Steering Committee Meeting Summary

by
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Heschong Mahone Group

February 26, 2003

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Contract Number 400-99-013

Steering Committee Meeting Summary

Report for Task 5.4.1 Integrated Ceiling Technical Advisory Group

February 26, 2003
HMG Project #0015a

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Preface

The HESCHONG MAHONE GROUP has produced this report as part of the Integrated Design of Commercial Building Ceiling Systems research element of the *Integrated Energy Systems - Productivity and Buildings Science* energy research program managed by the New Buildings Institute. Cathy Higgins is the Senior Program Director of this project for the New Buildings Institute.

The *Integrated Energy Systems - Productivity and Buildings Science* program is funded by the California Energy Commission under Public Interest Energy Research (PIER) contract No. 400-99-013. The PIER program is funded by California ratepayers through California's System Benefit Charges and is administered by the California Energy Commission (CEC). Donald J. Aumann is the CEC Programmatic Contact.

LEGAL NOTICE

INTRODUCTION

The Steering committee for the PIER Integrated ceiling systems design met on February 19, 2003 at Williams+ Paddon, Architects +planners Inc. The purpose of Integrated Ceiling Technical Advisory Group (TAG), is to review the research and to give guidance and direction to the study. The purpose of the meeting was to get input from manufacturers and design consultants on the direction the research team is pursuing in developing a protocol for designing skylight wells in T-bar ceilings.

The Morning session included presentations by HMG introducing the research project and other advisory group members discussing their experiences and product information. The members then took a tour of the skylights in Williams+Paddon office building. The afternoon session focussed on a work session where the research team and the technical advisory group prioritize which issues are in most need of being addressed.

STEERING COMMITTEE MEETING

Meeting Attendees

Steering committee:
Jerry Blomberg, SunOptics Skylights
Jim Kobs, Chicago Metallics
Joel Loveland, Seattle Lighting Design Lab
Chuck McDonald, US Gypsum
Attending by phone:
Bill Beakes, Armstrong World Industries
Dave Dall, Chicago Metallics

California Energy Commission Project Management: Don Aumann

Integrated Ceiling Systems Project Team:
James Benya, Lighting Design
Marshall Hemphill, Hemphill Industrial Technologies (on phone)
Jack Paddon, Williams + Paddon Architects
Lisa Heschong, HMG
Douglas Mahone, HMG
Jon McHugh, HMG
Puja Manglani, HMG

Meeting Agenda

10:15 - 11:15	Intro to Integrated Ceilings Project
	-Background, Case studies, Project concepts
11:15 - noon	Steering Committee Presentations
Noon - 1:00	Lunch and tour
1:00 - 2:00	Brainstorm on light well construction
2:00 - 3:00	Setting objectives for protocol
3:00 - 3:15	Coffee Break
3:15 - 4:00	Protocols for skylights, ceilings & light wells
4:00 - 5:00	Task assignments - team and TAG

Meeting Minutes

Please refer to Appendix A for the power point presentation handouts.

Introduction to Project: Problem Statement and Objectives

This part of the meeting dealt with introducing the group to the project outline in terms of the problem statement and objectives of the project. Prior Integrated ceiling projects, which form a part of, the integrated ceiling systems were also discussed. Following were the comments regarding the scope of the objectives.

1) *Scope of project and target market:* The discussion started with what should be the focus of this research. The focus of this research is on low-rise commercial buildings (one floor or top floor of 1-3 stories, 9-15'ceilings) like offices, retail stores, grocery stores and schools in California-basically the low-end "cookie cutter" construction types(not custom designed). These building types are spaces that traditionally use T-bar ceilings in their spaces. Offices and retail stores form 35% of the total new construction non-residential building area in California. Schools, which are owner occupied spaces, are willing to invest in productive environments. Even though 'quality of light' and skylighting design issues form an important part of the integrated ceiling system, it was decided that it was too detailed and specific and that were beyond the scope of this particular project.
2) *Noise issues*: According to the new ANSI ambient noise standard for schools, the goal is to achieve 35 dbA; 55 dbC, plus limits on reverberation in classrooms. This essentially requires the presence of acoustic ceilings in schools.
3) *Geometry question*: In terms of construction phasing, horizontal zones can be fixed in dimensions so that we can resolve spacing issues for the skylight well as it penetrates through horizontal strata that have been historically set aside

for building components (mechanical, lighting and sprinklers). Another consideration is the fact that the roof is not normally flat and can have a slope while the ceiling usually is flat. The goal is to standardize as much as possible in order to reduce the custom design aspects of light wells with the recognition that buildings are "messy" and that the designer will still have some coordination issues to deal with on an individual project basis.

4) *Spacing issues*: Spacing issues like structural, T-bar grid, skylight opening grid. mechanical, sprinkler and lighting were discussed. Along with the structure, the general requirement is for the HVAC units to be close to the core of the space, and in general, skylights need to be away from those areas. It was stressed that structural grid tends to govern the spacing of skylights. Williams+ Paddon have used hard ceiling surfaces to re-establish the T-bar grid so that it lines up with the light well. Skylight spacing is also driven by the use of the space below; in grocery stores, gondola placement/spacing dictates the floor area layout, which then guides the spacing and dimension of ceilings. In case of offices, the partitions govern the spacing. Usually office developers can't anticipate where partitions will go and they want a flexible enough solution that they can change over time.

   One strategy discussed for these different spacing issues is to make more roof penetrations, some which are covered with skylights and others covered with insulated "blanks" for spaces that currently don't need daylight. As the spaces change over time, the skylights and blanks can be moved around with respect to the need for daylight below.

   One issue on lighting integration is nighttime electric lighting quality with skylights. The proper luminaire spacing needs to be maintained to avoid dark areas under the skylight well at night. Thus, either the wells need to be smaller than the luminaire spacing, or the luminaires need to span the well, as is possible with a pendant system. The dark appearance of the skylight glazing or well sufaces at night is not as much of a visual quality concern, but may be an aesthetic issue for some designers or owners.

5) *Ceiling heights*: In terms of ranges of ceiling height considered, 10' to11' is an optimum ceiling height for direct/indirect lighting. Grocery store ceilings are typically from 12' – 18' especially the ones with simpler mechanical layouts for the main system. A height of 14' is typical for department stores and retail, except for big box retail stores, which don't often use T-bar ceilings. Office ceiling heights are still typically 9'. Expected ceiling height will typically determine the appropriate size and spacing of the skylights – smaller and closer together for low ceilings; larger and further apart for higher ceilings.

6) *Trends for T-bar*: What are the existing trends in the T-bars market in terms of availability and use? Different retailers have different motivations for use of T-bars, including aesthetics, acoustics, flexibility and cost. Several retailers are tending to do away with T-bars and using exposed ceilings for lower overall construction cost. Some retailers report that exposed ceiling gives them a newer "edgy" look, which their customers prefer. Others retailers avoid

exposed ceilings because they think it looks too low-end. T-bar ceiling is practically a given for office construction. For schools, it is likely to increase in response to new acoustic standards.

7) *Desirability of a rated assembly*: Rating a whole ceiling assembly, rather than its components, is not particularly desirable because it limits the flexibility of the ceiling and any change has to also be rated. It is also quite expensive to get a UL rating on one's ceiling assembly. Rated assembly might be okay for out-of-the-box assemblies. There are usually different ratings for insurance and for building codes. Most of the spaces that have been talked about are sprinklered and thus ratings are only an issue for fire exit corridors. Smoke vents are often used used in combination with skylights. If a fire breaks out in the plenum space, the light well can be a barrier to smoke venting. There is an ongoing disagreement if smoke venting is a good thing when combined with sprinklers - the smoke vents may keep the space temperatures low enough that the sprinklers don't turn on. This project will not focus on smoke vents. If the space is sprinklered, local jurisdictions may or may not require an additional sprinkler head up in the skylight well.

8) *Seismic issues with skylights*: If skylights curbs and throats are properly braced back to roof, they are not likely to be a problem. A separate issue is disruption of the roof seismic diaphragm by the openings for the skylights. The solution is often to increase strength of the diaphragm connections via extra nailing, screwing or welding. The cost of this is generally trivial compared to other issues. The primary impact is asking the structural engineer to do another calculation. Seismic requirements are identical for zones 3 & 4 (i.e. all of CA).

