late 50’s, I thought you might recall stuff from the beginnings.

Can you shed any light on this?

Thank you,
Helm

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Norm Scott to Helm 7/6/10:

Helm,

I think the tees being developed in Colorado is probably only true as a prestressed member. I believe there were reinforced double tees around in several places in the U.S. before 1952 but I cannot document them. I know we competed with a reinforced double tee made in a little precast plant in West Palm Beach in 1956 when I first went with R. H. Wright and worked as a sales engineer for Mac Taylor. I'm quite sure that WPB company (Peters Precast) was in business before R. H. Wright started in Ft. Lauderdale in 1954. Mac might know but his career only goes back to about 1954 when Wright started. I am quite sure Harry did not develop the prestressed double tee in 1950 when his firm was called Lakeland Engineering Associates. My guess is that he developed his section around 1954 when several Florida plants started and Plant City Steel was setting up their form business. Paul Zia worked for Harry in those early years and may know something but I'd be surprised if either Mac or Paul could establish hard information on any of this.

In the Mar-Apr 2004 PCI Journal I have an article "Reflections on the Early Precast/Prestressed Concrete Industry". In there I say the following which I still believe is correct: "In the mid-fifties, much of the technical information came from Leap Associates, a design firm founded by Harry Edwards in the early fifties. Harry was a visionary with a flair for promotion but he also had a solid engineering background. The firm was one of the first to offer engineering services. Although the double tee was first developed by Prestressed Concrete of Colorado with a copyrighted name "Twin-Tee" in 1952, Harry was largely responsible for promoting the product nationwide by preparing and distributing load tables shortly afterwards. It is doubtful that Harry knew about the Perlmutters' twin tee initiative. In both parts of the country the double tee section evolved from the notion of putting wings on a channel section to cover more area at less cost."

In those early days I don't think there was much interest in the Prestressed Concrete of Colorado clunky section. it was too heavy and I never saw a copy of it elsewhere. Of course, the copyright or patent may have kept some away but both Leap and Freyssinet had franchised plants by 1956.
and were offering load tables on more efficient sections. It is probable that both Plant City and Food Machinery Corporation were promoting their double tee forms to all the new plants starting up and this could have pushed things along too.

One thing for sure, precast reinforced channel sections predate 1950 by quite a few years (Choctaw bridges for one) so it didn't take a creative genius to come up with the double tee when pretensioning became practical.

It's of course up to you, but I don't think any of this warrants a public correction on your part. If you want to discuss any of this further I'd be happy to do so.

Norm

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Bryan Trimbath to Helm 7/9/10:

Hello Helm. As promised, attached are a couple of LEAP Newsletters from 1954 & 1955 where Harry talks about the “LEAP Double Tee”. These newsletters were sent nationwide and read by many if not most of the people in the prestress industry, as there wasn’t much information available from PCI at that time. I trust you will be able find a politically effective way to address this delicate issue in your upcoming PCI article. Obviously LEAP has been using this in its marketing for decades, not to mention PCI’s published statements. Unfortunately, Harry is not around to respond to Wally’s comments. By the way, I don’t think I mentioned when we talked the other day, but your speech at the convention was excellent.

On a side note since we are talking about precast history, as you know PCI was chartered in Tampa on June 18, 1954; the day I was born. Pretty big coincidence that a kid from West Virginia born on that date would wind up in Tampa, owning a structural engineering firm, specializing in prestressed concrete. I don’t know if this is destiny or a curse. The jury is still out.

If you find these newsletters interesting, I would be happy to email you more.

Bryan

Two newsletters from December 13, 1954 and July 1, 1955 are on pages 44 and 48.

Paul Zia to Helm 7/12/10: In response to Helm’s request for information:

Paul Zia
Helm,

It's very interesting to read about the discussions on the development of double tee. It brings back a lot of fond memories. Norm's assessment is more or less correct. What I can offer may help provide some more insights.

I left Shanghai and came to this country in 1949, shortly after I received my BS degree in civil engineering and just seven days after the Chinese communists took over Shanghai. With the support of a scholarship, I ended up at a small college called Florida Southern College in Lakeland.

As he wrote in his article, Harry (a mechanical engineer) and his two friends Roy Hill (a mining engineer) and J. D. Raulerson (a chemical engineer) from the International Minerals and Chemicals Corporation formed Lakeland Engineering Associates in 1950. He offered me a three-month summer job in 1951, and I became the first structural/civil engineer in the firm. Harry and his partners were very much interested in prestressed concrete, and I helped them in the analysis and design of many different prestressed concrete sections including double tees. We began to produce loading tables. We also did preliminary designs of a variety of hypothetical framing schemes. Nearly all our non-billable hours were devoted to prestressed concrete work. Harry had the vision of creating a prestressed concrete industry, mass producing standardized members for buildings with long-line pretensioning system.

In the fall of 1951, I left for Seattle to pursue my graduate work at the University of Washington; and in the summer of 1952, I went to Tacoma with one of my professors who introduced me to Art Anderson. Art had already established Concrete Technology and was producing long span pre-tensioned tee beams with a very thin web using high strength concrete of 7 to 8 ksi.

During 1952, while I was in Seattle, Harry asked me to help with certain design problems or with review of some designs for several projects. He also did a lot of travel to promote his vision on prestressed concrete by talking to many concrete producers, contractors, and precast concrete products companies, trying to convince them to build prestressed concrete plants. Also in 1952, he established LEAP Associate as a subsidiary of Lakeland Engineering Associates for business reasons. LEAP stands for Lake Engineering Associates Prestressing and it so happened that 1952 was a leap year. When I got my MS in December of 1952, Harry offered me a permanent job with Lakeland Engineering Associates; so I returned to Lakeland in January 1953.