9) *Well design and quality of light*: The intent of skylighting design should be to provide good lighting quality. The skylight performs best when it diffuses light over a large space, and ideally distributes some of the light onto the upper room surfaces…i.e. walls and/or ceiling. In large open retail spaces this is often achieved by reflectance back up off of a light colored floor. In schools and offices, however, a skylight well that concentrates all of the light downward will not meet these objectives. Another concern is avoiding the creation of a glare source from an extremely bright surface within the normal line of sight. One method to address this issue that was discussed was the creation of a light redirecting device at the bottom of the throat or splay…variously referred to as a “cloud” or “baffle.” A number of options were discussed that might redirect light onto upper room surfaces while avoiding the creation of an overly bright surface. It was agreed that there are many possible solutions that could lead to innovative products. The primary goal of this project would be to help designers or manufacturers understand the performance objectives of this product, and how such a product could fit into the skylight well system.

Case Studies

Six buildings with skylights and T-bar ceilings were presented to the committee. Following were the comments on the case studies presented:

1) Capistrano School: The daylighting design for this school was discussed to be not particularly good. The wall surfaces and flat ceilings are too dark without electric light – but have electric lighting around the perimeter to balance, which reduces electric savings. Inverted plastic diffuser makes a big difference, especially when hinged and make for easy cleaning. It would also be a good idea to have some method of redirecting the light from the skylight in spreading light farther onto the walls.
2) Olive Ranch School: some site adjusting was made to coordinate with structural grid– with c-channel to make neat joint at hip corners of the well. Metal angle at top of slope was custom bent for contractor; would be better to have standard parts.
3) Grocery A: In this case they used special order 2' x 5' tile for vertical splay portion of the light well. Prismatic lens allowed details in the throat portion of the light well to be hidden, but could also be a potential glare source. Issues of light control below the source. Hence light well functions of shielding and redirecting of light need to be considered in the protocol
4) Grocery B: In this building, the ceiling was illuminated from the bright floor below, except the wine aisle, which has dark flooring. Aisles orientations are perpendicular to the light well axis. A wooden frame is placed at intersection of the junction between the gypsum board splay well and acoustic tiles.
5) Williams + Paddon office building: The architect asked the ceiling mechanic to use standard parts and "best workmanship" and developed custom solutions for each of the skylights provided. Each light well was unique, and may change with the next tenant. In spaces where there were open ceiling spaces, it turned out to be $0.40-0.60/sqft more expensive than the ones with ceilings because it was not possible to use flex ducts to terminals.
6) There was also a discussion of possible louvers or diffusing lens at ceiling plane to hide much of the messy details above the ceiling plane. The concept of a metaphorical lighting 'cloud' to bounce or diffuse light coming down from the "source" was one such idea. The throat provides the source, the splay does little to distribute the light, except to help get the ceiling out of the way and to distribute the secondary bounce from below.

Brainstorming Session

How to make low cost, repeatable light wells –Integration of parts

This part focused on brainstorming on the various parts that need to come together to make a light well - the vertical throat, the splay and the joints, and who takes the responsibility for what part in the industry.

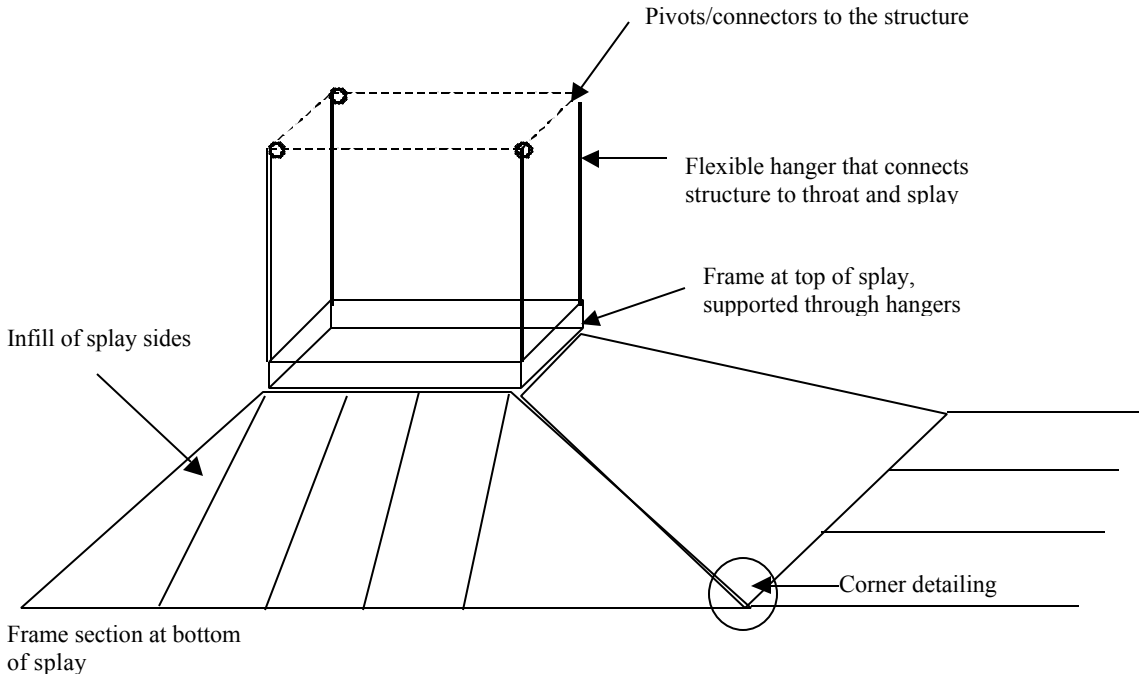
1) At present there is not an existing protocol for the integration process. The integration of skylights with other components has been largely done in the field. Chicago Metallics has created coffered ceilings in metal and acoustic panels – but it is mostly outdated (it was back in the 70's) – and it didn't sell well. (see Appendix A for sketches of coffered ceilings) Problems with the kits were getting pieces and parts all together. Hundreds of thousands of square feet were installed but were hard to sell and get right in the field. Parabolic lighting fixtures solved much of the glare problem that was addressed by coffered ceilings but at a much lower price. Initially coffered ceilings required proprietary luminaires, which did not please the luminaire manufacturers. Ultimately, coffered ceilings were developed that could accept many different luminaires.
2) The skylight manufacturer has the greatest motivation towards integrating the skylight with other systems since the t-bar systems are already flexible enough. Our protocol might have different manufacturers and proprietary offerings, but if the protocol defines roles to each manufacturer, interfaces could be made manageable and feasible. But the question is whether there is enough market to result in the development of special light well friendly ceiling products and there would have to be actual sales to support that.
3) In case of construction phasing, the question arose on how to protect the "real estate" of the skylight well, i.e. making sure that other trades stay out of that vertical space. One idea put forward by one of the retail construction managers is that putting the skylight "throat" in early reserves the space for the light well. Ceilings are often put in to the "white box" condition (walls, ceiling), especially in offices where partitions are added below ceilings.
4) Who connects the transition from the ceiling plane to the throat? T-bars are already the mass produced product. If the throat could be installed at the time the skylight goes in, there could be a slip joint at the bottom of the throat and a slip joint at the ceiling where the splay starts up. The throat could be an easily adjustable, insulated, reflective surface and can be hung from the roof/curb and can be braced for seismic loads.
5) The research team needs to standardize on skylight size we're working on-typically 4x4, 4x8, 5x6? Range of depths from curb to splay – it is highly variable. Typical skylight sizes are driven by the ceiling height. Range of depths for splay is based on standard geometry of the splay. We need modular rectangle at the ceiling plane and modular rectangle at the top of the splay.

   One possibility is to hang the splay assembly from threaded rod at four corners of the skylight.
6) The protocol needs to include standardized way for the market to put pieces together. One can't specify who makes what as the market will work that through. Fire characteristics should be discussed, but will ultimately be determined by local building department. UL listing would be good to have,

but it is limiting and very costly. Also to be included should be specification of the reflectivity of the throat material.

7) There was variability of approaches between the steering members – Jerry Blomberg believed that a standard splay unit is what is required, but James Benya wants flexibility in how it is put together.

8) Finally, the essential details/parts to work out are: 1 – Pivoting connection from curb to throat structure 2 – Adjustable (in height and angle) hanger for frame at top of splay. 3 – Materials options for surface of throat. 4 - Frame section at top of splay. 5 - Frame section at bottom of splay. 6 – Infill options for splay sides. 7 – Devices for light control and distribution. 8 – Determination of a constrained range of geometries and sizes



Objectives and Outcomes of Protocol

Four main protocol questions were asked to the manufacturers and designers at the meeting:

- What are the key outcomes you would like to see?
- What research is needed?
- Do you agree a prototype based on a throat, interconnection and splay?
- Is developing this protocol feasible in a 2 months period?

Individual opinions

Jack Paddon: It is reasonable to get to the big idea within 2 months. The essential components to solve are the three connections: throat, splay and ceiling. But it is hard to get clients who are ready to have skylights in their

buildings. Though now it is required by 2005 codes to have skylights in spaces that are larger than 25,000 SF (Jerry). (Ed Note - the code requirement is for spaces that have ceiling heights greater than 15 feet.)The throat needs to be most variable in terms of dimension and materials. The question is how to bring products to the market.

Chuck McDonald: The biggest challenge is how to solve basic design problems and who will take the responsibility of making what part. And another concern is for the acoustical consultant. The protocol needs to provide guidance to the grid manufacturer. If the design is fixed, we (ceiling manufacturers) can conceptualize the product.

Jerry Blomberg: The protocol should identify ideal solution from research and then figure out how to make it simple and elegant. The baffle at the top of the splay will be the key to making the lighting work optimally.

Jim Kobs: We (Chicago Metallics) need to check and research on what parts we have left that are not in current use but that can be reused (like their security partition system that was used in jails). The outcome we expect is to sell a million pieces by 2005.

Marshall Hemphill: The challenge is for the grid manufacturers to show how this could be accomplished with their standard parts. E.g. board moldings in metal and plastic that were used in the earlier designs could easily be reproduced.

Joel Loveland: The protocol needs an upgrade path so we don't pull the whole market down, and should discuss what is the best way to do it. The protocol can also come up with various levels of solutions like good, better best solutions.

James Benya: The need is to push for standardization and to reduce labor. The more simplified the specification, the better is it. The scope of the project should be to come up with a 'good' integration practice in low-rise commercial and not provide a gradient of good, better or best solutions.

Meeting Wrap up and Further Research

It was decided that it is possible to develop a protocol. Though we could cobble a system together from existing parts, we need some new parts to make an elegant system that is inexpensive and readily repeatable. . The main challenge to this protocol and design guidelines is to clearly define the functional requirements for the needed parts and pieces? Research is needed in current parts in the industry and what further parts are still needed to integrate them together. Will it be feasible and possible for the manufactures to make prototypes? This requires research and guidance from the steering committee. The outcome should identify problems and solutions and recommendations for design parameters for entire daylighting system, and for its components.

The tentative dates for the next steering committee meeting were decided to be either March 24th, or April 3rd, 2003 at SMUD, Sacramento.

Follow-up Discussion with Bill Beakes

Bill left the meeting early but had these follow on comments

Retail and office market is different than that for schools. He sees schools as the next big opportunity for skylights and T-bar ceilings.

Most of the discussion at the meeting was about rectangular vaults. We (the research team) should be also thinking about linear (long) vaults. These could be splayed only along the long axis - this makes construction easier.

He likes the idea of a tile splay but a throat and interconnection piece made out of something flexible like fabric. Flexible throat makes it easier to get around pipes and ducts. If diffuser placed at top of splay it hides ugliness of the throat.

Biggest concern about this whole system is leaks. Achilles heel is skylight and curb. But he sees partnerships forming between skylight manufacturers and ceiling tile manufacturers.

One question outstanding is how this would actually be constructed. The protocol is set up so that different entities can make their parts interchangeable but he thinks most likely way of integrating the systems involved is to have a consortium that comes in with a system that fits together and is installed by one entity.

He also likes the idea of incorporating the electric lighting in the light well above the diffuser. Control of lighting is invisible to the occupant since light is coming from the same place. Source of light does not change as daylight increases.

The success of this system is greater if it is designed in from day 1 but his experience is that ceiling manufacturers called in at the 11th hour. So the system must have a substantial amount of flexibility.

Splay is important because greater light transfer, less skylight openings needed

In response to the 4 protocol questions, his comments were as follows:

Feasibility

Yes the protocol is feasible in 2 months.

Key question is how does this protocol give advantage to the various players and does it provide the optimal advantage (minimal cost) to the building owner.

As Lisa pointed out the light well cuts through the strata traditional reserved for separate trades. If the system is component based - various manufacturers components are pieced together and different trades install, then the architect has to play the role of managing the various trades. If the system is not component based but sold and installed as a system by a consortium then the consortium manages the trades needed to get the system in place. Roofing, skylights, carpentry, electrical and mechanical contractors have to partner in delivering the system.

The coffered ceilings in the 70's were seen as a lighting system but the lighting designers didn't like the system because they got their fee from the lighting system not from the ceiling. [Lisa: This is a very important issue. Who designs the system, and how do their fees get determined…..]

Research needed

Two fundamental pieces of research is needed:

1. Integration of the building trades. Need to research the construction process.
2. Glare and brightness control. Does splay do this - what glare control is needed? Parabolics are an aberration. Puts all the light straight down. He would like a system that keeps contrast ratios below 8:1. Suggests we talk to Peter Nye at Peerless Lighting

"It is more important how I feel in a space than whether I can I can read. Reading is the minimal metric but how I feel impacts the human productivity dimension."

CONCLUSION

The steering committee meeting was an overall success. The participants concluded that a flexible throat design and a standardized splay design need to be worked on as part of the protocol. We need to create a framework for manufacturer/designer to come up with innovations for integrating skylights and T-bar ceilings. There is also a need to come up with innovative ideas for use of off-the-shelf components. We also need to try to constrain the problem to limited set of options and dimensions, following the 80/20 rule.

Long Term Goals

- Manufacturers to identify available and needed parts
- Guidelines in CISCA Handbook (Ceiling & Interior Systems Construction Association)
- Designer's Application Guide
- Ceiling Catalogs and Skylight Catalogues to have pre-manufactured light wells as part of their product offerings

Appendix. A -

Given below are some of the T-bar ceiling integrated methods used back in the 1970s and 19 (images provided by Marshall Hemphill)

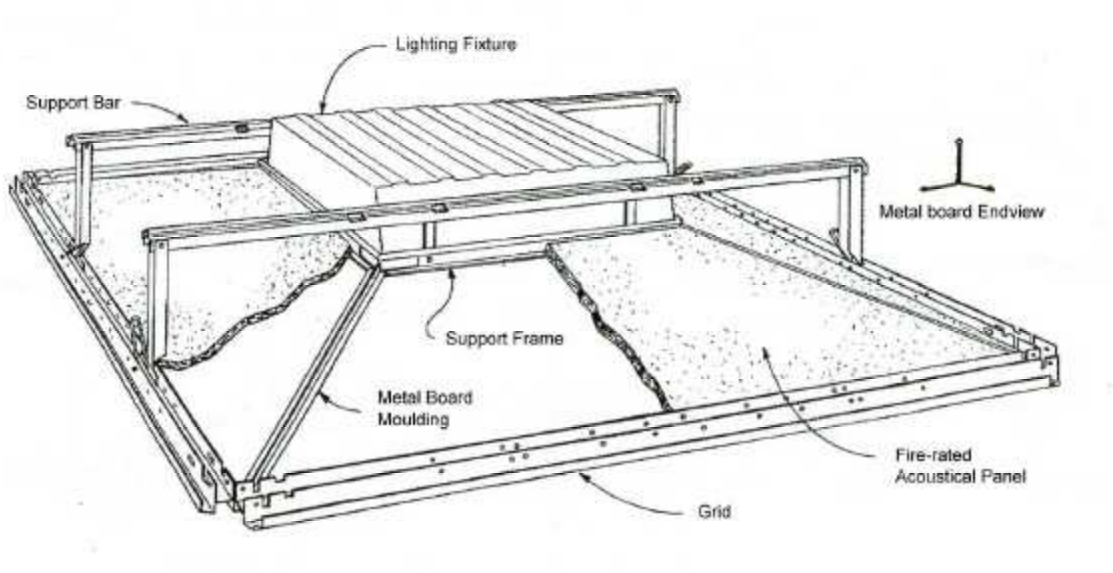


Figure 1: Coffered ceiling with lighting fixtures detail used back in the 70s and 80s