By then, Harry's effort began to bear fruit. First, Cone Brothers built the first prestressing plant in Tampa. Then Cone Brothers working with LEAP organized a public demonstration (with box lunch) in Tampa on the applications of prestressed concrete. There were more than 200 people in attendance including architects, engineers, government officials, and contractors. Double tee and channel slabs were loaded by stacks of concrete blocks to large deflections with full recovery. A 4” thick slab with 2” composite topping was loaded by a fully loaded ready-mixed concrete truck without failure. A 60 feet long 12” square prestressed pile was driven into the ground until refusal.
The success of the demonstration provided the stimulus for rapid development of prestressed concrete in Florida. LEAP became independent from Lakeland Engineering Associates as a separate company to provide engineering services exclusively to prestressed concrete industry. By 1954-55, in addition to the Cone Brothers plant in Tampa, other plants were built by R. H. Wright in Fort Lauderdale, West Coast Shell in Sarasota, Durastress in Leesburgh and later in Jacksonville, and Lakeland Prestress in Lakeland. LEAP also provided consulting services to prestressing plants in other states from NY down to Mississippi. In the Fall of 1955, I took a turn in my career path and left LEAP to teach and pursue my doctorate at the University of Florida. And naturally prestressed concrete became one of my major research interests my entire career.

My guess is that both Harry and the Colorado group developed the double tee almost concurrently. Kent Preston was an important player at that time, because he was in constant contact with every group who was working on the development of prestressed concrete. But I know for sure that Harry did not register or copyright any of the designs developed by LEAP, and no double tee was actually made in Florida in 1952 because there was no plant in Florida at that time. However, the double tees with thinner sections that were promoted by Harry did set the trend for the double tees of today.

Helm and Norm, if I have burdened you with too much detail, please excuse me. I always find my early years in Florida exciting.

Regards,

Paul

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Norm Scott to Paul Zia 7/14/10:

Paul
Thanks for your help to Helm on the double tee. I was also interested in the other information you provided. I didn't know about the chapter in your life when you left Shanghai and went to Florida Southern College. I also didn't know about the University of Washington and the hook-up with Art Anderson. I did of course know about your going from LEAP to the University of Florida which is where I first knew of you. Helm may call Mac Taylor...I'll be interested if he knows when that reinforced double tee in West Palm Beach started. It would have been natural to think of pretensioning it and I would be surprised if Rex Hartup didn't have a hand in some of this when he was selling forms for FMC. Of course Harry was very keen on the "keystone joist" early-on and that would naturally lead to the double tee also.

Norm

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Paul Zia to Norm Scott: 7/14/10

Norm,

You are absolutely right. Rex Hartup, just as Kent Preston, was influential in the early development of prestressed concrete in Florida. He was also in constant contact with us at LEAP. Their involvement was critical, one provided 7-wire strand and strandvise, and the other provided steel forms.

Harry's interest in "keystone joist" came from double tee, because it is natural to use the double tee form by not casting the flanges. His goal was to utilize the double tee form for as many different products as possible.

Paul

From Marian Methven 7/16/10:

July 16, 2010

Dear Helm,

Below are notes I've taken from several of the people here at Hamilton Form about the evolution of the double tee and some of the different double tee forms we've made. If you are looking for different information or something more specific, please let me know and we'll do our best to fulfill your request.

Double Tee History:

The first double tees were 4-foot, conventionally reinforced precast and were used in Florida on masonry buildings. The forms were cambered. Later, the 6-foot double tee was introduced. In the late 60's and early 1970s 8-foot double tees were common and were cast in self-stressing forms.

In 1967 and 1968, the early years of Hamilton Form, the double tee form most frequently built was the 8-foot DT with 22" stems. In general, the distance between the center stems was half the width of the double tee. During that time we were also building 4-foot double tee forms.
In 1972, the 10-foot double tee became the new kid on the block. One of the first we made was for McDonough Bros. in TX, which later became Manco. In 1980 we made a 12-foot wide double tee for JW Peters. In 1996 we built a 15-foot double tee for High Concrete. The first 15-foot double tee we made was actually 12-foot wide with bolt on cantilevered wings on each side to bring it to 15-feet. This was done for shipping considerations. Because of concern about deflection at the wings, we began making 15-foot wide double tees split on the centerline.

The deepest double tee we’ve made was in 1986. It was an 8-foot double tee with a 48” stem, built for Louisiana Concrete. We have also built double tee forms with a removable center section so that both a 12-foot (stems 6-feet apart) and 10-foot wide (stems 5-feet apart) product could be cast with the same form.

Double tee side rails also evolved from fixed side rails to bolt-down removable side rails to magnetic side rails. And, edges have evolved so that machines can ride on the edge of the form to service the beds.

The introduction of Vibrotrack™ on double tee forms changed form design. Channels were added to the exterior of the form where a sled with external vibrator could ride down the form. Vibrotrack greatly simplified the cumbersome vibration process and improved the quality of the product.

Initially the double tee form was designed as a vessel type form utilizing 3/16” skin with minimal longitudinal stiffeners. When the need to make self-stressing forms developed, solid round steel compression bars were added with jacking plates to resist the strand loads. In theory, the “jacking plate” transferred the prestress force to the compression bars.