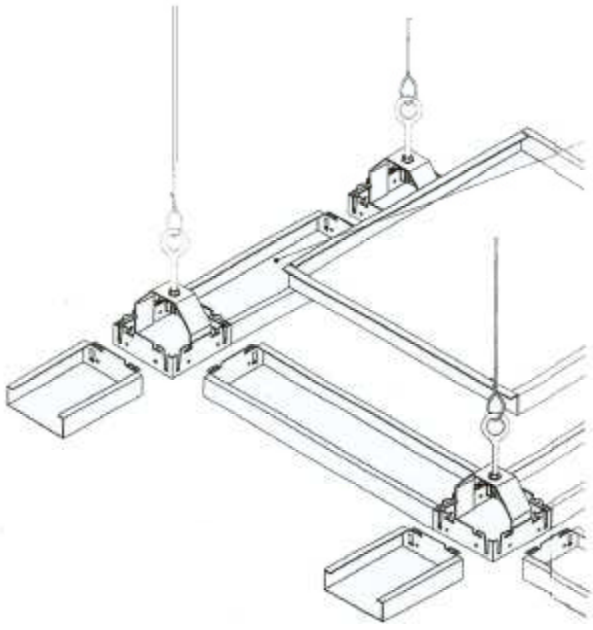


Figure 2: Suspension grid system used in 70s and 80s

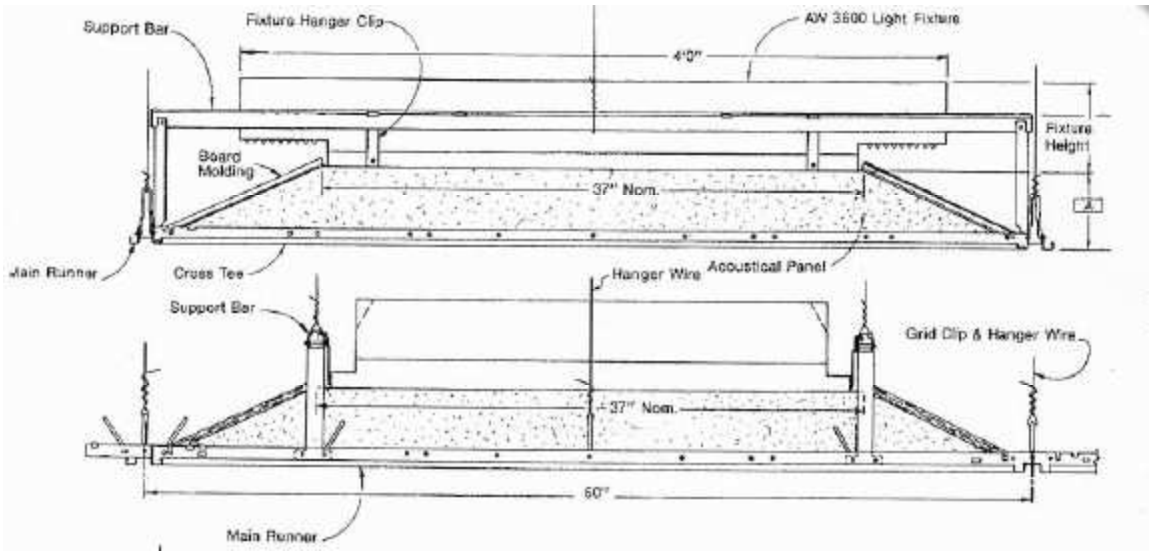


Figure 3: Details of vaulted modules that existed in 70s and 80s

Appendix. B -

Powerpoint presentation attachment

PIER Integrated Design of Commercial Building Ceiling Systems

Presented by

Jon McHugh, Lisa Heschong
& Puja Manglani
Heschong Mahone Group

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Steering Committee Agenda

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10:15 - 11:15	Intro to Integrated Ceilings Project Background, Case studies, Project concepts
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4:00 - 5:00	Task assignments - team and TAG

3

Introduction - PIER

- CEC Public Interest Energy Research
  - "Improve the quality of life in California by bringing environmentally safe, affordable and reliable energy services and products to the marketplace."
  - Funded through a California statewide utility bill surcharge
  - Funds research on energy and the environment

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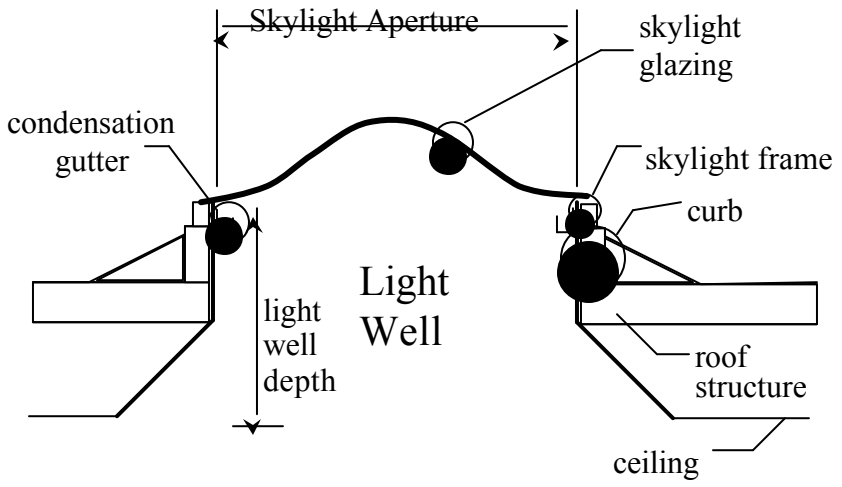
Skylight Components



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HMG PIER Daylight and Productivity

- Schools
  - Further analysis of original data
  - New study - Fresno Unified School District
- Retail
  - Replication study with a new chain, new sector
- Office
  - Automated Call Center: call handling time
  - Office workers : computerized alertness tests

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HMG PIER Integrated Ceiling

- Effectiveness of lay-in insulation
- Skylight testing
  - Visible transmittance & SHGC
  - U-factor
  - Photometrics
- Ceiling Integration systems

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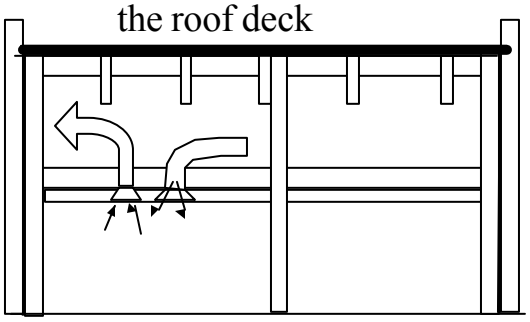
Ceiling/Roof Insulation

- Lay-in insulation above acoustic tiles on t-bar ceiling
- Insulation above a drywall ceiling
- Insulation below the roof deck
- Rigid insulation above the roof deck



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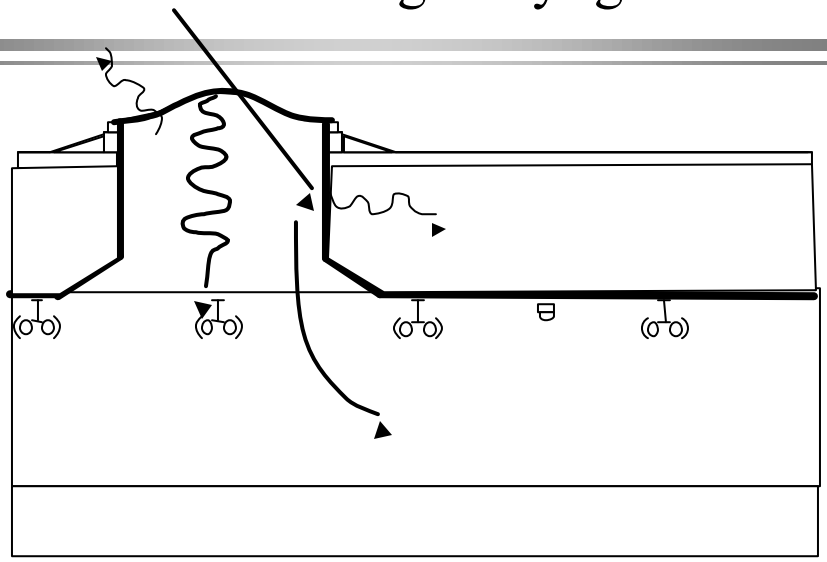
Heat Flow through Skylights