However, in the late 70’s Hamilton Form analyzed this design theory and found that in reality, part of this force was transferred to the form skin. Therefore, why not use the skin to resist the load? This led to a modification of the design philosophy of the self-stressing double tee form. The skin was changed to ¼” thick and the size and the quantity of stiffeners were increased. The load was carried in this combination of skin and stiffeners, eliminating the need for compression bars.

Before proceeding with its new design philosophy, Hamilton Form contracted tests with the help of CEG, Featherlite Concrete in Austin, Texas; now Coreslab, TX; and the University of Texas-Austin’s civil engineering department. Strain gauges were installed on a double tee bed built with the new design. The actual stresses in the form closely approximated the theoretical stresses. This gave Hamilton Form the confidence to proceed full speed ahead with its new double tee form design. The new design was a much more efficient use of materials in building a self-stressing double tee and other self-stressing forms.

In general, as double tees got wider, the stem depth increased proportionately. As the size of double tees increased, the next significant change from a form design perspective occurred when double rows
of strand were introduced. This concentration of low strand eliminated the need for depressing. The form required additional stiffeners and thicker jacking plates.

For heavily stressed DT forms, such as those used for bridges, a combination of skin, stiffeners and compression bars need to be used, and is still used today.

As a side note, I find it interesting that this month we got 2 new double tee jobs that are strikingly different; a 9-foot self-stressing double tee and a self-stressing Next Beam form. I can take pictures of the forms in production and when they ship if you think you may want to use them.

Best regards,

Marianne Methven

Helm to Mac Taylor 7/4/11:

Hello there Mac,

HAPPY 4th of July if you read this today. And if you don’t, I hope you had one. I also hope that you are well, remember me and are able to reply to this message.

Last year at the PCI Convention in Washington DC, I gave a short speech at the breakfast. In it, I credited Harry Edwards with the development of the first double-tee in this country. Afterwards, a couple of people challenged me and said it was the guys in Colorado. That prompted me to do some research. I have yet to reach a conclusion and think you might be able to help.

I did talk to Norm Scott who provided me with you as a possible resource as well as other useful information. Then I went to Wally Prebis in Colorado. He objected rather forcefully that anyone but Jack Perlmutter could be considered as the developer of the double-tee that he called a Twin-Tee. In fact, Wally sent me the attached note as well as the following images [Jack Perlmutter’s gravestone shown above] which I guess point out that Jack at least was a strong proponent of the usefulness of the double-tee. After all, they did a lot of buildings in Colorado using them.

I know you worked with Harry and some of the other pioneers of the industry. You were one of them. Do you have any recollections of the development of the double-tee?

Please feel free to reply to this email or let me know a good time for me to call you in the next week or so. I am determined to bring this to a conclusion so that at least I will know.

Thank you,

Helm

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Mac Taylor to Helm 7/7/11:

Hi Helm,

As you may or may not know, I started my career in 1954 with R.H. Wright & Sons in Fort Lauderdale, FL, where Norm Scott and I worked together, long before he was executive director of PCI. (He came to R.H. Wright in 1956.) This allowed me to attend the first PCI Convention at the Bahia Mar in Fort Lauderdale; I'm probably the lone survivor of the first PCI convention. [Paul Zia and Ray McCann may have been there and are still with us today]

I was on the PCI board with Ted Gutt and worked with Charlie Zollman on projects and the 3rd PCI convention in Miami Beach. Back then the conventions were run by PCI members. I could tell you some very interesting stories about Charlie. Another time maybe. I went to Harry Edwards' office in Lakeland, FL, and took a two week course on prestressed concrete design, taught to me by Paul Zia (small world).

A little clarification on Harry Edwards developing the first double tee--he may have developed the first prestressed double tee; however there was a precast company in Miami that had been producing reinforced precast concrete "Twin Tees" before the prestressed concrete (PC) "double tee". In fact when we started selling the PC double tee in the Miami/Fort Lauderdale market they made it difficult on us by telling the engineers and architects that the strands would fail in fires, slip in the concrete, etc. After testing in our plant, etc., we finally put them out of business, I believe. We have come a long way from the 14" deep 4' wide double tee, haven't we! It has been a great journey and I have really enjoyed it.

Helm, I hope I haven't rambled on too much but as a friend of mine, I thought you might be interested in a little PCI ancient history.

Best regards,

Mac
Mac Taylor to Helm 7/18/11:

Hi Helm,

I really think you should set the record straight on the “Double Tee/Twin Tee caper”. Write PCI and state: For the record, the first precast reinforced Twin Tees were first produced by a Miami precaster (Miami Lit-a-bar maybe) in the late 40’s. The first prestressed/precast concrete double tees were produced in Florida circa 1953, the first precast/prestressed concrete twin tee was produced in Colorado. You can quote me, if you like.

[Note: I asked Mac to clarify the above with a note on 1/27/14. His response was as follows:]

Hi Helm,

It is always good to hear from you. What I was saying in my email was:

1. The first precast/prestressed concrete Twin Tee was produced in Colorado. (This was from your email.)
2. The first precast/prestressed concrete Double Tee was cast in Florida circa 1953. (I had stated this wrong—should be the same—oversight.)

Note: We could not use the nomenclature Twin Tee because a precast concrete producer in Miami was already producing a precast concrete twin tee (reinforced with rebar not strand) and therefore Harry Edwards called our product Double Tee and not Twin Tee. As it turned out, the Double Tee was the most commonly used name; note the PCI design manual.

I’m not sure who the twin tee producer was; maybe Miami Lith-a-bar. They were also producing the precast concrete (lith-a-bar) joist. At one time I had literature on all of this but it didn’t make the cut when Jan and I downsized.