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Photometric testing

- Characterize the distribution of light by:
  - sun angles, skylight types, well depth
- Goniometric measurements
- Convert into photometric file format
  - Compatible with lighting software
- Photometric summary report
  - Polar plots, coefficients of utilization etc.
  - New way to evaluate skylights

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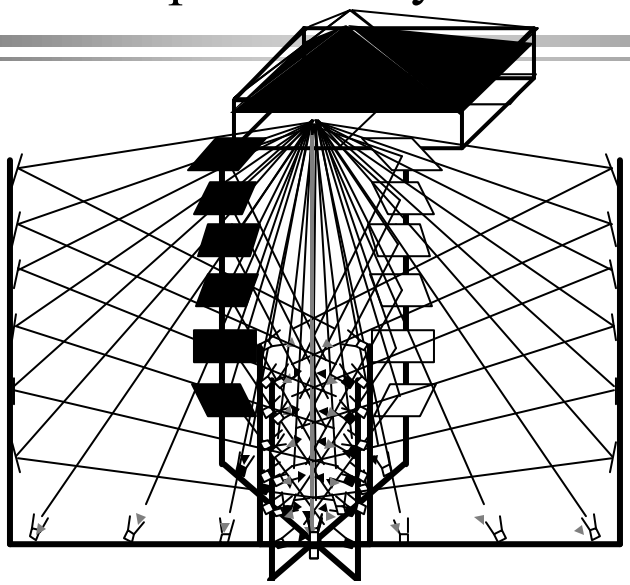
Goniophotometry



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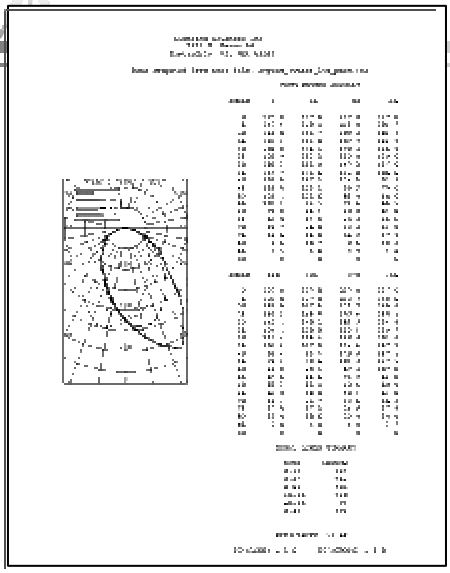
Photometric reports



- Same specification as electric lighting
- Polar plots - shape of light distribution
- Spacing criterion
- Coefficients of Utilization

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Skylight IES Photometric Files

- Compatible with all lighting software
- Prediction tools for
  - Light distribution - isolux graphs
  - Visualization
- Design tool for
  - Skylight specification and spacing
  - Compatible electric lighting lay-out

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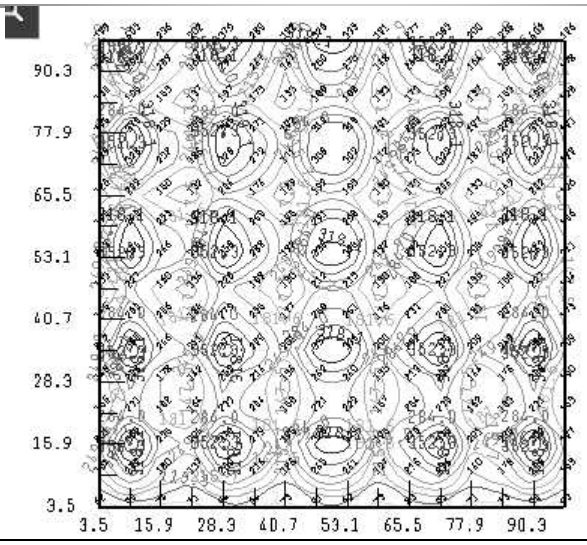
Isolux Contours



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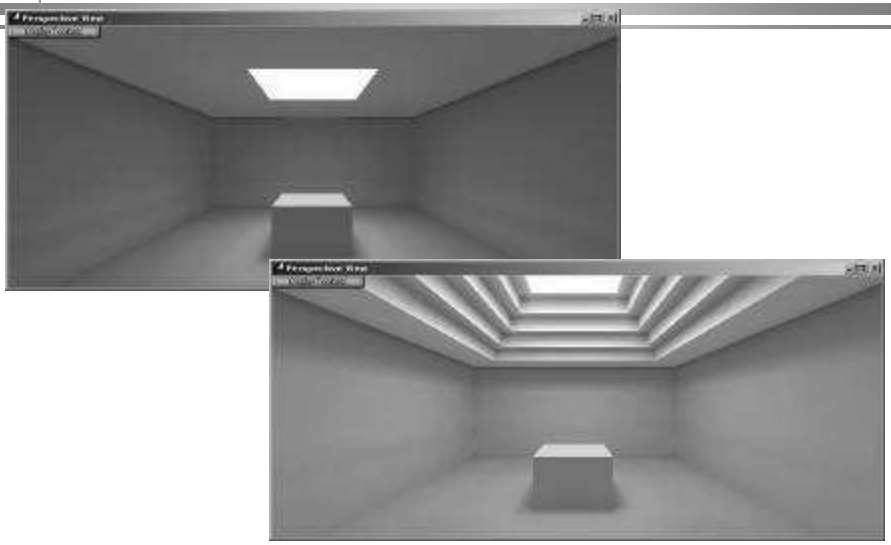
Comparing Light Wells



Why Skylights and T-bar Ceilings?

15

- Skylights are desirable for commercial buildings
  - save energy
  - improve productivity
  - enhance lighting quality
- T-bar ceilings widely used in commercial buildings
  - Acoustics
  - Aesthetics
  - Flexibility

Problem Statement

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- Currently well integrated T-bar ceilings with skylighting are custom systems
- Lack of pre-manufactured skylight well
  - Uncertainty of installed costs
  - Skylights often not considered for T-bar ceilings
  - T-bar ceilings often removed from design for Skylit Buildings
- Limits application of highly efficient, high quality ceiling system

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Retail without T-bar ceilings

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Core of Building w/o T-bar

Integrated Ceiling Protocol

- Provides excellent lighting, daylighting quality, thermal comfort, lower construction costs, acoustic performance, and energy efficiency
- Allows modularity and interchangeability of components
- Assures ceiling system meets overlapping safety, energy and environmental quality requirements

T-bar ceiling & drywall light well

Project Outcomes

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- Non-proprietary Protocol for a low cost, repeatable, skylight well compatible with T-bar ceilings
- Design Guidelines on how to apply the protocol to commercial buildings in California

California Building Statistics-

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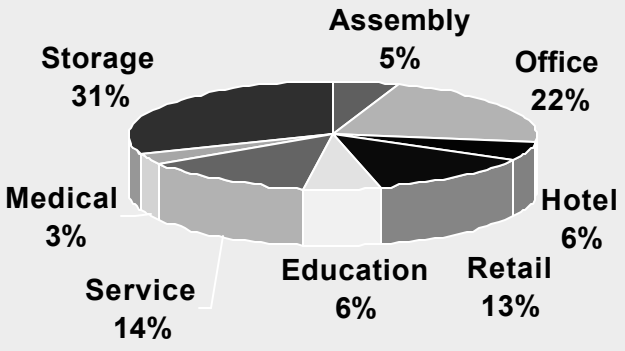
2000 Non-residential New Construction in CA



Source: FW Dodge Construction Database

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Targeted Occupancies

- Low rise buildings
- Spaces that traditionally use T-bar ceilings
  - Offices
  - Retail
  - Schools
- Office and Retail - 35% of building area
- Schools - owner occupied and willing to invest in productive environment

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Light well construction materials