Helm, I certainly hope this answers your questions. If not I will be happy to do what I can.

Hope to see you one day.

Best regards,
Mac

If you don’t care to do this, I will unless you have some objections. I really think the subject should be settled for history’s sake. All due respect to Colorado, but it is my understanding that you cannot patent a concrete section. You can copyright a name but the Twin Tee was being produced in Miami prior to Colorado and they said they had it patented. [With all due respect to Mac, I have concluded that he is incorrect about where the first prestressed double tee was made]

Incidentally, do you know what the cross section of the Colorado Twin Tee was? The Florida double tee was 14” deep; 4’ wide with a 1-1/2” flange which was changed to 2” in a few years when we decided Harry Edwards had not been conservative in his design. The 1-1/2” flange was subject to cracking.
The next few Emails are more recent and indicate what Frontier Dolomite did in 1955 using the same DT cross section that Harry Edwards used in Florida. Glen Switzer’s father, James Milton Switzer started the firm and lead its development into many interesting precast projects in New York.

Glen Switzer to Helm 10/31/11:

Helm
Attached is one of the articles for the 4’ dt’s my dad did back a few years. There are two pdf’s one shows the pictures of the load test and the fire test. The fire test picture isn’t very good but the load test is cool. The second pdf is more of the article. When this was copied that’s how it came out.
There are a couple of other things I will send I just haven’t put my fingers on them.
Hope you enjoy this. Note the date at the top. That’s my dad’s handwriting.
Thanks
Glen

James Milton Switzer-2008
 Attachment is an article from 1955 (2 attachments to see the full article)[below]
Dolomite Display
New Concrete U

Concrete, traditionally regarded as brittle, is now held against flames that destroy a steel weight up to four times its design load by a new concrete. This performance dramatically changes the characteristics of a new type of structural unit that was demonstrated to engineers and architects gathered at the Frontier Dolomite Products Corp., Monday afternoon. The announcement was made by copies of the new concrete unit, which is now being used in a building under construction. The process involves the mixing of concrete with steel, and the resulting unit is subjected to a strain of 14,000 pounds per square inch. The strength of the new concrete has been tested on a specimen which can be expected to remain intact indefinitely.

FOUR TIMES NORMAL LOAD—A 6-foot beam of pre-stressed concrete was under four times its “design load” as personnel of the Frontier Dolomite Concrete Products Corp. demonstrated to engineers and architects the characteristics of this new type of structural unit. The beam was subjected to successive heavier loads, showing that it recovered its shape after one and a half times the normal weight was applied, and gave way completely only after the normal load was more than doubled. Pre-stressed units are cast around steel cables which are under tension of 14,000 pounds. (USGI Photo)

FIRE TEST—Flames shot from the top of a frame made of concrete, as personnel of the Frontier Dolomite Concrete Products Corp. demonstrated the fire resistance of a pre-stressed concrete beam. A 20-foot concrete member subjected to the tests under normal load, was not lit. At the right, a steel beam similarly loaded, collapsed after 15 minutes of the test. The comparison was made to show the quality of steel, but to show that the fire was hot enough to destroy the steel member. Frontier Dolomite is the first firm in this area to make this new type of concrete structural units. (USGI)
Helm to Glen Switzer 7/2/13:

Hello Glen,

It was very nice spending some social time with you during the PCI Summer Conference.

I scanned the booklet [This refers to the complete document by Frontier Dolomite including the load test and fire test] you gave me and it is attached. I will send the original back to you soon.

I found it very interesting that Burr Bennett was the Engineer for Frontier. You must know that he went on to become PCI’s Executive Director for a period of time and was an original PCI Fellow in 1994 as well as a Titan in 2004. I have also attached copies of what were in PCI Journals announcing those achievements.

Good luck in your triathlon event this weekend. Don’t hurt yourself.

Thank you,

Helm

Attachment is test reports on 4 ft DT at Frontier Dolomite November 1955; also one about Burr Bennett
Glen Switzer to Helm 7/2/13:

Helm
Good morning. Yes it is always good to spend time both on PCI business and social time. I trust you made it home safely.
Thank you for sending this to me. I was young in the 50’s. I was born in 56. Even still I knew Burr Bennett. When I saw his picture you attached it was a face I remember as a kid. You know I am going to brag a little about my dad. When he got into prestressing in the early 50’s he did hire some remarkable people. Because Harry Edwards and my dad were close as well, Dad used Harry and Burr to develop the industry in western NY. There are so many prestressed jobs around the west end of the state I could show you and it is because of the team dad pulled together.
I have a history my dad wrote about his life and I need to go and review it to get some of the time lines for that period. Also I will be visiting with my dad in the next week and I hope he can remember those times and share with me. Now that I have opened this can of worms. [Note: Glen’s father died in August 2013 at the age of 94]
Have a good day talk with you soon
Glen

Helm to Mac Taylor 7/20/13:

Hey there Jan and Mac,

I hope you two are doing well and enjoying life.

Our last email communication about double tees was two years ago. I am still in search of the “truth” and thought I would bring you up to date.

Back to the Double Tee. I am still on a mission to fine the “Truth”. Toward that end, I have some business in the Denver area next month and have made arrangements to meet with Wally Prebis, Mike Altenburg and Leonard Perlmutter. That should be very interesting. In reading all the material I have, which includes accounts from Norm Scott and Paul Zia, I am inclined to conclude that the first actual “production” of double tees was in Colorado but perhaps the first “design” was done by Paul Zia in Florida. I will keep you posted if you like.