- Acoustic Tiles or Panels
- Drywall
- Sheet Metal
  - Used by tubular and ducted skylights
- Fabric
- Foamboard
- Other materials?
  - Plastics

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T-bar materials

- Typical T-bar Suspension grid components
  - 15/16", 9/16" face width
  - 2'x2', 2'x4' grid dimensions
  - Main runners, cross tees, wall angles, splay hangers, compression posts
- Materials: Extruded Aluminum, Rolled Steel, Fiberglass, Vinyl
- Suspension grid accessories

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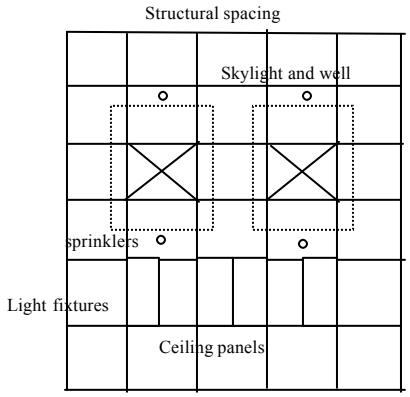
Integration of Building Components

- Spatial coordination
  - T-bar grid lined up with skylight spacing
  - coordination with other systems
    - mechanical, structural, electrical, partition layout
    - changes over time, flexibility of uses
- Temporal coordination - scheduling of trades
- Lighting integration
  - nighttime - light skylight well - not a "black hole"
  - daytime - seamless daylight harvesting
- Fire protection - additional sprinklers

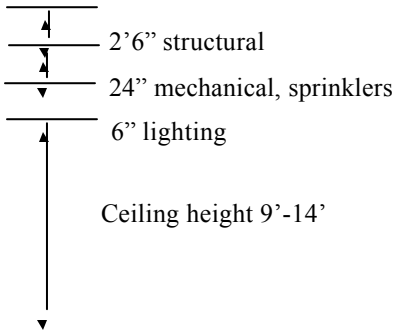
Spacing Issues



- Skylight opening based on structural grid
- Structural grid spacing 4’-5’
- T-bar spacing 2’- 4’
- Light fixture spacing 8’- 20’
- Sprinkler spacing 8’- 12’

Vertical spacing

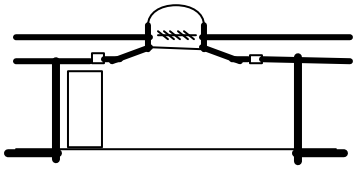
- Ceiling heights 9’-14’
- Plenum heights 4’-12’



Code Issues

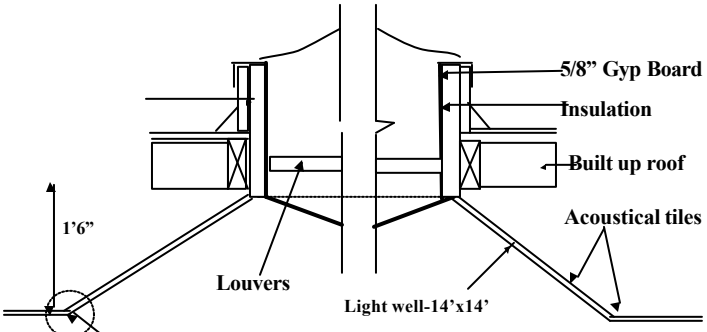
- Fire rating of materials
  - Flame spread
  - Smoke developed
- Fire rating of assemblies
- Seismic requirements for light wells
  - CA in seismic zones 3 and 4
  - Heavier the assembly greater bracing requirements
  - T-bar ceiling bracing with large "holes" in ceiling
- Structural impact on roof from skylight "holes"

Case Study- School at Capistrano, California

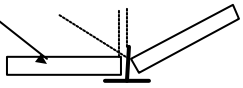


- 4'x4' light acrylic dome skylight with
- 14'x14' light well
- 17'x17' classroom with 9' ceiling height
- Plywood deck with insulation below deck
- Built-up roofing membrane
- 2' high throat made of 5/8"in[illegible]ed gyp-board
- Acoustical tile splay at 2' height
- Hanger wire & splay wires e[illegible]
- 2'x2' ceiling panels

Case Study- School at Capistrano, California



Section through skylight well

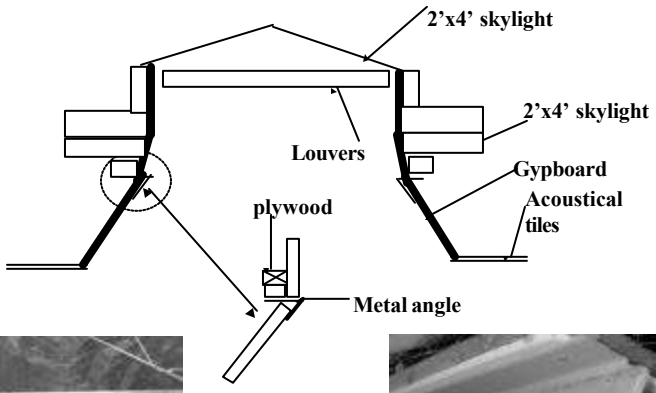


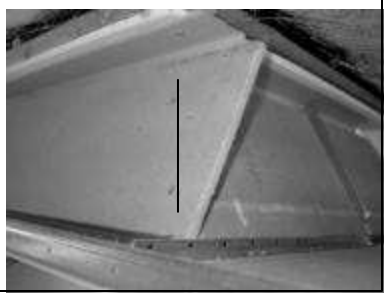
Detail between splay and tile

Case Study- Olive Ranch School, Roseville, CA

- Classroom size -20'x36'
- 2'x4' skylights with 4'x8' light well
- Structural spacing- 4'x4'
- Ceiling height- 9'
- Splay height -1' made of sheetrock
- Throat height-1' made of sheetrock
- Wall angle supports angled splay and vertical throat
- C-channel between two splayed tiles
- T-bars bent at places where splay meets ceiling

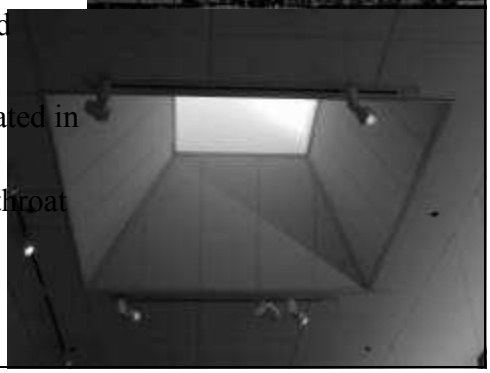
Case Study- Olive Ranch School, Roseville, CA



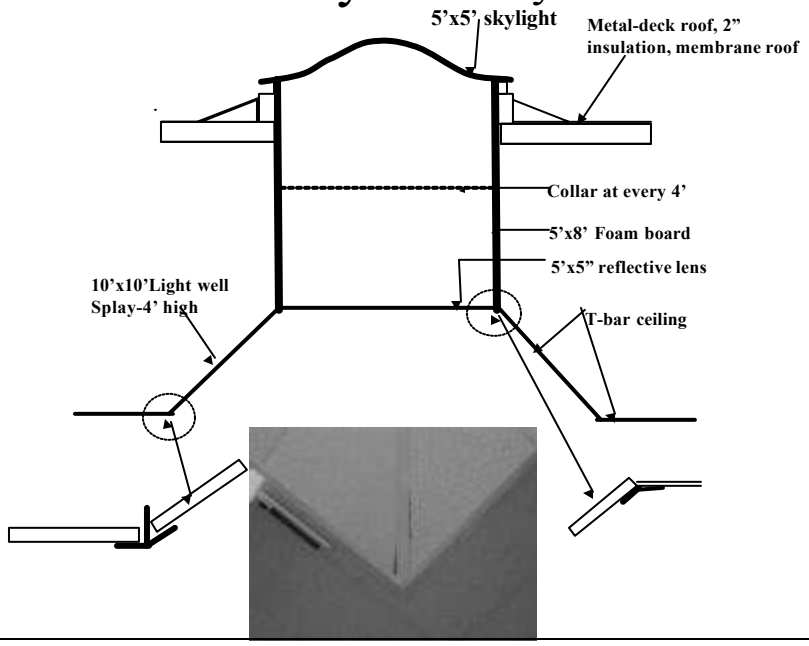


Case Study- Grocery Store A

- 5'x5' prismatic lens skylight with 10'x10' light well
- 14' high ceiling, 4' high splay and 8' high throat
- Splay construction -acoustical tile ceilings
- Throat construction-foam board
- Ceiling dimension 2'x4'
- Sprinklers at every 8', also located in light well
- Metal angle between roof and throat