Regards,
Helm
Paul Zia to Helm (In response to Helm’s questions in Blue Text) 7/26/13:

Helm,

Please see my answers to your questions (in blue text) below. They are shown in red and in parenthesis. I am copying our messages to Peter Finsen because he is interested in the information.

Paul

From: Helrnuth Wilden <hwilden@roadrunner.com>
To: 'Paul Zia' <p_zia@yahoo.com>
Sent: Sunday, July 21, 2013 8:14 AM
Subject: RE: FW: History of the Double-Tee

Hello Paul,

I hope you are well and not working too hard. I see from the Big Beam emails that you are still active and I think that is great.

While it has been a while (Holy mackerel, three years), I am continuing my quest to find the real truth about who developed the first prestressed double tee in the United States. Toward that end, I have a couple of questions about what you said in your email below from July 10, 2010.

You were with LEAP for the summer of 1951 and indicate that you designed some products including double tees. See highlighted text below. Were these for specific projects or simply speculative designs to help with the load tables?

(The designs were not for specific projects. They were design exercises to develop load tables. There was no prestressing plant and no casting bed in Florida in 1951.)

You then left in the fall of 1951 and returned to LEAP in January 1953. Do you have any idea what Harry did while you were gone related to the double tee?

(I don’t know if Harry did anything specific related to double tee in 1952. But I believe he continued promoting prestressed concrete and talking to potential producers (any one in concrete business) encouraging them to get into prestressing business and setting up prestressing plants.)

You later say that there could not have been a double tee produced in Florida in 1952 because there were no plants until later. Is it possible that a double tee was made as a prototype? (I don’t know for sure, but I doubt if that was the case in 1952 because the first prestressing bed in Florida was not built until 1953.)

Do you know when the first plants started producing prestressed double tees in Florida?
(It was in 1953 by Florida Prestressed Concrete Co. established by Doug Cone of Cone Brothers Construction. See my answer below.) I guess the answer to that is below.

Harry’s paper *Part 3-The Innovators of Prestressed Concrete in Florida* which was published in 1979 indicates that the first prestressed bed was built by Florida Prestressed Concrete Co. and actually has a picture that is credited to you. **Were you involved in the design of that bed?**
(Yes, I did design that flat prestressing bed intended to produce a variety of products using different forms. Different demonstration products were produced on that bed and the demonstration was conducted in December 1953 as described in Harry’s article.)
Was it indeed the first?
(It was the first in Florida. It was built in the summer of 1953.)

Was it a double tee bed? From the picture, it actually looks like a flat slab bed.
(No, it wasn’t. After the very successful load-test demonstrations in Tampa in December 1953, several plants were built in the spring of 1954 and initially all-concrete double tee beds were built, but steel liner plates for the two stems were added soon afterwards. So, as I recall, the first to produce double tees commercially were Florida Prestressed Concrete Co., Durastress, and R.H. Wright.)

Helm
---------------------------------------------------------------------------------------------------------------------

Paul Zia to Helm 7/27/13:

After the very successful demonstration tests at Florida Prestressed Concrete Co in December 1953, prestressed concrete industry began to emerge very rapidly in 1954 and 1955. In early 1954, LEAP became the consultant to the initial five prestressed concrete companies in Florida, which became the charter members of Prestressed Concrete Institute with Harry Edwards serving as its Secretary-Treasurer. When I left LEAP to go to University of Florida in September 1955, LEAP had already added eight more prestressed concrete companies as its clients. And Frontier was one of the 13 LEAP clients. It was at that time I met Burr Bennett -- who visited LEAP’s office in Lakeland several times in 1954 and 1955 -- and we became good friends ever since and worked together through PCI and ACI. In his later years, he often joked that I taught him prestressed concrete on the back of an envelope!

Thank you again for bringing back to me so much fond memories.

Paul
---------------------------------------------------------------------------------------------------------------------

Mac Taylor to Helm 7/27/13:

Hey back to Helm from Mac and Jan,

The real truth about the Double Tee, as I think I previously stated, is that it was first (as far as I know) the reinforced concrete precast “twin tee” made in Miami. I still can’t remember the producer. I came to work for R.H. Wright in June 1954 and we were making precast/prestressed concrete Double Tees and it is my recollection that they also were being produced in Lakeland, Leesburg, Tampa, etc. at least a year or so prior to that time. Paul Zia of course would know. In July 1954 I spent a week in Lakeland, FL being taught prestressed concrete design by Paul Zia at Harry Edward’s office—Lakeland Engineering Associates Prestress (LEAP). PCA might have something in their archives of the early precast Twin Tee.
Thanks so much, Helm, for the updates. They are certainly appreciated and I look forward to hearing more about the “Double Tee Caper”. Please let me know if I can ever do Helm a favor. It would be my pleasure.

Best regards,

Mac

---

**Mike Altenberg to Helm 8/3/13:**

Dear Helm

I received your letter and notes about the origination of the double tee.

I am hoping to have Bill Loper, a partner in the business who was involved as Leonard and Jack Perlmutter in the development of the product.

I can tell you now that there was no attempt to patent the shape. Also, we were so busy at accessing capital that we never copyrighted the name "Twin Tee".

I became popular with the many projects that we used it on, that no one questioned its development.

At that time, we were general contractors and had control of the products used in the many buildings that we built.

Actually Harry Edwards visited George Hanson and our facility in 1952 [Corrected later to 1953] prior to his invention of the double tee.