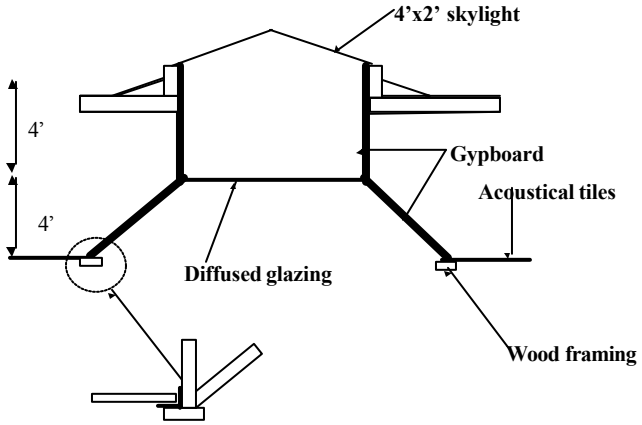
Case Study- Grocery Store A



Case Study- Grocery Store B

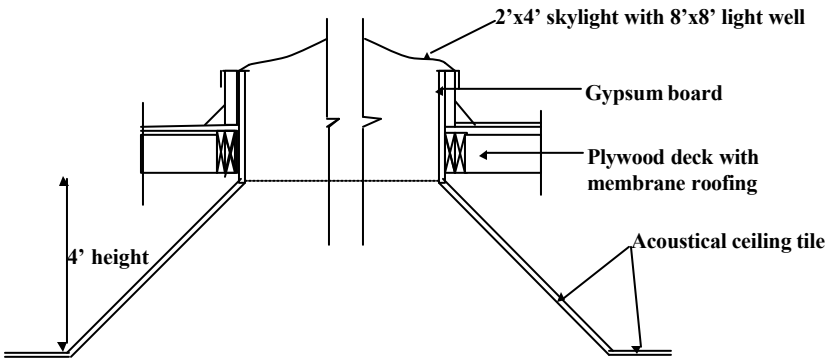
- 4'x 20' skylights with 8'x28' light well
- Splay (4' high) and throat (4' high) made of gypboard
- Sprinklers spacing 8' apart
- Wood framing between gypboard splay and ceiling
- 2'x4' ceiling panel size
- Ceiling height

Case Study- Grocery Store B



Case Study- Williams+Paddon Office, Roseville

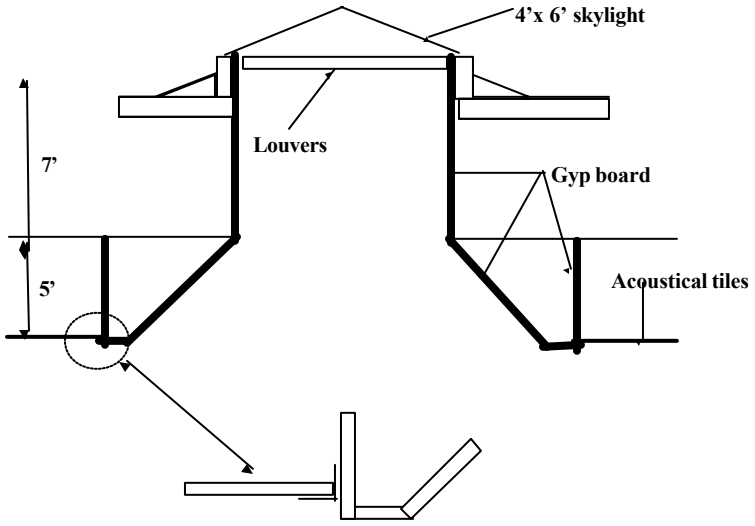
Case Study- William+Paddon Office, Roseville, CA



Case Studies-SMUD Office, Sacramento

- 4'x6' skylight with 12'x12' light well
- 11' high ceiling
- 4' high splay - gypboard construction
- 6' high throat -gypboard construction
- Ceiling panels 2'x2'

Case Studies-SMUD Office, Sacramento



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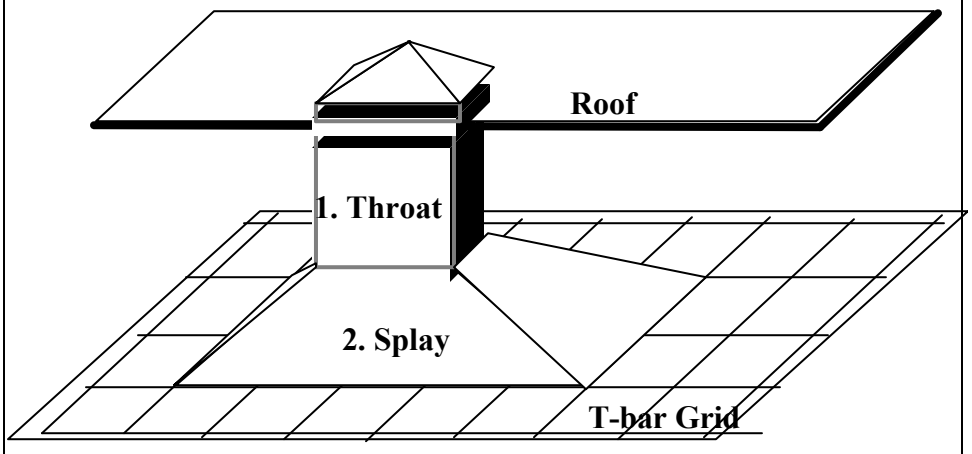
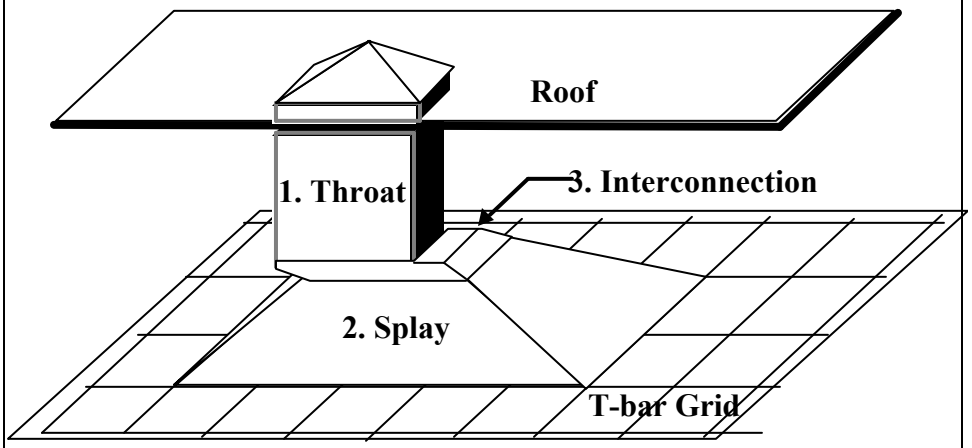
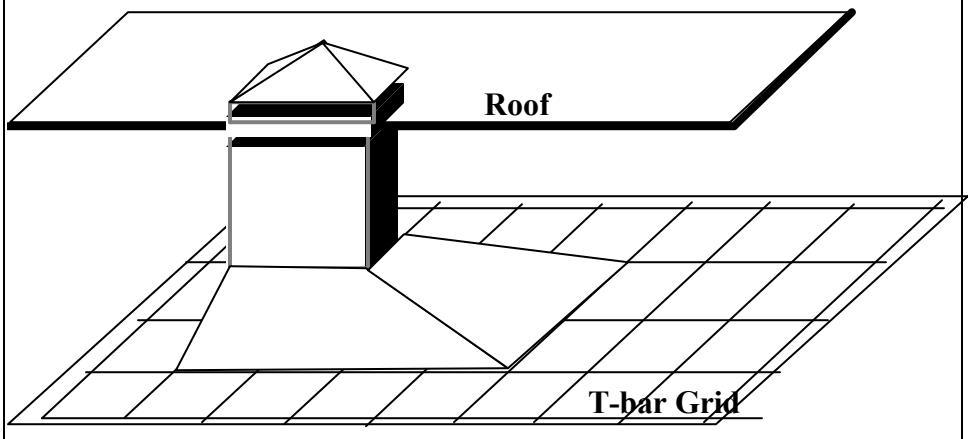
Three parts of a light well