We are looking forward to seeing you on August 18th

Mike Altenberg

---

**Subsequent Events:**

On August 18, 2013, I had breakfast with Leonard Perlmutter, Mike Altenburg, Wally Prebis, and Jason Krohn at the Wild Egg in Denver with the intent of getting some helpful information “right from the horse’s mouth”. I did. Mike recalled that the first prestressed double tees were 6 ft wide with 3 ft between stems which were very wide since Prestressed Concrete of Colorado was concerned about fire endurance. These were the double tees used in the Beatrice Cold Storage Building.
Leonard Perlmutter provided me with a number of publications from those early days in the 1950s. They included load tables for their 5'-6” and 6'-0” prestressed double tees that were published in 1957 as well as articles from local papers discussing some of the early prestressed concrete structures.

The following images are samples of the material that Leonard Perlmutter provided to me:
PRESTRESSED CONCRETE CONSTRUCTION

by

PRESTRESSED CONCRETE OF COLORADO INC.

DENVER, COLORADO
Twin Tee stably supported at one end by precast columns & beams with anchor and bearing on precast beams supported by site planters.
The following TWIN TEE chart and table gives the dimensions of the various types of TWIN TEE. Variations in widths are obtained by changing dimensions A and B to arrive at the desired slab width.

<table>
<thead>
<tr>
<th>TWIN TEE TYPE</th>
<th>MAXIMUM WIDTH</th>
<th>A AND B DIMENSION</th>
<th>C DIMENSION</th>
<th>D DIMENSION</th>
<th>WIDTH OF LEG AT BASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>T61</td>
<td>5'-0&quot;</td>
<td>1'-3&quot; to 0'-3&quot;</td>
<td>6&quot;</td>
<td>2&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>T92</td>
<td>6'-0&quot;</td>
<td>1'-3&quot; to 1'-3&quot;</td>
<td>6&quot;</td>
<td>2&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>T82</td>
<td>5'-0&quot;</td>
<td>1'-3&quot; to 0'-3&quot;</td>
<td>6&quot;</td>
<td>2&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>T82</td>
<td>6'-0&quot;</td>
<td>1'-3&quot; to 1'-3&quot;</td>
<td>6&quot;</td>
<td>2&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>T92</td>
<td>7'-0&quot;</td>
<td>1'-3&quot; to 0'-3&quot;</td>
<td>10&quot;</td>
<td>2&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>T82</td>
<td>6'-0&quot;</td>
<td>1'-3&quot; to 1'-3&quot;</td>
<td>10&quot;</td>
<td>2&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>T92</td>
<td>5'-0&quot;</td>
<td>1'-3&quot; to 0'-3&quot;</td>
<td>12&quot;</td>
<td>2&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td>T92</td>
<td>6'-0&quot;</td>
<td>1'-3&quot; to 1'-3&quot;</td>
<td>12&quot;</td>
<td>2&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td>T92C</td>
<td>5'-0&quot;</td>
<td>1'-3&quot; to 0'-4&quot;</td>
<td>12&quot;</td>
<td>3&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td>T92C</td>
<td>6'-0&quot;</td>
<td>1'-3&quot; to 1'-3&quot;</td>
<td>12&quot;</td>
<td>3&quot;</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>
The following images are from *Part 6- Early History of Prestressed Concrete in Colorado in Reflections on the Beginnings of Prestressed Concrete in America* by George Hanson.

*Fig. 10. A 6-ft (1.83 m) wide double-tee was developed from existing channel slab designs to allow larger spans between beams in the cold storage warehouse for Beatrice Foods.*
Anchoring the strands at the bulkhead was a challenge overcome by Jack Perlmutter and Mike Altenberg.
Fig. 6. Late in 1952, Prestressed Concrete of Colorado built its first production prestressing bed. (Note: Twin Tee slabs stored to left of bed.) The original 50-ft (15.2 m) bed, built in 1951, proved inadequate for economical production purposes.
**Mike Altenberg to Helm 9/21/13:**

Dear Helm,

You asked about the 50’ bed that we used to fabricate the fence posts for CF&I.

This was our first attempt at using Roebling 3/8 strand.

After much experimenting with anchorages, we came up with the conical shapes and 3 pc. inserts to anchor the strand.

The forms were steel with end pieces every 10’ or so.

The forms were not self-stressing. They were anchored to a flat concrete slab.

George Hanson designed the ends of the bed using wide flange vertical beams with steel plates anchored to the beams with a hole drilled to receive the strand followed with the anchors.

The strand was pulled to the desired length designed by George. The wire ties were placed thru the sides of the form to anchor the metal fencing.

After attaining 5,000 PSI, the strand was released and cut at the end of each post.

The forms were fabricated at a local steel company and the ends for securing the strand were designed by Hartmeister Mfg. Co, long since gone.

My experience was acquired observing the operation that had moved to a 40 acre lot with rail available.

I spent a lot of time with Hanson and took a course in drafting at a Community College.

I never met Harry Edwards. He was a friend of Len's brother, Jack. I always knew that he visited the plant in 1952.

As you may know, it was thru Jack's initiative that we got into the business.

My best wishes to you and Jason,
Mike Altenberg

---------------------------------------------------------------------------------------------------------------------

**Mike Altenberg to Helm 11/12/13:**

We never promoted or sold a 4’ TT. Even if we made a channel slab, it would be made of a 6’ TT
Without the flanges which would be at 3’ cc
Mike

---------------------------------------------------------------------------------------------------------------------
The Beatrice Cold Storage building is still in use today and is owned by DenCol, a specialty steel supplier. I made several attempts with DenCol to allow us access to the building, but was denied due to some proprietary information within the building. However, much to my surprise, my friend Jason Lien managed to get access into the building and took some pictures which follow.

Arial View of DenCol complex. Building in red is the one with the first prestressed double tees in the United States, built in 1952.
Conclusion:

With all that said, it is my conclusion that the first prestressed double tees were made by Colorado Prestressed Concrete Company in 1952.

This is the cross section of those first prestressed double tees.
A Word about Harry Edwards:

Harry Edwards, while he may not have produced the first prestressed double tee, probably did more to promote prestressed products in general than anyone else at the time. His newsletters [See pages 44-48] provided to me by Bryan Trimbath and seminars were extremely helpful in those early days when specifications and design methods were not yet published.
The following four images are from *Part 3 of Reflections on the Beginnings of Prestressed Concrete in America* written by Harry Edwards:

Fig. 11. The first load test on a 14-in. (358 mm) deep, 4-ft (1.2 m) wide and 25-ft (7.6 m) long double-tee. Note the small deflection. Span lengths were later increased to 60 ft (15.3 m).
Fig. 25. Demonstration test of 100-ft (30.5 m) long prestressed channel slab at R. H. Wright & Son, Fort Lauderdale, Florida.
Fig. 24. Demonstration test by Cone Brothers Construction Co. in Tampa, Florida (1954) of 2-in. (51 mm) thick prestressed slab with 4-in. (102 mm) composite topping. The span was 30 ft (9.2 m) long.
Fig. 36. Prof. T. Y. Lin and Harry Edwards having lunch at one of the early Florida conferences on prestressed concrete (taken at R. H. Wright plant in Fort Lauderdale).
LEAP NEWSLETTER

No. 23.

STRETCHING THE DOUBLE TEE

The LEAP Double Tee roof slab has tremendous possibilities for longer spans. The 14 inch deep Double Tee can be made to span as much as 80 feet and cantilever 30 or 40 feet. The only big problem is handling during delivery and erection. The tools for this stretching operation are as follows:

1. Light weight aggregates
2. Bunching of prestressing strands at mid span to increase the eccentricity.
3. Wide separation of the strands towards the supports.
4. The use of more prestressing steel in each stem.
5. Using giant corrugations or folding of the roof deck.

Let us venture into some light mathematics of the Double Tee. We need to know some physical properties. Consider only one half the Double Tee.

Area = A = 90 sq. in.
Wt. with Dense Ag. = 93#/'
Wt. with lt. wt. Ag. = 65#/'
Moment of Inertia = 43 l in 3
Y = bottom fiber to neutral axis = 10"

Consider first the LEAP Double Tee roof slab No. R14056. This uses 5-3/8" diameter prestressing strands in each stem. The strands are pulled straight through parallel to each other, and are spaced 1½ inches apart. The eccentricity e is 5.5 inches.

Now determine bottom fiber stress in the concrete due to prestressing

\[
\frac{P}{A} = \frac{5 \times 11,200}{90} = 622 \text{ psi}
\]

\[
\frac{P_e \bar{Y}}{I} = \frac{5 \times 11,200 \times 5.5 \times 10}{1431} = 2150 \text{ psi}
\]

\[
\frac{2772}{\text{psi}}
\]
For roof loading we can safely use up to 0.05 \( f'c \) tension in the bottom fibers at mid span on design load. In this case we will use 250 psi tension.

\[
2770 + 250 = 3020 \text{ psi}
\]

Assume \( W = 93 + 2 \times 35 = 163 \) pounds per foot.

\[
I = \frac{I}{w} \frac{3020 \times 1431}{1.5 \times 163 \times 10} = 42'-0"
\]

This figure of 42'-0" is the maximum span for a 35 pounds per square for superimposed load. The limit on this design is bottom extreme fiber stress toward the ends. More steel could be added if the ends could take it. The figure of 2770 psi is the actual compression of the bottom fibers near the ends. It will cause an increase in camber and some plastic flow. It requires a high strength concrete.

This high end stress can be reduced simply by reducing the eccentricity at the ends. Hold the steel at mid-span in its previous location and raise it at the ends until the distance from center gravity of concrete to center gravity of steel is 2 inches. Then the bottom end stresses are:

\[
\frac{P}{A} = \frac{5 \times 11,200}{90} = 622 \text{ psi}
\]

\[
\frac{P_{ei}}{I} = \frac{5 \times 11,200 \times 2 \times 10}{1431} = 782 \text{ psi}
\]

This figure of 1402 psi is far below the allowable limit. Camber and plastic flow have been reduced. A lower strength concrete can be used. The amount of prestressing steel can be substantially increased thus increasing the span.

Bunching of steel is permissible at mid span, so let us try another design with more steel and fanned out at the ends and touching at mid span:

![Diagram of steel arrangement](attachment:diagram.png)
\[ \frac{P}{A} = \frac{7 \times 11,200}{90} = 870 \]

\[ \frac{P_{e}}{I} = \frac{7 \times 11,200 \times 7 \times 10}{1431} = 3,835 \]

Total 4,705 psi at midspan
4,955 psi tension

Before dead load

\[ I = \frac{4955 \times 1431}{1.5 \times 163 \times 10} = 54' \text{ - } 0" \]

Determine bottom end fiber stress with an e of 3"

\[ \frac{P}{A} = \frac{7 \times 11,200}{90} = 870 \]

\[ \frac{P_{e}}{I} = \frac{7 \times 11,200 \times 3 \times 10}{1431} = 1,050 \]

Ok. for 6000 psi

2,520 psi #2 concrete

Thus we have increased the permissible span by bunching, fanning, and increasing the number of strands from 3 to 7. These two extra strands at six cents per lineal foot have increased our Double Tee only six cents per square foot.