Three parts of a light well



Asymmetric splay (site-built)



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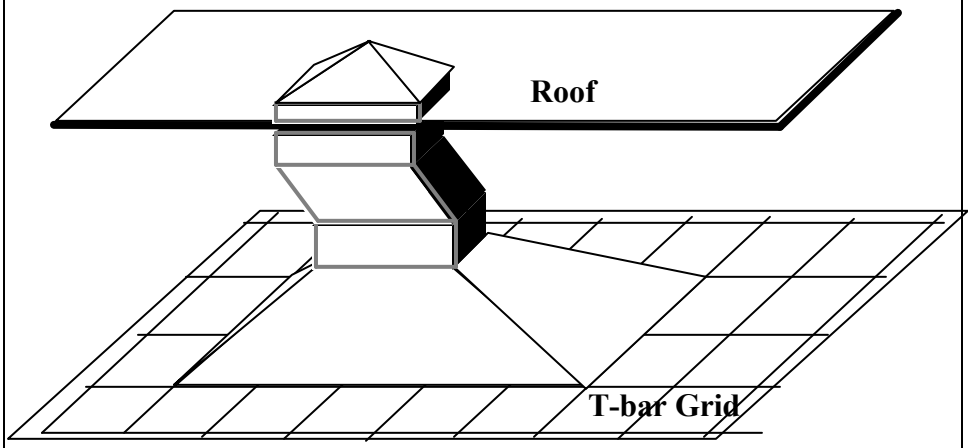
Adjustable Throat



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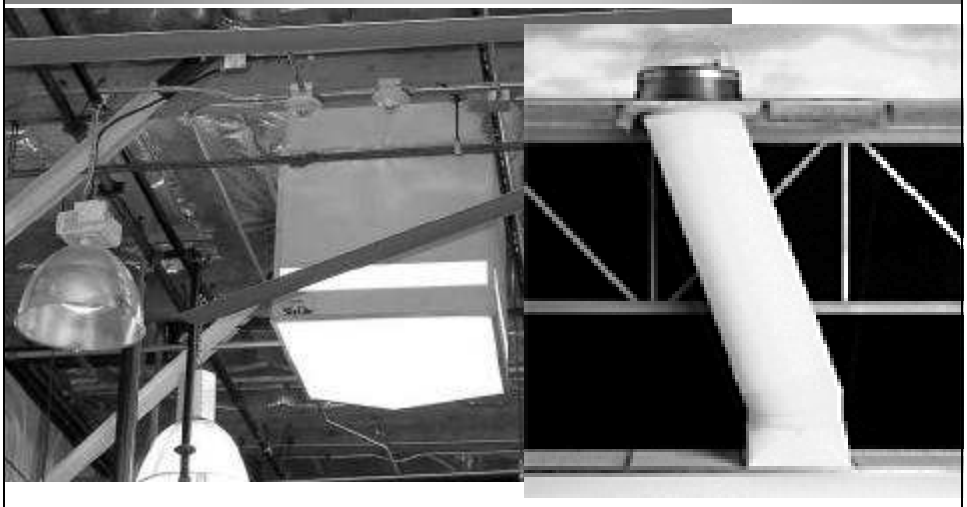
Pre-manufactured throats



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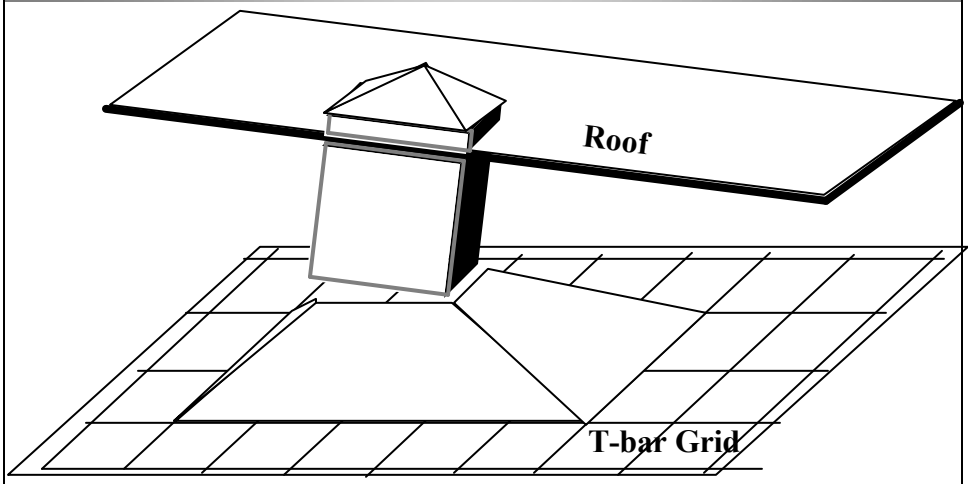
Dealing with roof tilt



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Steering Committee Presentations

- Your experience with skylights and T-bar ceilings
- Other interconnection protocols between skylights and other building products
- How can existing materials and protocols be adapted for high quality light wells?
- Existing construction skills, tools, and installation standards

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Lunch and tour (noon - 1 pm)

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Brainstorm on light well splay

- How to make fixed splay section
  - Similarities/differences to coffered ceiling
- How to make variable splay section
  - What activities involve most labor?
  - What aspect most important for aesthetic?
  - What pieces are needed?
  - How do we define pieces/functions?

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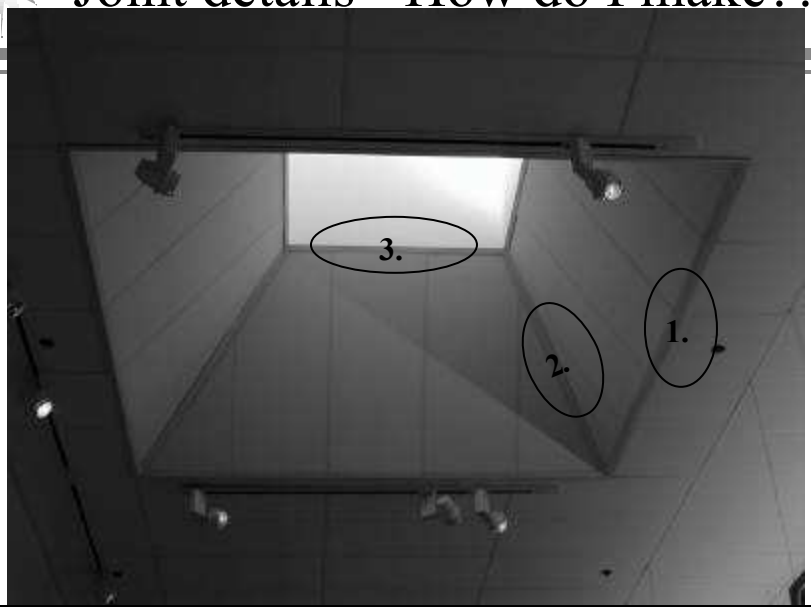
Joint details - How do I make??



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Brainstorm on light well throat

- What materials are most appropriate?
- Does throat need to structurally support the splay?
- Should throat have a light diffuser?
- Should throat be specular?
- Should throat be perpendicular to roof?
- How should throat connect to splay?

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Setting objectives for protocol

- What are the key outcomes you would like to see?
- What research is needed?
- Do you agree a prototype based on a throat, interconnection and splay?
- Is developing this protocol feasible in a 2 month period?

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Coffee Break

Protocols for skylights, ceilings & light wells

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- What protocols currently exist?
  - Is protocol explicitly defined?
  - How does one assure compatibility across manufacturers?
- What tests must be passed to be acceptable in the California market?

Task assignments - Int Ceiling advisory group and project team

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- Tasks for advisory group
  - Products that can be used in splay, throat or interconnection
  - Protocols that are currently being used
  - Performance requirements of existing ceilings
- Tasks for PIER Int Ceiling Team
  - Research report - end of February
  - Draft protocol - mid March