Light weight concretes made with expanded shale aggregates have been very intriguing to the prestressed concrete designer. They have two physical properties which have given limitations. These are a low modulus of elasticity and a tendency to plastic flow at the higher stresses.

The low modulus of elasticity of expanded shale concrete gives about 1/3 more deflection under load than the dense aggregate concretes. This makes the individual four foot wide Double Tee too flexible for these long 50, 60, and 70 foot spans unless they are joined firmly at their edges to adjacent slabs. Even the dense Double Tees must be joined at their edges. The deflection must be investigated for each use of long span Double Tee.

Camber and plastic flow in long span Double Tees made with light weight aggregate can be controlled by designing to a low fiber stress. This is now easily obtained on prestressing beds designed for sloping strands.

Maximum span for light weight aggregate Double Tee with 7 strands per stem and 35° per square foot paperimposed loading is
The English text on the page reads:

\[ l = \sqrt{\frac{fL}{1.5w}} = \sqrt{\frac{4955 \times 1431}{1.5 \times 135 \times 10}} = 59'0'' \]

at 25 p.s.f. loading

\[ l = \sqrt{\frac{4955 \times 1431}{1.5 \times 115 \times 10}} = 64'0'' \]

at zero p.s.f. loading

\[ l = \sqrt{\frac{4955 \times 1431}{1.5 \times 65 \times 10}} = 85'0'' \]

This last \( l \) is calculated merely to show the possibilities for use in folded plate construction. The Double Tee is designed to take its own dead load. Lay them on the building to form a giant corrugation or folded roof deck.

On these folded plates the edge joint must be designed to take horizontal shear. The Double Tees may also be used as a form to pour a two inch topping. Bond between the Double Tee and the topping may be increased by casting wires or cables in the top surface of the Double Tee and ripping it out a few hours after pouring. Reinforcing steel for the topping must be designed for each job.
LEAP NEWS LETTER

Cost Comparisons of Roof Decks

We have made an interesting cost study on the comparison of a LEAP Double Tee slab with a steel bar joist and gypsum roof deck. The results of this study are plotted on the attached chart.

The costs of the bar joist and gypsum deck are based on the highest and lowest prices currently being used throughout Florida. For example, the highest price used for the cost of steel erected was 204 per pound, and the highest cost of poured gypsum deck was 40¢ per square foot. The lowest price of erected steel used was 12¢ per pound and the lowest cost for gypsum was 34¢ per square foot. Since drawing up these curves, we have run across two installations which have been quoted as low as 9¢ per pound for the cost of steel.

The LEAP Double Tee curves represent the highest and lowest erected prices in common use throughout the State.

Very truly yours,

HENRY H. EDWARDS

LAKELAND ENGINEERING ASSOCIATES, INC.
**Some other interesting information learned along the way:**

Harry Edwards did produce the first prestressed double tees in Florida in 1953. As an enthusiastic promoter of prestressed concrete, he helped an emerging market grow on the east coast. He was concerned about the technical aspects of prestressed products and was instrumental in conducting the first load tests and fire tests on 4 ft wide double tees. These were done by Frontier Dolomite Concrete Products in Lockport, NY in 1956.

The following images from “Pretensioned Prestressed Concrete Demonstration at Frontier Dolomite Concrete Products, Inc. Lockport, New York, November 21, 1955.”
These tests were developed by Burr Bennett who later became the 4th Executive Director of PCI serving from 1968 to 1978.
Acknowledgements:

I wish to thank the following people who helped me with this endeavor:

**Wally Prebis.** Wally is the former Executive Director for the Colorado Prestressed Concrete Association and co-wrote the article by George Hanson mentioned above.

**Norm Scott** before he passed away in April 2013. Norm was the 2\textsuperscript{nd} Executive Secretary of PCI and was responsible for moving PCI’s headquarters to Chicago to be more centrally located and close to PCA.

**Paul Zia.** Paul was the first structural engineer working for LEAP. He went on to become a recognized researcher in prestressed concrete at North Carolina State University.

**Mac Taylor.** Mac was a sales engineer for R.H. Wright in the early 1950s and hired Norm Scott into the industry.

**Leonard Perlmutter.** Leonard was the brother of Jack Perlmutter and an owner of Colorado Prestressed Concrete Company in the early 1950’s. He served as PCI President (Now called Chairman) in 1977.
**Mike Altenburg.** Mike was a young salesman for Colorado Prestressed Concrete Company in the early 1950’s and participated in the development of the first double tees were made. He served as PCI President (Now called Chairman) in 1985.

![Mike Altenburg](image)

**Irwin Speyer.** Irwin is a consulting engineer and worked with Colorado Prestressed Concrete Company in those early years.

![Irwin Speyer](image)

**Marianne Methven.** Marianne is the Director of Marketing for Hamilton Forms in Fort Worth, Texas, a leader in the form manufacturing business.

![Marianne Methven](image)
**Bryan Trimbath.** Bryan is the current owner of LEAP Associates in Tampa, Florida and worked with Harry Edwards

**Glen Switzer.** Glen is the son of James Milton Switzer the owner of Frontier Dolomite. He is currently Sales and Marketing Manager for DURR-STRESS Inc. in Leesburg, Florida.

**Jason Krohn.** Jason is Managing Director, Technical Activities for PCI.
Rachel Detwiler. Rachel is Editor-in-Chief, *PCI Journal*


Respectfully prepared by

*Helm*

Helmuth Wilden, P.E., FPCI